Regional forecasting on labour markets

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Regional Forecasting on Labour Markets

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Regional Forecasting on labour markets is a regional approach to generate data about future developments that cover adequately the information needs of labour market actors. Approaches from different European regions are presented in this book. Furthermore, the central elements of these approaches are discussed with respect to their problems in data and / or methodology. Some solutions are discussed within the different models presented.

This book was developed by several members of the European Network of Regional Labour Market Monitoring.

Key Words: Regional Labour Market, Regional Forecasting, Regional Information

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Foreword

Although there is an increasing importance of internationalization and globalization, the regional approach to insure competitiveness of enterprises and the workforce are of increasing importance. From a regional view a functioning labour market and an effective labour market policy are key factors. Premise for both parts is adequate information for labour market actors. Although most regions have data about actual and past developments on the labour market, they lack information about future developments on regional level. Such early information is becoming more important for the regional competitiveness because with their help labour market actors can react in time and can prevent mismatches. Regional labour market policy could also be more efficient if information about future qualification and occupation needs exists. One instrument that generates such information and knowledge is Regional Forecasting System on Labour Markets.

During the workshop “Forecasting the Development of Employment: Methodologies and Systems” which took place in July in Frankfurt and the conference “Pictures of Work Flexibility”, which took place in September in Rome, approaches and methodologies of Regional Forecasting Systems from various European states were presented and discussed. Most of the presentations, supplemented by a few further contributions, are gathered in this volume for publication. We expressly thank the authors for their contributions.

This collected volume is the fourth publication in the line of the European Network of Regional Labour Market Monitoring. The first focussed on regional labour market monitoring concepts in European countries, the second described approaches towards target group monitoring in European countries, the third conceptually expand the approaches of target group monitoring while the current volume collects approaches and methodologies on forecasting with a regional perspective.

We would like hereby to thank the Hesse Ministry of Economics, Traffic and State Development and European Social Fund, Frankfurt Economic Development, the City of Offenbach and the district of Groß-Gerau. Their support made this collected volume possible.

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I Introduction

While product markets are becoming more and more global, there is an increasing demand by regions to provide tools and information on regional labour markets. This is the result of the understanding that regions have to insure that their labour suffices both in skills and numbers to fulfil the needs of the regional employers. Furthermore, functioning institutions insuring transparency and planning on future skills need are an important factor to attract new investments by firms, but also to insure a good match between workers living in the region and firms employing those workers.

The location decision of firms takes the local supply of skills into account. Continuous problems to recruit personnel can lead them to reconsider their location decision, and eventually relocate. New firms, considering location, investigate the skill imbalances that exist or will occur in the near future, and threaten their optimal mode of production. As the future remains uncertain, despite all the efforts, current approaches to address imbalances, regional efforts to identify and solve them before they become problematic, might convince firms to locate in regions that promise a steady and reliable provision of skilled workers that they need. In such a context they might even be convinced that they, just as all other firms in the regions, are an important partner in making sure that what is available on the local labour market reflects the needs of the firms. They will take their share in educating and training workers to fulfil the skill demand.

Skill shortages can have a negative effect on the functioning of firms. In the short run the firm will have to forgone business opportunities and thus profits. Machines will not be used to their full potential. In the intermediate to long run, firms will adjust to the shortage in some way. They might attempt to attract the required workers more actively, by raising wages, poaching from other firms, or by attracting workers from other regions or countries. They might be able to substitute some part of the required labour by changing the production process. All of this is, however, a reaction to a situation that needs costly adjustment.

Many firms recruit a large share of their personnel locally. Especially lower to intermediate level workers search employment preferably within their local region. This is due to the relocation costs, i.e. the costs of moving the worker and their families closer to the workplace, being more problematic for workers who have lower incomes than those who have higher incomes, mostly higher educated workers. It is therefore not surprising that higher level and higher paid positions are quite often recruited on a national level. Higher educated workers, while they prefer to find new employment locally, are used to work on a national level.

In order to be an attractive region both for workers and firms, there should be a balance of labour demand and supply, on each skill level, but preferably also on the occupational level. It is by no means necessary to plan the education of workers and the match to firm's demand in detail, the old manpower approach rather modern skill forecasting attempts to make future imbalance visible. By increasing the transparency of the labour market, all participants on the labour market can act to overcome imbalances quickly, or insure that future imbalances will not manifest itself.

There are many countries that have some form of evaluation of future skill demand and supply, in order to identify imbalances. The current volume aims to take a regional view. While the national skill demand and supply might be quite balanced, regional imbalances might require enormous movements of skilled workers. While solving imbalances can use national and international movements of skilled workers to those regions that need them, and from regions that have a surplus, it is by no means the only or best solution, nor is it feasible to solve imbalances single handed.

There are many approaches to cater to several different needs. Countries differ in their approaches, sometimes inspired by existing national model, sometimes requiring direct input from it, and other times being rather independently developed and estimated. The diversity of approaches allows it for the practitioner and the interested reader to learn about the approaches, goals, problems, and also their advantages. The volume is intended to inspire you to learn from the best practices or ideas that you can find, and to understand how some of the problems can be circumvented.

The contribution by *Wilson* describes the British approach to regional skills forecasting and monitoring. While they build on the national forecasts both in methodology and in outcomes, it is the combination of several sources of data for different levels of geographic aggregation that allows a detailed, regional analysis of the regional labour market. Their Local Economy Forecasting Model (LEFM) combines the national and regional forecast made by the IER and Cambridge Economics with key economic and labour market indicators on the regional level. The main philosophy behind the model is that also on the regional level the same methodological approaches as the national forecasts should be used. They overcome the problem that aspects of the national model cannot be estimated or translated to the regional level by combining several data sources. Whenever it is possible and useful, regional data is included, but supra-regional or national data substitutes in cases that are not suitable for regional approaches.

The Dutch regional model consists of a separate estimation of the general development of the expanding or contracting occupational (and skills) demand and in addition the replacement demand that has to be filled in order to remain the current occupational structure at par. Confronting the combined demand, both replacement and so called expansionary demand, with the supply of graduates from both vocational and higher education, yields estimates of future skill mismatches for the region. As in the British regional model for skills forecasting the Dutch model also builds upon the methodology and framework provided by the national model. *Kriechel*, *Cörvers* and *Heijke* argue that this has the advantage of consistency of national and regional models. A bottom-up approach from several regions would otherwise not necessarily be comparable to outcomes from the national model. It makes sense to work with top-down studies in countries like the Netherlands where there is an established national model. Typical data shortcomings of the regional data are also mentioned in the Dutch approach. Whenever necessary, national data or interim results are used to fill gaps in the regional model. They use RAS procedures, however, to insure that the underlying distribution based on the national distribution is in accordance with known regional totals of various distributions. This makes it likely that the adjusted national data provides a good input into the model in accordance with regional differences.

The article by *Knobel*, *Crass* and *Trabert* describes a regional approach to occupational and skill forecasting that is not based on a national model. Their regional forecasting approach models the supply, and separately the demand of the regional labour market. The demand side consists of the expansion demand and the replacement demand like the Dutch approach. The expansion demand is forecasted by modelling time series models whereas the supply is projected by a regional population forecast. The Rhine-Main-Region attracts an great amount of commuters. This was an additional challenge that had to be dealt with. Of great interest is also the mix of different approaches to gauge the appropriateness of the results: the explicit combination of the quantitative results with the qualitative input from industry and labour market experts is new. In addition the chapter describes within the methodology, how the problem of insufficient data, given the regional approach, is handled by overcome time lags.

The contribution by *Hampel*, *Kunz*, *Schanne*, *Wapler* and *Weyh* shows the importance of spatial spill-over effects in the time-series estimation of regional employment. They compare different techniques of estimating regional time-series of employment. The suggested estimator, including a spatial element or the region, is then compared to several other, more standard time series estimators: the ARIMA, the exponentially weighted moving average (EWMA), and the structural-components approach. The predictions of the model are short term, up to a period of two years, and they are intended to extrapolate recent, regional trends to allow policy makers to work with employment figures that are more recent than the published, regional statistics. The chapter shows why it makes sense to use the different techniques, and what their strength and weaknesses are. The inclusion of spatial dependencies, for example, is shown to improve the model, however given the complexity it is yet unfeasible to use such an approach in the ARIMA or the EWMA model.

The article by *Bade* shows how the regional share of total labour volume can be estimated. In his set-up the regions are interlinked, and he shows how the forecast depends on the choice of the time-series estimator. The chapter provides an important point: He discusses how the choice of the estimator can be guided by economics assumption about the consistency of regional developments and their aggregation into a supra-regional or national whole. The estimation for the period 2001-2010, i.e. 10 years, is done using time series estimators. Regional employment shares (by industry) are used for several regional levels, down to 96 planning regions and even 440 districts for Germany.

The contribution by *Zavanella*, *Mezzanzanica*, *Pelagatti*, *Minotti*, and *Martini* present a two-step approach for regional skill needs forecasting as has been done in Italy. It combines the decomposition into productivity and demand shocks with time-series forecasting methods on a regional level. Methodologically, employment is explained by the share of employment in a sector and the productivity of the labour in a sector. Effects of the introduction of new products or production methods that lead to initially more labour input and subsequent learning can be modelled just as the increase in overall demand that should lead to a higher overall allocation of labour into that sector. In other words productivity and demand shocks can be modelled separately. They use regional accounts data on productivity, employment and population for the Lombardy region. Furthermore administrative information on number of employees, number of firms, hirings and firings, education and training are also included. Forecasts are done by sector and for a time frame of 12 months. This is then estimated using time series methods. The authors compare three different econometric methodologies, ARIMA, VAR, and unobserved components models (UCM). While the first two techniques are commonly used, the last one is less common. The UCM estimation technique imposes some structure onto the time series by decomposing it into trend, cycle, seasonality and noise elements. The authors explain the underlying idea in their chapter in more detail, and also show the (practical) advantage of using the UCM approach over the more common econometric methodologies.

Hillau describes the French approach to regional skills forecasting. In the regional model of the Provence-Alpes-Côte d'Azur region. The methodology builds on a series of statistical models for the development of the workforce (by industry), training, and evolving occupations. Within the region covered, six sub-regions are distinguished and modelled. Combining the different models on supply, demand and spatial estimations, regional predictions are made to aid policy and training planning.

Quite a different approach is presented by *Humpel* and *Kargl*. The AMS-Skills Barometer they present for Austria, is a system that is based on detailed information on job vacancies from a wide range of publications, enriched with background information both quantitative and qualitative on the occupation. Different from all the other approaches is the prominent qualitative aspect of the model in which detailed information on the (changing nature of the) job content can be distilled. But it also allows to use traditional information on historic trends and developments of the occupations, enriched wherever possible with forecasts that have been published. Those forecasts are included to reflect a four year forecasting period. Regionalization of the AMS-Skills Barometer is done on the level of the nine federal states of Austria.

Finally, by *McGrath* the situation in Ireland is described. The chapter has a focus on the institutional framework of the structure of early skills need identification in general, and the forms and uses of the various data collected. While the skills needs system is actually a national model, the forecast in combination with the detailed (regional) data is also used for regional applications. In his discussion McGrath explains that, so far, the need for regional differentiation was not seen, it is expected to become more important in the future, though. The Irish chapter goes into detail into the important aspect of institutional setting. It is not only important to provide adequate data, but also to insure that the data fulfils the needs of the intended users, is accepted by a wide variety of different interest groups, so that policies can be based upon them. As McGrath describes in his chapter how this is institutionalized in the context of skills forecasts and labour market monitoring. Also, similar to Wilson and to a lesser extent the Dutch and Rhine-Main case, the Irish approach shows well how the combination of skills forecasting and different other data-sources providing up-to-date information on various aspects of the labour market, enhances the usability of the entire system.

Within the articles different regional models are discussed. The models are very different but the problems in regional forecasting are the same. So the different approaches solves their problems in different ways regarding aspects of processing of data, but also of presentation and implementation. In the following it is discussed how the different models deal with problems of processing data and dissemination of the results.

First, one of the problems of work on the regional level is the trade-off between detail and accurateness of the result. One way of incorporating this is the use of scenarios. In many regions the labour market is influenced by a handful of big organisation that has a big impact on the labour demand, both in terms of quantity but also in the skill-mix. The effect of changes in those companies personnel policy is hard to estimate using the methodology of the national (and regional level). Changes are not always gradual on the organizational level. In order to have an understanding of the possible outcomes of shifts, scenario analysis, as it is also discussed in the contribution by Wilson, is a way to deal with. A different approach is presented by Knobel et al., where only the 10 major occupational groups are used for the forecast. In the Dutch model, a RAS procedure is introduced, that tries to recover a within occupation age distribution based on the total distribution of age and occupation. A third way to deal with the data problem is described by Wapler et al., Bade and Zavanella et al. In essence, the time-series approaches are also acknowledging the data problem by not even pretending to been able to forecast the occupation or skill demand, but rather concentrate on the number of workers employed.

Second, another problem of forecasting systems is the presentation and implementation of the results in the actual decision making process. Some aspects are discussed in the institutional settings of Ireland by McGrath. In this context the AMS-Barometer in Austria should also be mentioned, as it is an instrument that attempts to bring together as much information and classification from various sources, quantitative and qualitative, such that the result can also be used in a similar fashion as the more quantitative forecasting systems. A different aspect is that of interaction between users and producers of the forecasts. Some discussion on this can be found more extensive in the chapters on the United Kingdom, the Netherlands, the Rhine-Main Region, and on the Provence-Alpes-Côte d'Azur region. The table on the following page shows a summary of the presented models.

Overview of Regional Forecasting Models

	Time frame	Data	Region	Method	Chapter
UK	10 years	Detailed occupational and educational level; additional regional data supplementing forecasts; national model	Several independent studies of different regions in UK	Model of various sources of demand, supply; Skill shortage prediction	II
Netherlands	5 years	Detailed occupational and educational level; national model	Province	Model of various sources of demand, supply; skill shortage prediction	III
Rhine-Main-Region (Knobel et al.)	5 years	Employment on occupational and qualification level; regional model	Rhine-Main-Region: City of Frankfurt and Offenbach, District of Groß-Gerau	Model of demand, supply: time series estimation, regionalized employment projections, expert panel	IV
Germany (Wapler et al.)	Short term, up to 2 years	Regional employment numbers	Labour Market Districts (176)	Time series estimation	V
Germany (Bade)	10 years	Regional employment numbers (shares)	Planning region (96); District (440)	Time series estimation	VI
Italy	1 year	Several skill levels, sectoral employment, productivity	Part of Lombardy	Time series estimation	VII
France	Various	Detailed data on occupations (224) and educational level	Six sub regions within Provence-Alpes-Côte d'Azur	Modelling of demand, supply, evolving occupations	VIII
Austria	Trend forecasts: 4 years	Analysis of job advertisements; Quantitative labour market data; Expert interviews	Nine federal states	Compilation of available forecasts; Expert interviews	IX
Ireland	5 years (ESRI)	43 occupational subgroups	National (with possibility to regionalize)	Shift-share	X

II Local and Sub-regional medium-term skills forecasting in the UK[1]

Rob Wilson

1 Introduction

This chapter explains how different kinds of economic and labour market data, at national regional and local levels, can be combined in a consistent and systematic fashion to paint a rich picture of a local economy and labour market. This includes the ability to develop a range of scenarios and to assess impacts of external shocks. Most countries in the world now have well established economic and labour market data at national level (including formal, national accounts, and detailed information on employment, population, etc.). Increasingly such information is now also being collected and constructed at a regional level. However information is much more limited at a sub-regional and local level. Technological advances connected with the information and communications technology (ICT) have facilitated making estimates and constructing models at this level, using building blocks based on such detailed data. The term national level is used here to refer to the whole of the United Kingdom (UK). Regional refers to the 9 English regions and the other constituent countries within the UK (Scotland, Wales and Northern Ireland). Sub-region or local levels refer to any smaller geographical areas.

Development of a Local Economy Forecasting Model (LEFM)

The Institute for Employment Research (IER) and Cambridge Econometrics (CE) have been involved in forecasting at Regional as well as National level since the mid 1970s. Regional projections have now become a standard feature in the UK, being based on the same kinds of models used at national level. During the 1980s and 1990s changes in the direction of government policy within the UK regarding delivery of training led to a renewed interest in model building and forecasting at sub-regional and local level. In parallel to growing demand, technological developments have made it possible to access and analyse increasingly complex and detailed data sets and to build more sophisticated models. Together these two factors have resulted in both a demand for, and the possibility of supplying, local model based projections in a consistent and robust manner. This chapter describes how the Local Economy Forecasting Model (LEFM) has been developed in the UK to meet these needs.

The main aim of generating projections using LEFM is to provide a quantitative benchmark of economic and labour market prospects for the local area concerned. The projections are based on secondary data sources as described below. In the first instance they may not incorporate much specific local knowledge or insight and are intended as a starting point for further analysis rather than a projection of what is most likely to happen. The local results are tied to a particular national and regional scenario of the type described in Wilson *et al.* (2006).

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[1] The chapter draws on the results of the Cambridge Econometrics (CE) regional economic modelling research programme, and the Local Economy Forecasting Model (LEFM) research programme undertaken jointly by CE and the Institute for Employment Research at the University of Warwick (IER). CE and IER have developed the LEFM as a tool for forecasting local economic development in small geographical regions and local areas within the UK, consistent with the regional and national forecasts and simulations from the CE Multi-sectoral Dynamic Model of the UK economy. The contribution of the staff of the two organisations is acknowledged here. Any remaining errors are the responsibility of the author.

The LEFM approach recognises explicitly that any attempt to understand the changing demand for skills must be founded upon an understanding of economic change. Key drivers of changing skill requirements include:

- technological change - especially ICT;
- competition and changing patterns of consumer demand;
- structural changes - including globalisation, sub-contracting and extension of supply chains;
- working practices - such as the introduction of team- or cell-based production; and
- regulatory changes.

The results from LEFM reflect all these factors although they are not all dealt with explicitly in the local case.

General Outline of LEFM

LEFM is a computer software package designed to enable users to produce their own economic projections for local areas within the UK, linked to CE/IER's broader national and regional projections. It provides a complete economic picture of the local area, covering various key economic and labour market indicators, as well as employment.[2] The national and regional forecasts produced by CE/IER provide the context as well as the immediate driver for the local forecast. Users may have a range of alternative national/regional forecasts to choose from and can extend this by adding further forecasts to their database as these become available. Various options are also included in the package to enable users to tailor the local projections to their own needs, taking into account local information. Details of how this is done are set out below.

LEFM is intended to provide a useful and thought-provoking tool for analysts and policy makers working at local level, which can enable them to explore the various possible futures they face. The package has been widely used in local government, by local education and training providers, careers guidance companies and many more. The package has also been extensively used by CE/IER on behalf of a vast range of clients to explore alternative futures, including regional development agencies and many commercial clients.[3]

The remainder of this chapter is divided into 7 sections. Section 2 sets out the rationale for producing local level projections and the benefits and limitations of forecasting. Section 3 sets out in more detail the philosophy behind LEFM. Section 4 then goes on to outline the structure of the model, including how it relates to National and Regional forecasts and how local information is integrated. The basic methodology is discussed in Section 5, including data construction, classifications, and the model solution. Section 6 then presents some typical results based on various application of the approach. Section 7 concludes by summarising the key features of the approach and possible future developments of the package. Appendix A gives details of the data generation process.

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2 The prototype version of the model was first produced in 1993 and used to produce tailor made projections for a number of organisations. Version 2, introduced in 1994, represented the first general release of the software. Since then there have been numerous developments and enhancements. Version 7 was released in 2007 and the model and software package are still being developed.

3 Add link to list of clients on IER website: http://www2.warwick.ac.uk/fac/soc/ier/

2 Local Forecasting Needs and Problems

Why forecast at local level?

Almost everyone is involved in planning and forecasting, even if this amounts, in practice, to assuming 'no change'. Forecasts are of value to a broad range of potential users within a local area. Policy makers charged with the responsibility of setting the institutional framework and delivering government policy; those concerned with providing goods and services, including education and training programmes; employers, educationalists; and, of course, individual students and workers, all of whom have an interest in trying to peer into the future and to ensure that their own decisions result in the best possible outcomes (however these might be defined).

Forecasts can therefore be seen as having two prime roles: first to guide policy decisions made by the government and its representatives; and second, as a general aid to the individual actors operating within the labour market, providing them with information which can aid their own decision making and planning. In some minds planning conjures up images of inflexible bureaucracies and misallocation of resources. Such mechanistic planning is probably a chimera. But some form of long-term planning is necessary, particularly where large investment programmes in either physical or human capital are involved. LEFM provides information about the possible futures that might emerge and illustrates how these alternatives depend on various key assumptions.

Assessing the impact of economic change and evaluating the success of local policy in the UK is the concern of a variety of agencies with responsibilities for local economic development and the provision of skills. In addition to local government authorities, these comprise the regional governmental agencies responsible for regeneration, the Scottish, Welsh, and Northern Irish devolved administrations, as well as many other organisations, including the local arms of the Learning and Skills Council. All of these operate within an increasingly open trading and economic policy context, with the EU in particular providing an environment of both rapidly accelerating economic change and diverse policy initiatives.

The increased policy and facilitative role played by such local and regional agencies has sharply increased the interest in economic and skills forecasting at levels below the national level, including impact and evaluation methods at the local level. Such forecasts are required to provide a systematic framework for the assessment and evaluation of future economic and labour market outcomes to changes in policy, as well as to external shocks, and to assess likely impacts on the need for skills. Programmes for local regeneration, new education and training initiatives undertaken at the local level, the opening or closure of a new factory, or new transport infrastructure all have complex economic effects on a local area and will themselves be conditioned by external economic events outside of agency control. A model-based analysis is therefore valuable for assessing the economic impact of economic events on a local economy. LEFM has been designed to allow for the establishment of both the direct and indirect impacts of economic change and can be used to address sensitivity to a range of exogenous assumptions.

Taking advantage of the Information Revolution

As the perceived need for information at local level has grown, so has the capacity of the databases and the power of equipment required to process data. The information revolution that gathered pace over the 1980s and early 1990s means that analysts and policy makers now face the prospect of an enormous increase in the amount of information available. Data are becoming more easily available in many ways, with many on line databases. Large survey databases such as the Labour Force Survey (LFS) and Censuses of Population and Employment can be accessed and analysed with increasing ease. In some respects, there is a danger of being overwhelmed by the mass of data available and a key problem is to avoid information overload and to sort out the key messages.

Forecasts are intended to identify the key trends and to highlight the main issues that will be important in the future. LEFM provides a tool which brings together relevant information about the local economy and presents it in an easily digestible form, while at the same time drawing out the implications for the future of continuation of past trends, as well as enabling 'what if' scenarios to be developed.

What to Forecast?

Many organisations have a direct interest in the labour market. Other bodies have a broader remit and require information of a more general economic and social nature. It can be argued that forecasts which focus too narrowly on the labour market lack the depth of understanding necessary for useful policy analysis. In order to gain a more complete understanding of the forces influencing the labour market it is therefore necessary to consider and forecast more than just employment. A complete forecast should cover various other key economic indicators. Ideally, this requires the use of a detailed multi-sectoral macroeconomic model.

The fact that forecasts have, in practice, often been very narrowly focussed just on employment is, of course, no accident. It reflects the availability of data, which is such a binding constraint on model building and forecasting, especially at local level. However, with the increasing availability of regional and sub-regional information these limitations are becoming less important and a new generation of models are beginning to appear which exploit this resource and can provide users with a much richer picture of developments in a particular locality. Thus, as well as industrial employment levels, analyses by occupation, gender and status (full-time, part-time, self employed) are now feasible. Other aspects of the labour market such as demographic change, labour supply, and unemployment can also be covered. In addition, the possibility of building more complete economic models of particular localities, based around an input-output analysis which takes proper account of the technical inter-linkages between sectors, and the behavioural relationships between the various actors in the economy (individuals, companies, public institutions, etc), is now feasible.

Accuracy of Forecasts

It is important to have a clear appreciation of the limitations of any forecast. Forecasters do not have a crystal ball and cannot foresee the future precisely. Rather they try to map out the consequences of a series of assumptions about patterns of behaviour and policy stances for likely future developments. Often the term projection is used (dependent upon certain assumptions) rather than a forecast (which for many people has connotations of a more precise prediction).

A projection has been defined as a conditional statement about the future 'if X then Y'. In contrast, a forecast is sometimes defined as attaching a likelihood or probability of this state of affairs actually coming about. In practice, attaching such probabilities to a particular point forecast implies a risk, as most people who have placed a bet on a horse can testify! Predicting the future path of the economy is considerably more complex than predicting the outcome of such a race. Unlike simple statistical exercises such as conducting an opinion poll, it is not straightforward to attach margins of error or confidence intervals to projections of economic variables which are dependent on an enormous range of different factors. Despite attempts by some to make a clearer distinction between projections and forecasts, most people continue to use the terms more loosely. In what follows the terms forecast and projection are therefore used interchangeably.

Forecasters often present a range of scenarios intended to encompass the most likely outcomes. Whether or not this is done, all 'point' forecasts should be regarded with appropriate scepticism. No forecasters would argue that such projections are more than a broad brush picture of what the future might look like. Indeed it is almost a certainty that any particular precise point forecast will be wrong! To expect anything else is to misunderstand what the forecaster is trying to achieve. Projections are not precise predictions of the future but should provide an indication of the direction, scale and pace of change. Having said that, most forecasters regard their latest projection as the most likely outcome, given the information then in their possession. They may hedge this with some alternative but less likely scenarios around the central view. At the end of the day, they should be regarded as intelligent guesses rather than accurate predictions. Finally, it is important to emphasise that much social science forecasting is concerned to identify potential problems and pitfalls. If action is then taken to avoid problems these the forecasts will inevitably be wrong. The key question is not therefore whether they are accurate but rather are they useful?

Limitations of Forecasting

There are of course severe limitations in our ability to predict the future. These include:

Data problems - there is often some difficulty in establishing the current position let alone forecasting the future. These difficulties may be especially acute at local level.

Limits to understanding - although the social sciences have made considerable strides over recent years there are still major gaps in our knowledge about how systems and individuals behave.

The fact that, past behaviour may not always be a good guide to the future.

Technical difficulties in forecasting that are often ignored due to data problems.

A final set of problems relates to the fact that *some events are inherently unpredictable* (such as earthquakes or other acts of god, political events etc.).

The Benefits of Conducting Local Forecasts

The production of a forecast or set forecasts for a particular locality should not be seen as an end in itself. Rather it is best regarded as part of a process of improving understanding about what is going on in the local economy. This understanding can then guide policy makers and other actors operating within the local economy (such as individual workers, students and employers) to better decisions. The main benefits can therefore be summarised as follows:

The aims and objectives of intervention can be made clearer and the ability to evaluate policy can help to establish a virtuous circle.

Forecasts can provide a focus for discussion and co-operation and may help to breakdown old misperceptions about local markets.

Forecasts should enable those involved to take a more strategic and proactive approach to problems (rather than a "fire-fighting" and reactive one), as the implications of current trends and outcomes for the future are explicitly explored.

Finally, forecasts can also provide guidance to individual actors enabling them to make better decisions about their own futures.

Local Forecasting Requirements

In developing a forecast for a local area the analyst will normally have a number of requirements.

- links to and consistency with national and regional forecasts;
- the need to take full account of specific local information;
- the facility to assess the sensitivity of local forecasts to assumptions about change locally, regionally and nationally.

Typically a local forecast needs to draw on national or regional data (including projections) in order to supplement limited local data. As noted below, this is often handled in an *ad hoc* way, with consequent difficulties in interpretation. Moreover, where local projections are based on forecast changes at the national level, the user typically finds it difficult to assess their local significance, or test the sensitivity of the local forecasts to the underlying assumptions made by national modellers. For example, in the current economic climate how sensitive is the local economy to relatively faster or slower growth in the world economy?

In addition a number of changes that may have occurred or are in prospect for the local economy could denote an important break from previous experience. In such cases local views and information should be embodied in the forecasts in order to take account, for example, of the entry or exit of major employers in the locality.

Local Impact Analysis

Analyses of the impact of major new investments or plant closures have been conducted for many years. Most have adopted a fairly eclectic and often *ad hoc* approach, but a few features are common to most studies. These include the use of 'multipliers', to assess the second round effects of such changes in incomes and expenditures, and an input- output element to reflect the inter-linkages between companies due to purchases of raw materials and intermediate products.

Multiplier models, such as those originally developed by Greig (1971) and Armstrong (1993) form the basis for most studies. The size of the multipliers depends on inter-linkages between economic organisations and the propensity to 'import' into the area. These propensities may vary for the various types of demand (consumers' expenditure, investment, etc.). Armstrong's study shows how this can affect both first round and overall effects. Greig's analysis suggests that if immigration and emigration are significant then the standard multiplier based on marginal propensities to save etc could lead to an understatement of the income and employment effects on a project which creates 'permanent' employment. The study by Billings and Katz (1982) highlights the problems which can arise if the parameters for a particular impact do not match the 'average' values. They propose a method for using firm specific data to correct for this. This may be important in dealing with some impacts. Harrigan (1982) extends an earlier analysis by Burford and Katz (1977 and 1981), suggesting ways in which multiplier impacts can be made with only limited information.

Studies of infrastructure projects emphasise that there are two main phases associated with construction and subsequent operation. These may have very different economic and socioeconomic effects (Batey *et al*, 1993). Within each phase a number of elements can be distinguished:

- major injections to final demands;
- interlinkages between producers (input/output);
- income/expenditure loop effects;
- labour market impacts, including effects on unemployment and patterns of migration and commuting.

These elements may be interlinked. For example, the scale of commuting into or out of the locality will influence the share of consumers' expenditure which is spent within the local area. Although the 'normal' case will involve the consideration of an exogenous change in final demands, it is possible to envisage different starting points, including demographic/labour market ones (i.e. shifts in local labour supply or commuting patterns).

In the case of closures, the most obvious immediate effect is the loss of employment and subsequent reduction in incomes. This may be moderated by redundancy pay and unemployment benefit and in any event should take into account the fact that the effect on disposable income will be less than that on total income as noted in the study by Johnson *et al.* (1979) on the closure of the UK steel pant at Bilston.

Major second-round effects operate through the inter-industry linkages to suppliers. Some studies have also considered effects on customers (of intermediate inputs) but these have proved difficult to quantify and are often ignored. The importance of this type of second-round effects, operating on the local economy via input and output linkages, will depend on the scale of such intermediate demands and on the share of them that is supplied locally.

The other main second-round effects operate through the income-expenditure loop. The strength of this loop will depend, amongst other things, upon the occupational mix of the people involved. Higher level occupations may have different consumption patterns and different propensities to consume within the region. Similarly shifts in the balance of employment and unemployment in the local area may be an important consideration.

There is a very large literature on the use of input-output coefficients from broader areas to analyse impacts in a local economy. A key problem identified is the difficulty of dealing with inter-locality trade and the problems caused by very strong industrial specialisation at local level.

Studies of the impact of closure on the labour market such as that of the Shotton Steelworks by Chakravarty *et al.* (1981) emphasise the fact that those who lose jobs are often atypical compared to the average in terms of age and skills. This may be important from a modelling viewpoint when thinking about effects on unemployment and also on subsequent impacts on incomes and expenditures.

A key feature of LEFM is its ability to simulate the effects of a major new investment or a plant closure in a local economy. Following this process through, the user is asked to provide relevant details of the 'impact' they wish to explore and its key characteristics in terms of the way LEFM operates. This entails filling in a series of forms which prompt the user to provide key indicators relating to the investment of closure. This information includes:

- whether it is a new project or a closure;
- what industry is affected;
- the scale of the effect;
- timing;
- linkage effects with other industries;
- initial employment impact.

The model suggests possible values for some of these assumptions based on existing relationships at regional or national level, but the user is at liberty to change these.

The impact module within LEFM only deals with a single impact at any time. However, by running separate impacts and combining them together more complex scenarios can be developed.

3 The Philosophy Behind LEFM

Probably the most common approach to local level forecasting has been to use a national or regional forecast as a basis for predicting local trends. However, local circumstances are invariably very different from the broader national or even regional picture. Every locality has its own unique characteristics. This means that growth rates based on general national or regional forecasts are often not appropriate for local needs. However, the lack of adequate data at local level has often constrained what can be achieved.

Typically, such forecasts can be done in such a manner as to take into account the *current* economic and labour market structure of the locality. Although they do have the advantage of being linked to a national forecast which was developed in a consistent and systematic fashion, rarely are local differences taken into account in a more fundamental fashion. The forecasts developed have therefore been quite generally quite mechanistic. There has been little attempt to recognise: technical inter-linkages between sectors within the locality; the relationships between the locality and the wider economy; nor to understand the behavioural patterns which have resulted in the current position.

LEFM has been developed with the expressed aim of meeting the need for local level forecasts while explicitly addressing some of these limitations. The package has been designed right from the start to provide a 'hands on tool' for practitioners in order to enable them to develop their own local forecasts in a logical, systematic, consistent and coherent manner.

A key element of the Philosophy behind LEFM is that any attempt to model a local economy should, in principle, adopt the same methods as at the broader regional and national levels. It should recognise that the behavioural mechanisms and economic and technical constraints faced by the various labour market and economic actors are basically the same as at a national or regional level. In practice, what is possible in terms of modelling is constrained by the available data. However, improvements on this front over the last few years, as described above and in the next section, mean that a serious attempt to build a local economy forecasting model, with a more complete technical and behavioural content can now be made. The main features of the model are set out below. The approach is based on the use of a calibrated *social accounting matrix* for a local area.

The LEFM package is designed to combine projections from CE/IER's national/regional forecasts with detailed information from the UK's National Online Manpower Information System (NOMIS). The latter contains a vast database of labour market and economic indicators for local areas, based on a variety of different data sources. The focus is on employment but the model also includes many other labour market indicators such as population, activity rates and unemployment, as well as producing estimates of key economic indicators such as local output, consumers expenditure and gross fixed capital formation.

The economic prospects in any particular local area will however, depend on a whole host of local factors which only those 'close to the ground' will know about. The aim of the LEFM package is to provide a set of benchmark projections, based initially on the assumption that the local area performs in line with national or regional trends, taking into account past performance and patterns of behaviour. Past relationships between local and national or regional performance are used to produce this initial projection. This basic benchmark can then be supplemented by local level information, often of a qualitative nature.

Another key aspect of the philosophy behind LEFM is that local forecasting is not regarded as an end in itself but as part of a process designed to improve understanding of the local economy and to explore the various possible future that policy makers and others are likely to face. The package facilitates the production of consistent and coherent, quantitative pictures of what the future may look like, which can then be used as a starting point for more qualitative discussions. The user manual for LEFM includes some hints on how to compare employment structure within a local area with the broader picture and outlines some of the considerations to be borne in mind in developing a more custom-built projection using local knowledge.

The issues faced at the local level that LEFM is designed to deal with are:

- limited information;
- complex interdependencies;
- increasing ‘openness’ of local economies to competitive external economic markets;
- change as a fundamental characteristic of competitive markets;
- local economic ‘surprises’ usually caused by external forces;
- local strategies mainly directed at long-term supply-side factors.

A model based assessment of the trading process for locally specialised products provides a framework for understanding the associated impacts of external and internal effects on private and public sectors. External economy and regeneration policy effects will impact on the ‘demand-side’ through income and employment effects in the rest of the economy (for example the effects on household consumption and unemployment of a major local firm opening or closing), but also through ‘supply-side’ adjustments to the local economy. These supply-side effects will come through investment, productivity changes and other enhanced competitiveness effects, as well as through patterns of supportive population and labour movement, although there remain considerable gaps in our knowledge of how these effects work.

4 The Structure of LEFM

General Description of LEFM

The structure of the LEFM modelling framework is indicated in Figure 4.1. Essentially, a geographical boundary is drawn around the local area and the focus is then on measuring the flows of goods and services and people across that boundary, as well as the technical, economic and behavioural linkages and relationships that govern outcomes within it. At the model's heart is an analysis of the extent to which local output and employment by detailed industry depend on spending within the local area, or on markets outside the geographical boundaries of the local area. The critical elements are the estimates of a full flow matrix of expenditure components for the local area. The model follows the conventional SNA accounting structure, distinguishing consumers' expenditure, investment, government consumption, intermediate purchases by industries and trade flows on the basis of information available locally and regionally. Hence, the local multiplier effects of an investment project can be simulated in a systematic and reproducible manner. The model solution has as its key inputs national and regional results from a CE/IER national/regional macroeconomic forecast, and relationships between local trends and corresponding regional or national ones at a detailed industry level.

National and Regional Forecasts and Scenarios

LEFM forecasts are designed to be consistent with the regional and national forecasts produced by CE/IER. The user can select from a range of such forecasts. (These are updated by CE/IER on a six-monthly basis). The use of alternative scenarios is particularly valuable for assessing sensitivity of forecasts to underlying assumptions about the UK and world economies. These projections can then be further customised to reflect local knowledge and information.

Options for introducing local views include:

- modifications to the industrial employment estimates to reflect local knowledge;
- modifications to the labour supply assumptions;
- ability to amend local 'export shares';
- facility to conduct impact analysis.

The data sources actually used in the LEFM programme can be divided into two main types:

- historical data for the local area;
- parameters and growth factors based on CE/IER national and regional forecasts.

In LEFM employment data play a central role, since this variable provides the most detailed and reliable information at local level. Most of the economic indicators at local level are derived by combining information on the corresponding regional level indicator and the local area's share of regional employment or population.

LEFM includes information on:

- **Jobs and the Economy,** providing an overview of general labour market trends and prospects for the local economy, focussing on GDP/value added, gross output, productivity and industrial employment by industry (see Table 4.1).. The workforce in employment comprises both employees (full-time and part-time) and individuals in self-employment, all distinguished by gender. Other economic indicators, including components of final expenditure (consumption, investment and trade flows including exports and imports to/from the local economy, and their implication for inter-industry commodity demand (41 commodities)); personal disposable income; are also included. Comparable data are provided for the UK and region for all the main indicators.
- **Skill needs and supply,** presenting information on trends in the occupational structure of employment (see Table 4.2) both in aggregate and within industries. Estimates of replacement demand are also provided. In addition data are provided on qualifications typically required, as well a demographic trends (population by 5-year age bands, working-age population, the la-

bour force (on LFS definition), unemployment, all distinguished by gender) and various other labour market indicators, including commuting flows.

Changes in the industrial structure of employment have implications for skill requirements and training needs. These are represented in the LEFM output by occupational employment, (data on key and generic skills and on qualifications, are also available). Obtaining reliable data on occupational employment within individual industries is problematic. Only the Census of Population (CoP) provides a sufficiently large sample to provide really accurate data. More recently, the increase in the size of the Labour Force Survey (LFS) has begun to provide a more reliable alternative source. Occupational employment matrices used in LEFM use both sets of data.[4]

The projections of occupational structure are based on a model developed by the IER. It uses data from the CoP plus information on more recent trends from the LFS. For each industry the percentage of people in an occupation by gender for each Census year are examined. These patterns of occupational structure at a detailed industrial level are then extrapolated into the future. The projection is fine-tuned by reference to data from the LFS and other qualitative information on occupational trends. These modify the results from the simple projections and lead to a rather more realistic outcome than might arise from a simple linear projection.

Many projections of occupational employment focus on the total numbers of people that are expected to be employed in such jobs in the future. While such estimates can provide a useful indication of areas of change, highlighting the likely ‘gainers’ and ‘losers’, they can give a misleading impression of job opportunities and training and education needs. Even where the projections indicate significant employment decline over the medium-term, there may nevertheless be quite good career prospects, with significant numbers of new job openings. This is because, as long as significant numbers are still likely to be employed in the future, then employers will need to replace those employees who leave because of retirement, career moves, mortality or other reasons.

This so-called ‘replacement demand’ may often dwarf any ‘expansion demand’ resulting from growth in employment in a particular category and can easily outweigh any negative changes due to projected employment decline. The scale of replacement demand usually outstrips the scale of expansion demand many times over, although there are variations by sectors and occupations.

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4 The Annual Business Survey – Inquiry (ABI) and its predecessors the Annual Employment Survey and the Census of Employment) provides the most reliable source of industrial employment estimates. These figures are combined with data on occupational structure taken from the Census of Population and the Labour Force Survey in LEFM.

Estimation of replacement demand rests on information on flows in the labour market. Replacement Demand estimates are based on LFS data, including information on flows within the labour market which are age- and gender-specific:

- *retirement rates;*
- *mortality rates* and *;*
- *inter-occupational mobility.*

Illustrative results are also developed by 15 qualification levels. These are based on applying typical qualification structures within each occupation to the local occupational employment data. The "typical" values are drawn from LFS data for the whole of the UK. These results do not therefore reflect specific local patterns. Data from the LFS are not available to enable such customised analysis.

Figure 1: LEFM - A Local Economy Forecasting Model

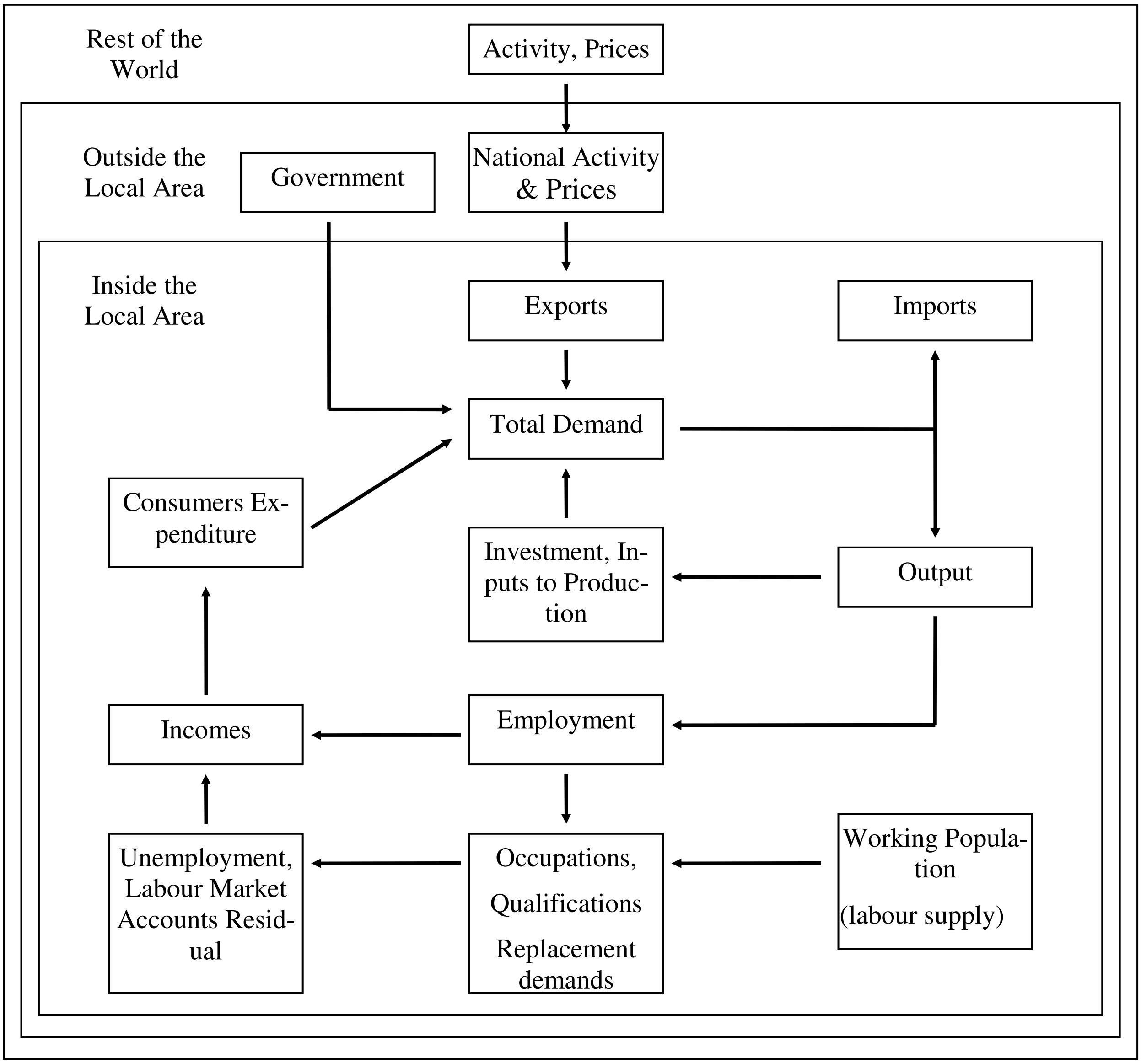

Table 1:Classification of Industry Groups (SIC 2003)

Industries		SIC2003	Industries		SIC2003
1.	Agriculture	01,01,05	22.	Electricity	40.1
2.	Coal etc.	10	23.	Gas Supply	40.2, 40.3
3.	Oil & Gas	11,12	24.	Water Supply	41
4.	Other Mining	13,14	25.	Construction	45
5.	Food, Drink & Tobacco	15, 16	26.	Distribution	50, 51
6.	Textiles, Clothing & Leather	17, 18, 19	27.	Retailing	52
7.	Wood & Paper	20, 21	28.	Hotels & Catering	55
8.	Printing & Publishing	22	29.	Land Transport	60, 63
9.	Manufactured Fuels	23	30.	Water Transport	61
10.	Pharmaceuticals	24.4	31.	Air Transport	62
11.	Chemicals nes	24 (ex 24.4)	32.	Communications	64
12.	Rubber & Plastics	25	33.	Banking & Finance	65, 67
13.	Non-Metallic Mineral Products	26	34.	Insurance	66
14.	Basic Metals	27	35.	Computing Services	72
15.	Metal Goods	28	36.	Professional Services	70, 71, 73, 74.1-74.4
16.	Mechanical Engineering	29	37.	Other Business Services	74.5-74.8
17.	Electronics	30, 32	38.	Public Administration & Defence	75
18.	Electrical Engineering & Instruments	31, 33	39.	Education	80
19.	Motor Vehicles	34	40.	Health & Social Work	85
20.	Other Transport Equipment	35	41.	Miscellaneous Services	90-99
21.	Manufacturing nes	36, 37	42.	Unallocated	

Notes: (a) Standard Industrial Classification. ONS 2003.

Table 2:Occupational Categories (SOC 2000)

	Sub-major groups	Occupation minor group number[a]
11	Corporate managers	111, 112, 113, 114, 115, 116, 117, 118
12	Managers/proprietors in agriculture and services	121, 122, 123
21	Science and technology professionals	211, 212, 213
22	Health professionals	221
23	Teaching and research professionals	231, 232
24	Business and public service professionals	241, 242, 243, 244, 245
31	Science and technology associate professionals	311, 312, 313
32	Health and social welfare associate professionals	321, 322, 323
33	Protective service occupations	331
34	Culture, media and sports occupations	341, 342, 343, 344
35	Business and public service associate professionals	351, 352, 353, 354, 355, 356
41	Administrative and clerical occupations	411, 412, 413, 414, 415
42	Secretarial and related occupations	421
51	Skilled agricultural trades	511
52	Skilled metal and electrical trades	521, 522, 523, 524
53	Skilled construction and building trades	531, 532
54	Other skilled trades	541, 542, 543, 549
61	Caring personal service occupations	611, 612, 613
62	Leisure and other personal service occupations	621, 622, 623, 629
71	Sales occupations	711, 712
72	Customer service occupations	721
81	Process plant and machine operatives	811, 812, 813
82	Transport and mobile machine drivers and operatives	821, 822
91	Elementary occupations: trades, plant and machine related	911, 912, 913, 914
92	Elementary occupations: clerical and services related	921, 922, 923, 924, 925

Notes: (a) Standard Occupational Classification. ONS 2001.

5 Detailed Methodology

Data construction versus model solution

It is possible to distinguish two separate stages in the process of building a local economy model for a particular area: *data construction* and *model solution*.

Data construction refers to the preparation of (mainly historical) data to provide data for estimation of model parameters, starting values for the model solution, and some indicators that the user may be interested in but which are not used in the model. Data construction also involves the preparation of forecast inputs for LEFM taken from CE/IER's national or regional forecasts.

As noted above, employment data play a central role in LEFM, since it is on this variable that the most detailed and reliable information is available at local level. Most of the economic indicators at local level are derived by combining information on the corresponding regional level indicator and the local area's share of regional employment or population.

Classifications

IDIOM, is a FORTRAN-based model-management software package developed by CE. This is used to construct LEFM. It adopts the concept of *classifications* to organise variables. The dimension of a non-scalar variable (where a scalar means a variable defined only over time, e.g. total population over time) is defined according to a model classification, e.g. industries or employment types. This allows the dimensions of the model to be changed very easily.

The classifications used in LEFM (with current size) are:

Acronym	Variable		Size
AG	age groups	NAG	20
C	consumers' expenditure	NC	68
E	employment type	NE	6
G	government expenditure	NG	5
KR	investing sectors	NKR	16
LG	labour group (gender/status)	NLG	6
OC	occupations	NOC	25
Q	commodities	NQ	41
SR	stockbuilding	NSR	1
V	investment assets	NV	5
Y	industries	NY	41

A similar classification to the industrial classification also underlies the analysis of commodity demand and supply, including value added by industry although some more aggregate classifications are adopted for certain components of demand such as investment.

Basic Data Generation

Data are not available for many of the key economic indicators at local level. Estimates are produced based on the employment data and on certain assumptions about the relationship between the local and regional level indicators. A variety of methods are used to impute values for economic variables at the local level, drawing on the various sources used. These methods are programmed so that the database is reproducible and can be updated readily when new data are available.

The most difficult part of the calibration of the social accounting flows relates to trade across the geographical boundaries. The objective is to produce plausible simulation values by starting with ‘sensible’ values and then iterating and adjusting to get ‘sensible’ overall flow results. For the primary, energy and manufacturing industries most of local output is treated as being supplied to a national pool, and virtually all local demand as being satisfied by imports. Much higher starting values are used for private services, and still higher for government services. A judgement having been made on the proportion of local demand that is satisfied by local production, then the implied result for exports is calculated. The export supply ratio is then examined and revisions made until plausible values are obtained. This process allows for local knowledge to be introduced where this is available, for example over the markets for a key local firm.

The procedure used to generate the basic data at local level begins with data on employment by industry, unemployment and population. Other indicators are based on this information as described in detail in Appendix A below. The data on employees in employment by industry, which distinguish full-time and part-time as well as gender for the local area, are taken from the Annual Business Inquiry (ABI) and its predecessors. This provides very detailed data on employment by industry at a local level based on surveys of employers. This local level information is available from NOMIS. At the time of writing the most recent ABI results available are those for 2006.

Up to date information on self-employment by industry at local level is not available. The main data source here is the LFS and the (much less frequent) Census of Population (CoP). Estimates of self employment are generated within the LEFM programme, using the assumption that the ratio of self-employed to employees at local level are the same as those at the corresponding regional level, industry by industry. This procedure allows for the fact that these ratios may vary between males and females and across industries. These data are consistent with those used in CE/IER's macroeconomic model database.

Data on occupational employment are taken from the 1981, 1991 and 2001 CoP, supplemented by more recent estimates from the LFS. The occupational totals from the CoP do not match the ABI based totals for a number of reasons (coverage, differences in definition, timing etc). In particular the former is a survey of *individuals* within *households* focussing on place of *residence*, while the latter is an *establishment survey*, focussed on the *place of work*. These differences can result in major discrepancies at local level (due in particular to commuting patterns). In CE/IER's national assessment work the overall occupational estimates are constrained to match the ABI based employment data. A similar procedure is adopted at local level. The overall totals resulting from the occupational projections are therefore constrained in the LEFM package to match the industrial totals.

Model solution (forecast)

The model's structure is broadly similar to that of the Cambridge Multi-sectoral Dynamic Model of the UK economy (See Barker and Peterson (1987), Wilson (1994) and Barker *et al.* (2001) for further details). However, the specification adopted for the functions that solve for endogenous variables in LEFM are necessarily much simpler due to the more limited data available.

Consumers' expenditure is driven by changes in local incomes and the (regional) saving ratio. It is disaggregated to commodities according to the regional allocation. Investment by sector depends on local industry output, or local population (for social investment).Government consumption depends on population. Local area exports depend on national demand (measured by national output) by detailed commodity. Local imports depend on local demand for each commodity (coming from final expenditure and intermediate consumption).

With regard to output, in the case of some commodities local output is wholly exported, and so is determined by exports. An implication is that local demand is entirely satisfied by imports.

Employment by industry depends on local industry output, and is disaggregated by type and occupation according to trends projected by IER.

With regard to labour supply, population by labour group (gender) and age group, LAP, is exogenous. Activity rates (i.e. the proportion of each labour group and age group that is in the labour force), LAR, are initially exogenous set but then dependent on the projected value of unemployment across alternative scenarios.

The model generates preliminary labour market balances or 'job shortfalls' by simply comparing projected employment with projected labour supply. The initial benchmark projection of unemployment is based on a continuation of past patterns of performance in the local area compared to the broader region. The actual outcome that emerges will depend upon a whole host of factors which are not taken into account explicitly in the model (e.g. commuting flows, migration, claimant registration rates, double jobbing, levels of government training schemes etc). The model allows the user to explore a range of alternatives regarding how supply and demand may be reconciled by changes to these elements. For example, if demand for labour is expected to grow more rapidly that supply then this implies that either:

- Demand may not be met; or
- Something else has to give (i.e. greater inward commuting into the local area or inward migration (thereby boosting labour supply)).

The model cannot predict what the outcome may be but it highlights where there may be an issue to be addressed.

Income from employment is calculated by multiplying the number of employees in each industry by the average income per employee in that industry. A similar treatment is implemented for self-employment income. Unemployment benefit depends on the number unemployed. Other income is allocated according to population.

Calibration of Employment and Unemployment

The model is calibrated so that over the historical period it tracks the observed employment data by industry for the local area. For the benchmark forecasts, employment by industry is assumed to continue to maintain the same relationship with the regional patterns as in the past at a detailed industry level. Calibration is achieved by altering local gross output. This in turn is achieved by changing net trade flows ("export shares"). The latter are treated as a residual item.

Unemployment is calibrated in a similar fashion to replicate the observed historical pattern and, in the benchmark forecasts to maintain the previous relationship between local and regional unemployment levels. This is achieved by amending the 'Labour Market Accounts Residual (LMAR), which is the difference between the sum of labour demand (employment) plus unemployment, and labour supply.

Issues in Data Availability for Local Economy Analysis and Forecasting

General issues: One of the factors encouraging the development of LEFM has been the improved availability of quantitative official statistics, e.g. for counties, local authority districts, travel-to-work and local Learning and Skills Council areas. There are a number of criteria for assessing the usefulness of such local data sets. These include; appropriateness, consistency, reliability, availability, timeliness and comprehensiveness. Secondary data from government sources are not normally entirely appropriate for local economy classification and forecasting, since the statistics are primary collected as part of the administrative process of government rather than for modelling. The main sources focus on the labour market, either residence - or workplace-based, and are less detailed, less frequently available or less reliable than comparable national economic data sets.

Inconsistency: often arises from changes in coverage or classification. The consistency of local and regional statistics has frequently been upset by the changing definitions of industries and of alternative boundaries used by government for reporting. In recent years the statistical authorities have established a consistent series in the form of so called 'frozen ward' data sets. As their name suggests, these areas are fixed or frozen in time so that they can be used for time series comparisons of employment change. (Wards are geographical areas defined for electoral voting purposes). This information lies at the heart of LEFM.

Rapid change in location and working practices is a characteristic of economic growth. This impinges on the *reliability* of data which depends also on the how representative the information is. This is a larger issue than simply the statistical reliability of surveys such as the LFS (LFS). Reliability relates to sampling techniques and size, but also to the sampling frame. Non-response, under-coverage or the sampling frame being out of date are important issues in local data sets, especially when there may be significant delays in their processing and release.

Availability: requires a commitment to provide information by government bodies. The *concerns* of confidentiality provide an understandable, if perhaps over-emphasised, restriction on the availability of information on local-level economic activity. It would be refreshing to see government statisticians seek more creative ways of disseminating information from such sources as taxation records or company returns at the local level without feeling that they are breaching those sensible confidentiality constraints that ensure response.

Timeliness: covers the need for up-to-date data and the frequency as well as the collection time-matching of different sources of information. This is particularly problematic at the local level where the latest employment and population statistics are often several years old and may be collected at very different times in the year.

Comprehensiveness: is linked to availability but also covers the generation of matching information sets for individual agents in the economy, thus avoiding the methodological fallacy of associating particular correlations in data sets for groups and regions to generate spurious causal inferences. The danger is that these may have a policy impact, e.g. in linking multiple deprivation measures for local areas to local policy inputs in order to correct these measures. Anonymous sample records giving individual data from the official data sets are a major advance in finding a solution to this problem.

6 Some Examples of the Application of LEFM

This section provides some brief descriptions of the use of the LEFM approach, illustrating various features and methodological issues.

Toyota investment in Derbyshire

The paper describes the use of LEFM to model the impact of Toyota's investment in Derbyshire. The results confirmed the major impact that the inward investment was likely to have, including second round effects arising from both local multipliers and intermediate demands., highlighting that much of the additional demand would leak outside the local area.

The analysis illustrated: the difficulties in assembling relevant information; the fact that marginal effects often differ from average values; that the employment affected by such impacts may be atypical; that migration and commuting issues require careful attention; and finally that the boundaries adopted for administrative purpose rarely reflect economic boundaries. (Wilson, Assefa and Beard, (1995))

Studies for local health service labour markets

IER has conducted a number of studies of local labour markets in the health care sector using the LEFM approach. The study by Baldauf and Wilson (2002) provides a general overview of labour market developments and prospects for the Coventry and Warwickshire area, focussing on trends in the level and structure of employment, key labour supply indicators, and projections of the demand for labour in the sub-region. A prime aim was to draw out the implications for the health sector, highlighting implications for the recruitment, retention and professional development of healthcare workers. (Baldauf and Wilson, 2002)

Estimating the demand for and impact of major housing and related developments in South Eastern England

These and similar studies provide an assessment of the demand for and likely impact of various major housing developments in the South Eastern part of the UK. Obtaining planning permission for such developments is a complex business, requiring quantitative assessments of employment and related impacts. LEFM has been widely used in such work, including the development of many sets of benchmark projections of what is likely to happen in various local areas throughout the UK. Often this also includes an estimation of effects on skill demand and supply, as well as a more general assessment of labour demand and supply and their implications for housing. (cf. Wilson (2003) and Wilson and Briscoe (2005a and b, and 2006))

LEFM has also been used to establish a counterfactual: what is likely to happen in the absence of such new developments. Such projections can help to identify geographical areas which are expected to experience very significant increases in labour demand and the structure of that demand by sector and by occupation. Existing industrial structure is often found to be a critical driving force for employment prospects, with areas specialising in marketed services tending to do much better than those dependent upon the declining manufacturing sector. However, the impact module within the package also allows discontinuities including the impact of new developments to be systematically explored. Such impact analysis shows how the fixed building investments and the creation of direct jobs on the designated employment land will lead to multiplier effects that spawn a further round of job creation.

Study of regional economic Development for Advantage West Midlands (AWM)

LEFM has frequently been used to study issues relating to economic development and related labour market issues, and including implications for the environment. This study was undertaken in support of the review of the West Midlands Region Economic Strategy (RES). The aim of the study was to set out what is likely to happen in the region in economic, labour market and environmental terms over the next 10-15 years and to focus upon the possible implications for AWM policy interventions. (Green, Hasluck and Wilson (2006)

Skills in Areas Affected By Rural Decline

The LEFM approach is not limited to closed geographical areas. It can also be applied to combine smaller geographical building blocks which are not contiguous. For example a broader geographical region can be divided up according to criteria such as whether the smaller areas within it are rural or non-rural. This study addressed the role of skills in 'areas affected by rural decline' within the county of Lincolnshire. The model highlights the implications of a continuation of the trends experienced in the recent past, with further decline of employment in the agricultural sector hitting rural areas. It also highlights the need to replace workers in many occupations who are leaving the labour force as they reach retirement age. The study highlights that a key problem for the county is the poor qualifications of its existing workforce, and the low aspirations of many of its workers and employers. It is the highly skilled which local employers have found hardest to recruit, while such highly skilled workers have the fewest opportunities for employment in the local area. The challenges faced by Lincolnshire are therefore not just that of finding replacement activities for the declining agricultural sector, but also meeting the demand for labour in the context of an ageing workforce. (Owen et al. (2007))

Labour Market Projections for Scotland

For number of years IER has also produced projections for sub-regions within Scotland such as the Highlands and Islands and other parts of Scotland, using an LEFM methodology. Most recently consistent results for the whole of Scotland, the Highlands and Islands, the Borders and Central Scotland have been produced (as in Livanos and Wilson (2007)). The projections present a picture of what the labour market in different parts of Scotland might look like in the future, if past trends and patterns of behaviour continue. The emphasis is on the changing structure of employment and labour supply.

The approach adopted involved using the WMRO 'REEIO' model (an extension of LEFM with additional environmental indicators).[5] The study highlights a number of challenges facing the region as a consequence. The projections include some initial estimates of implications for the environment without additional intervention, highlighting the need for change to achieve energy, waste and water use targets. The study emphasises that many of the key drivers of change lie outside the control of people in the region. However, it also highlights that the projections developed are not inevitable. By changing patterns of behaviour and performance, alternative, better, outcomes may be achieved.

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5 West Midlands Regional Observatory Regional Environmental-Economic Input-Output Model See http://www.wwflearning.org.uk/scpnet/tools/reeio/

Thames Gateway: 2012 Olympics and other developments

This study explores the impact of the 2012 Olympics and other major developments on a relatively deprived part of London and its environs. The paper by Wilson (2007) is a first step in this project. It presents new set of CE/IER employment projections for the Thames Gateway area, based on the LEFM approach. The benchmark projections are based on well established trends in patterns of behaviour and performance that have been observed over recent years and do not take account of any major discontinuities that the Olympics may cause. These factors will be considered explicitly in the next stage of this project which will develop customised scenarios (using LEFM).

Study of the impact of the Military on the economy and labour market in SW England

The South West Region contains some of the most important concentrations of military activity within the UK. The aim of the study is to build up an overview of the economic significance of the military presence within the Region. Using LEFM it provides both an assessment of the direct importance of the military within local economies throughout the region and, by exploring the input-output linkages, also provide an assessment of the dependence of other local economic activities on the military presence. The project is intended to help to identify the nature of any skills-gaps (and possible future skills-gaps), both within local areas, and across the region.

7 Conclusions

The LEFM package represents one of the first serious attempts to develop a forecasting and simulation tool for local economies based on limited information. Although there is considerable scope for expanding and improving upon the present treatment, its track record over the past 15 years demonstrates both the potential of the approach and the very real demand for this type of analysis.

LEFM provides:

- an efficient means of generating tailored local economy projections that makes maximum use of the national, regional and local information available;
- easy updating, allowing the user to draw on and reassess previous analysis;
- a rigorous and transparent method of analysis, yielding results that can be readily traced back to assumptions;
- easy links to regularly updated, authoritative forecasts at the national and regional levels;
- an explicit way to introduce local knowledge and views;
- substantial sectoral detail, so that projections can be identified closely with major local firms;
- labour market detail (sector, gender, occupation);
- the ability to implement scenarios and sensitivity testing;
- the ability to carry out impact studies (eg opening/closure of a large establishment);
- easy access to results for evaluation, plotting and file transfer to other software for report writing, presentations etc;

A number of areas for further improvement and possible development have been identified. These include:

- Extension beyond the UK to enable similar analysis at a European level, based on common data sets and the E3ME multi-sectoral macroeconomic model;
- Further analysis of commuting flows and the difference between workplace and residence based estimates of employment structure;
- Incorporation of more local data on economic indicators;
- More customised economic estimation of local relationships.

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Appendix A: Details of Data Generation Process

Employment by Industry (YEO)

Historical estimates are based on ABI and LFS information. For the future,

employment by industry = YPRO x Y

Where YPRO is a measure of productivity based on regional data and Y is industry output determined as described below.

The model is calibrated so that in the base forecast YEO moves in line with regional trends.

Calibration is achieved by altering local gross output levels (Y). This in turn is achieved by amending the export share ratio.

Industry Employment by Gender and Type

Historical estimates are based on the ABI/LFS. Self employment is estimated by assuming similar shares to the regional level.

Estimates for the future are based on the use of a matrix convertor. Values for the convertor are based on extrapolations of historical data for the local area.

Employment by Occupation and Industry

Historical data are taken from the Census of Population and LFS. These data are used to generate occupational employment shares by industry.

For the future, employment by gender and occupation is obtained by applying projected occupational shares to YE0.

Labour Supply etc.

Population (by age and sex) are taken from official ONS/GAD sources and are projected in line with official forecasts.

Activity rates (by age and sex) are based on official information and projected in line with official forecasts for the region.

Labour Force (by age and gender) = Population x Activity Rate

Unemployment (U)

Historical data are based on official estimates of Claimant Unemployment.

For the future, unemployment (U) is computed as the difference between supply (labour force, LF) and demand (employment (E)) taking into account net commuting (NC) and other factors, which are combined into the Labour Market Accounts Residual (LMAR).

For the benchmark forecast unemployment is projected to move in line with the regional forecast. The net commuting residual is computed to complete the identity.

LF - E = U + LMAR

Incomes

Income from employment = employment x YIFE

where YIFE is average income from employment based on regional information.

Similar treatments are adopted for income from self employment and other incomes.

Consumer Demand

Total consumers expenditure = APC x Disposable income

Where APC = Average propensity to consumer based on regional data

Consumption by category is based on regional pattern

Investment Demand

Investment = KOR x Gross output

where, KOR = capital output ratio based on regional data

Social capital formation = fixed share of regional value *

Government Expenditure

Government expenditure = fixed ratio of regional levels *

* Shares based on population in the local area as a proportion of total population in the region.

Exports and Imports

Exports = BQX x Total commodity output

where BQX is a fixed share of commodity output

Imports = fixed share of local demand

(If there is no local production of this commodity then this ratio is zero)

(If all output of a particular commodity is 'exported' this ratio = 1.0)

Intermediate Demand and Total Commodity Demand (Q)

Demand for commodities by industries as raw materials and intermediate inputs is based on UK input output information

Classification convertors based on UK input output tables are used to convert the components of aggregate demand into demand for commodities including intermediate demand.

Industrial Gross Output (Y) and **Value Added by Industry**

Total industrial gross output = YQC x Q

Where YQC is a transformation matrix from commodities to industrial output, again based on UK data.

Value added is a fixed ratio of gross output, the ratio being based on the regional value.

III Regional Labour Market Forecasts in the Netherlands*

Ben Kriechel, Frank Cörvers, Hans Heijke

1 Introduction

Making labour market forecasts, differentiated by education and occupation, has a long history. In the sixties the 'Mediterranean Regional Project' developed the so-called 'manpower requirement model', which – depending on a presumed growth of the economy – could predict which schooling was necessary.[1] The approach fitted into the then current line of policy in which regional-economic development could be achieved by fulfilling the requirements with respect to education and schooling.

This planning approach in the manpower requirement model was later criticized. One of the main points of criticism concerned the assumed relationship between occupations and education. Possibilities for substitution across different educational degrees or other forms of adjustment processes to solve disequilibria on partial (occupational) markets were absent from the model.[2] The available data was presumed to be insufficient to give a realistic picture of the labour market, and future labour market developments were seen as fundamentally unpredictable.

In addition to methodological criticism, there were also serious attacks on the policy aspect of the planning approach to the labour market. Failure of the government in the 70s to cope with the economic crisis resulting from the oil crisis and the changing industrial structure diminished the confidence in economic development. In the 80s economic policy changed towards less government intervention and strengthening of the market mechanism to increase the competitive power of the economy. There was no room in this approach for direct government intervention. Instead, strengthening on the supply side of the market was pursued, while the diminishing public sector, in which many activities had formerly had a high level of policy intervention, was now left to the forces of the market.

However, free markets cannot guarantee optimal allocation of resources or optimal welfare if the market is insufficiently transparent to all market participants. Increasing the transparency of the labour market for school leavers and other market participants in the educational sector fitted the policy view of that time.[3]

This new vision of the government's role in society, emphasizing the importance of transparency of the labour market for school leavers, provided the framework for labour market forecasts in the middle of the 80s. As a result, the Research Centre for Education and the Labour Market at Maastricht University was established. From the start, it addressed several points of criticism on the former manpower model. The available data was better and more detailed than the data available in the 60s and 70s. The forecasting models used the latest labour market theories, with special attention being given to

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* This paper benefited from comments by Christopher Hilbert, as well as from participants of the WZB / IUB workshop on skills needs.

1 See Parnes (1962).

2 See Blaug (1967)

3 See also Borghans (1993a,b).

different forms of interaction and substitution.[4] To do justice to the uncertainty remaining within the quantitative results, a translation towards a range of qualitative indicators was made, going in five steps from “very poor” via “reasonable” to “very good”. Furthermore, several indicators were developed that gave an indication of an educational degrees’ breadth of substitutability and the dependence of the development of an occupation or educational degree on the economic cycle.

While still falling short of the economic ideal assumption of perfect information, labour market forecasts can nevertheless summarize the most likely predictions for the intermediate term of five years. The forecasts provide an early warning system to participants taking decisions on future hiring on the one side of the labour market or educational decisions on the other side. These forecasts distil the current development on the labour market if the participants do not change their behaviour significantly. However, the intention is to provide the necessary time for participants to adapt their behaviour on the basis of the forecasts in order to optimize for the future situation. Giving an indication on the degree of discrepancies allows the economic actors to adjust optimally.[5]

One of the developments in the labour market forecasts was the need for regional disaggregation. Much of the matching on the labour market, but also policy-making, is done on the regional level.[6] Provinces differ in the sector distribution of labour, and subsequently in the occupational structure. The demographic structure of occupations can also differ over regions, leading to differences in future developments. This has led to the development of regional models of labour market forecasts for various Dutch provinces: RAIL for the province of Limburg, RAMING for the province of Gelderland, and RATIO for the province of Overijssel. These models were built on the methodology of the national model. However, given the size of the provinces and the availability of data, some simplifications were introduced.

In this chapter we will discuss some issues of the regional model. In section two, we will briefly discuss the national model. Section three deals with the choices made to adapt the national model to the regional situation and circumstances. Section four discusses one specific trade-off in some detail: regionalization versus detail in the occupational or educational classes. Section five discusses the practical implementation of the forecasts, especially with regard to the user’s wishes and demands. Section six concludes with an outlook on future developments of the regional model and the challenges to be tackled.

2 The national model of occupational and educational demand

The forecasts of labour market demand are based on replacement demand, expansion demand, and the labour market supply of school leavers. Skills are differentiated for more than 100 occupational groups and types of education. The classifications used are compatible with the classifications of Statistics Netherlands, and hence with ISCED and ISCO.[7] The components of the forecasts for occupational groups and types of education and how they are related, are given in Figure 1. Based on forecasts of labour force

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4 Borhans and Heijke (1996).

5 Borghans and Wieling (2001).

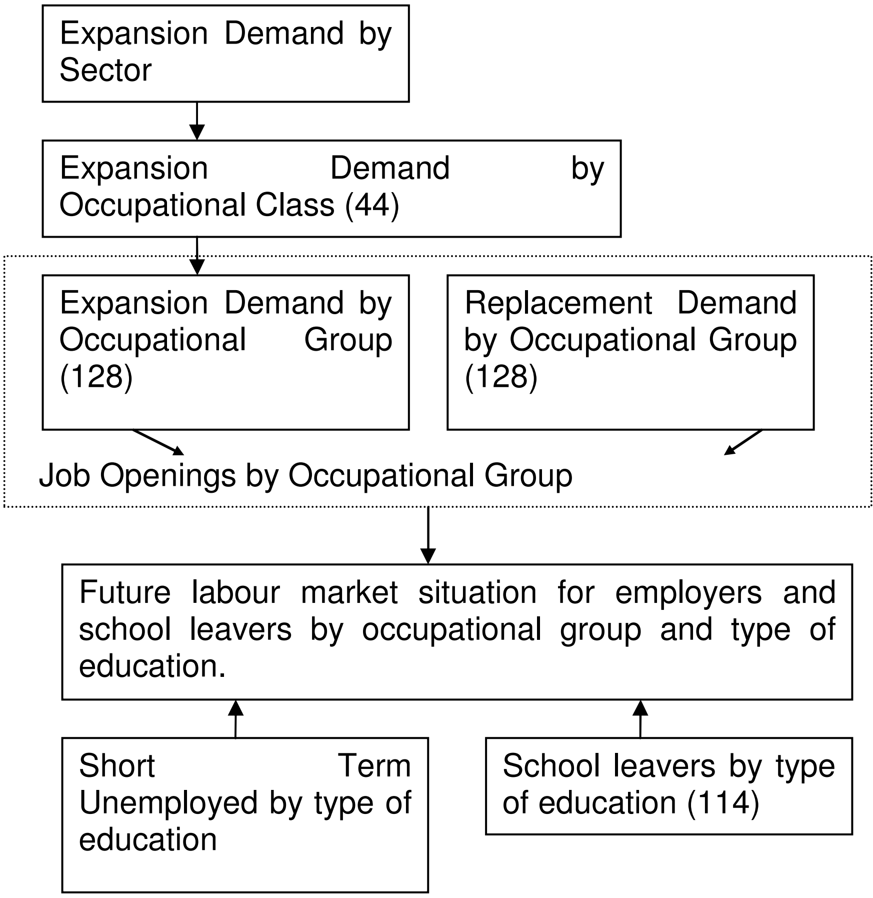
6 For a discussion of the embedding of the regional forecasts into labour market monitoring see Kriechel (2007).

7 A more detailed description of the national methodology and the underlying economic concepts can be found in Cörvers, de Grip and Heijke (2002).

development in the sectors of the economy, we established the expansion demand of occupations and education types. This is the degree to which an occupation grows over time, or, in the case of negative expansion demand, how it shrinks. Replacement demand is the second part of labour demand. It specifies the percentage of workers who need to be replaced because they leave the labour market for various reasons.[8] This demand side of the labour market is set off against the supply side. Here, school leavers form the largest group that enters the labour market on the supply side, to balance expansionary and replacement demand.

An important input for the national model of occupational and educational demand is the sector employment forecast of the Netherlands Bureau for Economic Policy Analysis (CPB), the official institute of economic forecasting for the Dutch government. They provide general forecasts of economic growth and their broad translation into short- and medium-term labour market developments. These forecasts are based on the CPB Athena model.[9]

Figure 1: Occupational forecasts diagram



Notes: The numbers in brackets represent the numbers of different occupational groups or classes used.

Another input is the demographic development of the labour force. For this, we use demographic forecasts that are also provided by the CPB. The demographic forecasts in

8 The main factor of replacement demand is of course (early) retirement.

9 The Athena model and its methodology can be found in CPB (1990).

combination with long-term economic scenarios provide the basis for future labour market developments. The scenarios include recent or expected future policy reforms affecting the labour market, the changing attitude on participation over cohorts of workers and long-term (technological) trends influencing the labour market. These are summarized in expected changes of the participation rate for the different age groups and sexes. The expected participation rate and demographic developments constitute the basis for the expectations on the future labour force that will be available in the Netherlands.

The prediction of national school leavers of all levels are based on the data of school enrolment but also on the number of diplomas issued (and expected), as compiled by the Dutch Ministry of Education, Culture and Science for full-time education.[10] These forecasts are further disaggregated and corrected for the omission of the inflow from part-time education.

Historical trends on the labour market were used as the basis of the modelling effort both for the replacement demand and the expansion demand of workers. On the basis of the labour force survey of the Netherlands ("Enquête Beroepsbevolking"), we can establish long-term developments of occupations. We can also establish their distribution over sectors and educational degrees. The clustering of occupations was based on the ISIC and ISCO classifications.[11]

The forecasts are widely used in various informational products for study and career guidance both at high-school level and within the vocational schools, colleges and universities. There are products catering specifically for counsellors and for students. Furthermore, government administration, ministries, and other public sector institutions make use of the forecasts for their policies on issues regarding the labour market, especially with respect to the transition of school leavers and graduates to the labour market.

3 From national to regional level

The regional model uses the national forecast as an input and, to some extent, also as a substitute for missing data. Wherever possible, regional data is used to fill the model in order to achieve a region-specific forecast of occupational and educational demand.[12]

3.1 Inflow of graduates

The inflow of graduates into the labour market is based on the national inflow into degree programmes and the national prediction of outflow in the next five years. These predictions also constitute the basis for the national forecasts of the inflow of graduates into the labour market, which are used for ROA's biennial labour market forecast where the future number of school leavers and graduates are offset against the expected vacancies in the medium term of five years. Figures are based on broader forecasts by the Ministry of Education and calculations of the number of labour participants upgrading their skills by receiving higher degrees, or degrees within other fields than those that their current ones.

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10 Ministerie van Onderwijs Cultuur en Wetenschappen (2004).

11 Heijke, Matheeuwsen and Willems (2003).

12 A description of the regional model, focussing on spatial aspects and its application in the province of Gelderland, can be found in Cörvers and Hensen (2005).

These national figures of expected school leavers and graduates form the basis of the regional models. We, however, have based the number of students who enter the regional labour market on the current regional distribution of education levels in regional employment relative to the national labour market. In other words, we expected the *current* education level of the labour force to reflect the expected demand and composition of the future labour force. Ideally, we could observe the inflow and outflow of students into the different degree programmes on a regional level. Nevertheless, the inflow on the labour market could still be distorted by the fact that schools are by no means evenly distributed over the Netherlands. The province Utrecht, for example, has a much higher student population on *all* levels of education than their own labour force would need. These educational institutions provide education for students from other regions who will eventually enter their own regional labour markets.

Another aspect of measuring graduates on a regional level is that it falls short of the initial mobility of especially higher degree students (higher professional education (HBO) and university education (WO)). For these students it is quite common to study further away from their parents' home and also from their initial work. This is in addition to the higher mobility of these higher educated workers. Therefore, the regional forecasts focus on the lower and intermediate educated. Figures for the higher educated workers are also reported as an indication, but do not constitute the main focus of this study.

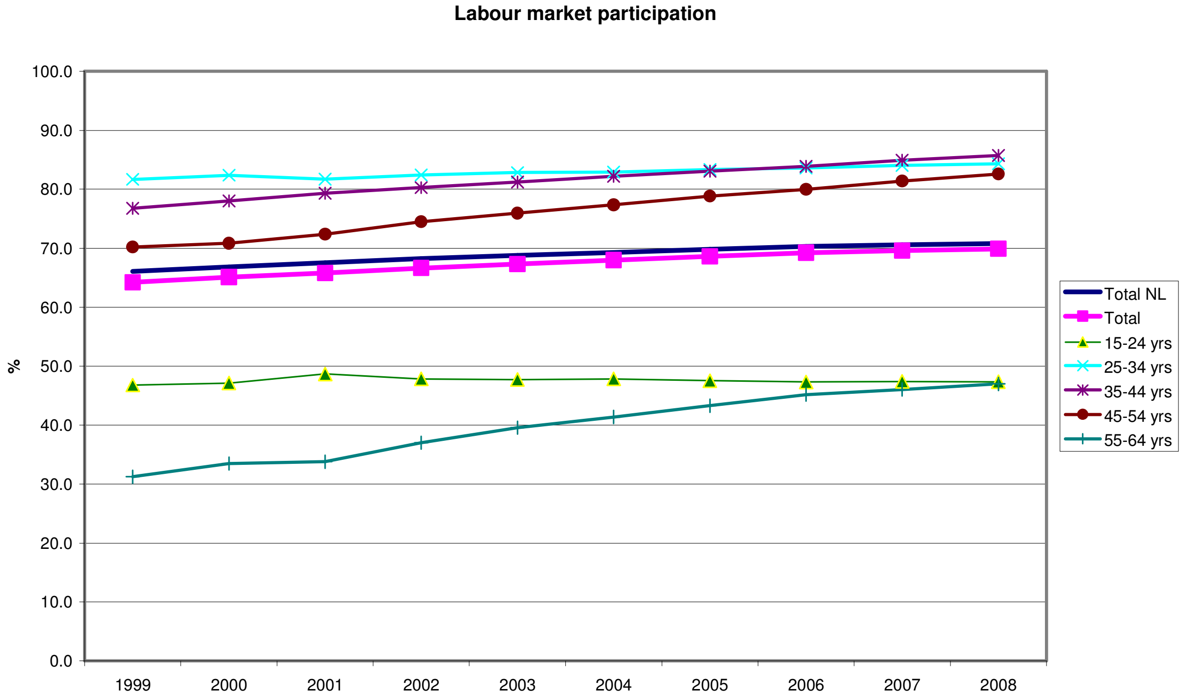
3.2 Regional sector forecast and regional participation rates and expansion demand

As is the case with national forecasts, the basis for the development on the regional labour market is a forecast of the labour market developments in the 14 sectors of the economy. These labour market forecasts are provided by Netherlands Statistics (CPB) for the national level and by provincial economic research centres (BEO for Gelderland, and Etil for Limburg and Overijssel) for the regional level. These regional forecasts are based on the national forecasts of economic development, using the available information on the regional labour market structure as provided by counties and provinces.

A forecast for future changes in participation rates is also provided by the CPB for the national level, and by the regional economic research centres for the regional level. Figure 2 shows the differences in predicted labour market participation rates of the province Overijssel (line with squares) and the national level (bold line). Note that the total participation rate in Overijssel is predicted to be slightly lower than the one for the Netherlands.

The provincial labour demand forecast in each sector shows the growth (or decline) of the labour force in each of the sectors of the economy. These forecasts of developments are applied to the current composition of the regional labour force by sector and its educational and occupational structure. The current distribution of occupations (educational degrees) across sectors is therefore region-specific. The sector forecasts combined with the regional distribution over occupations (educational degrees) constitute the basis for the forecasts of labour developments on the occupational (and educational) level. The translation of the replacement demand based on the sector developments into the 44 occupations was done by the national matrix of sector-occupation development. This matrix combines the joint economic development, as well as (long-term) occupational shifts within the sectors. A further translation of 44 occupational groups into the 128 occupations was also done by using the national matrix of relative occupational shares in the 44 occupational groups.

Figure 2: Labour market participation for the province of Overijssel versus the Netherlands



Source: Ratio II, see: Borghans et al. (2005)

3.3 Replacement Demand

The other component of labour demand is replacement demand. Replacement demand is driven by the demographic (age) structure of occupations and the participation rates within age cohorts. It is important to distinguish between the male and female labour markets with respect to replacement demand as they have shown historically to perform quite differently with respect to exit rates over age cohorts. Replacement demand is calculated using regional data.[13] The cohort/gender-specific outflow is based on the national estimation. In the national model, outflow per age cohort and gender is estimated using historic data of outflow per occupation (or educational degree). These outflow coefficients are then combined with the predicted changes of participation rates to calculate expected outflow coefficients for the next five years. Increasing participation rates mitigate the expected outflow of workers, and hence diminishes replacement demand. Replacement demand is therefore the result of the occupation-specific age-sex distribution of workers, the (national) outflow coefficient of the occupation, and the expected changes in the (regional) participation rate. The replacement demand takes different levels and changes in participation rates of age groups and gender into account. We have used separate five-year cohorts for males and females. Figure 2 shows a slightly more aggregated participation rate by 10-year age groups which are not differentiated by sex. One can still see marked differences in participation across the age groups. Taking the region-specific

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[13] Note though that the age structure of occupations (degrees) must be extrapolated using the RAS procedure, which is explained in the next section.

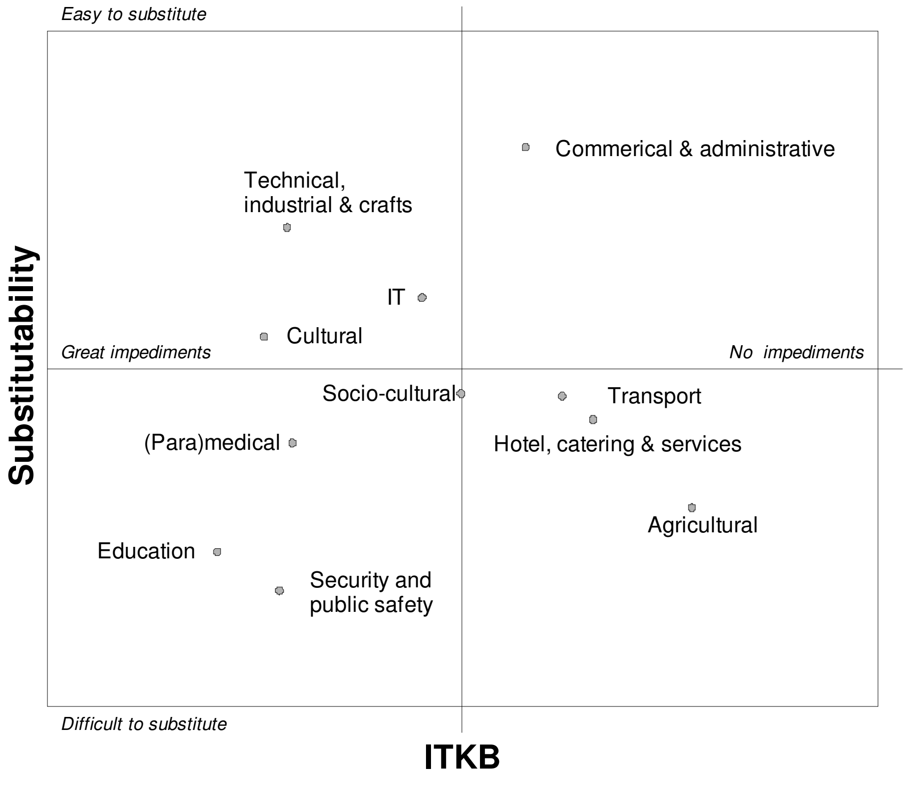
demographic situation with its regional participation rate is therefore important for assessing the regional replacement demand.

3.4 Confronting supply and demand

The confrontation of supply and demand is done by calculating indicators of the future labour market situation for all occupations and education levels. The supply is the inflow of graduates and school leavers combined with the short-term unemployed. The demand is the combination of replacement and expansion demand. The resulting indicator is translated into a qualitative characterization of the labour market: there can be *no, almost no, some, serious* and *very serious* recruitment problems, depending on the size of the indicator. The role of the indicator is twofold. Firstly, it allows to quickly scan through the occupations asking for more efforts in recruitment and helps people to find work, and secondly it gives indications for all occupations while de-emphasizing the specific numeric outcome, which is inherently imprecise.

While the indicator is calculated for all occupations (ITKB) and for all education types (ITA), in the assessment of the overall labour market situation it may be useful to aggregate the indicators to a higher level. Figure 3 gives an example of how the indicator may be used. On the horizontal axis, we have plotted the degree to which we expected employers to have difficulties finding suitable personal ("*Impediments*"); the higher the value on the axis, the fewer problems we expect (*"No impediments"*). On the vertical axis, we have plotted the degree to which the occupations could be filled by substituting ("*Substitutability*") workers from related occupations and educations. The higher the value, the easier it is to substitute for a specific occupation.

Figure 3: Indicator of future labour market situation and degree of substitutability in Overijssel



Source: Ratio II, see: Borghans et al. (2005)

Table 1: National versus regional data

	Netherlands	Overijssel
Number of occupations with less than 2500 workers	2	79
Percentage of the total number of occupations	1.60%	61.70%
Percentage of the workforce	0.10%	15.60%

Source: EBB 2002, own calculations

3.5 Cell size and sampling size: Detail versus Regionalization

A major challenge in making detailed prognoses is always the cell size of the occupations. In essence, the trade-off between sampling-related disturbances in these observations, and the degree of detail determine the maximum detail. For the national model, the 128 occupations form a reasonable trade-off, allowing detail in its distinction between occupation, while insuring that the underlying data sources are sufficiently stable to make the useful forecasts.

Table 1 shows that using a single year of the national labour force survey warrants only two occupations in the most detailed occupational distinction in which less than 2500 workers are found.[14] The picture for the province of Overijssel is – of course – much worse. Almost two thirds, 79 out of the 128, of the occupations have less than the required 2500 workers, representing 15.6 percent of the total workforce in the province. This problem can be overcome by using two- or multiple-year averages over occupations, but that comes at the cost of losing variation and specific trends needed for the forecasts.

3.6 RAS procedure

A RAS procedure is used to overcome the data problem on the regional level.[15] First of all, the totals for occupations age/sex distributions are used to fit a regional age distribution onto the data. The basis is the national distribution, *A*, with the condition that the cell totals of the regions are met. Using regional data on the disaggregate level is not possible for two reasons: only very few occupations will have a cell size that is sufficient filled to be considered sufficiently reliable for publication, even if we pool two-year averages (cf. Table 1 of occupations that have less than 2500 workers per occupation). Secondly, using data on a very low level of aggregation will lead to fluctuations in the occupation/age cells due to sampling rather than due to economic effects. This would result in a variation in the data that is due to the sample size of the labour force survey and not to economic or structural changes.

The RAS procedure allows us in this context to use the regional level totals in an occupation or educational group, together with the regional counts of the labour force age distribution. In order to get a matrix of e.g. occupation specific age distribution, *C*, a

14 This number is used as Dutch Statistics considers cells with fillings of less than 2500 workers as unreliable and should therefore not been published. For calculations using two-year averages, they are permissible. Note that these figures are based on weights, and underlying these there can be a much smaller number of respondents.

15 The RAS procedure is developed in Stone and Brown (1962).

biproportional adjustment of the initial matrix, *A*, is done. The RAS procedure searches for vectors *r* and *s* to fulfil:

$$c_{ij} = r_i a_{ij} s_j \quad \forall i, j$$

subject to:

$$\sum_j c_{ij} = b_i \;\; \forall i$$
$$\sum_i c_{ij} = b_j \;\; \forall j$$

under the constraint that the sum of all cells along the rows *i* fulfil the row total, and the sum along the columns *j* fulfil the column totals that are given. Where *a* denotes a cell in the base matrix, *A*, *c* denotes a cell in the matrix, *C*, that needs to be derived. To start the procedure, the elements of the base matrix are adjusted to reflect the regional row totals.

$$\bar{c}_{ij} = \frac{b_i}{a_i} a_{ij} \;\; \forall j$$

Next, using the adjusted cell filling $\bar{c}$ the column total constraint is satisfied, while violating the row total constraint.

$$\hat{c}_{ij} = \bar{c}_{ij} \frac{b_j}{\bar{c}_j} \;\; ; \forall i$$

Now in the second step the just derived cell filling $\hat{c}$ is adjusted to satisfy the row constraint, by using the ratio between the regional row totals (b_j) and the row total of the just estimated matrix $\bar{c}_j$:

$$\bar{c}_{ij} = \hat{c}_{ij} \frac{b_i}{\hat{c}_i} \;\; ; \forall j$$

These last two steps are repeated until convergence is achieved.

3.7 Top-down versus bottom-up[16]

Summarizing the above, ROA's regional forecasting model is actually a top-down approach where national forecasts form an important point of reference for a region-specific forecast based on an exhaustive exploitation of the available information on the structure of the regional labour market. On the national level, national data is applied to changes in employment in various sectors of industry, which ROA takes from the Netherlands Bureau for Economic Policy Analysis (CPB), and to flows from education onto the labour market, which are largely taken from forecasts by the Ministry of Education, Culture and Science. Using these, ROA ensures that its labour market forecasts are consistent with authoritative national forecasts that provide the basis for policy decisions on important social and economic issues in the Netherlands. ROA makes as much use as

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16 This section is based in part on an earlier publication: Cörvers (2003)

possible of regular forecasts on future growth of employment and flows from education onto the labour market. This enables ROA to concentrate on developing its own authoritative expertise within the specialized field of the match between education and the labour market.

Another pillar on which labour market forecasting and the information system are built, is the *Labour force survey (LFS)* of Statistics Netherlands (CBS). The LFS provides information on the number of working people, analysed by economic sector, occupation, training, age, sex and working hours. Information from Statistics Netherlands on the number of students in various types of education is also used. Data is used to estimate the models with which developments in the labour market are forecast. The labour market indicators that give a picture of the employment position linked to the choice of a particular occupation or type of education, are also determined on the basis of these data. As mentioned before, these indicators concern alternative employment options, competing types of education, and sensitivity to cyclical variations in employment levels.

In a top-down approach, the data sources used at the regional level cover all segments of the labour market. These data sources should be consistent with other important national economic developments, such as economic growth, employment growth, demographic trends, and can be consistently differentiated to lower levels of aggregation. These data sources are often available nationally on a regular and coherent basis. This implies that data can be used in time series analyses, which is important for forecasting models.

The data sources in a so-called bottom-up approach[17] are incompatible with one another and provide partial, often specific but inconsistent and ad hoc information on overlapping labour market segments. Besides, not all data requirements to cover the whole labour market are met, while not all data can be adequately used when sources are too inconsistent with one another. Obviously, it is difficult to integrate data from various sources in a single or several consistent and regular data sets. Another disadvantage of the bottom-up approach is using specific data as input for a partial regional model of the labour market, thereby excluding adjustment processes between regions (e.g. commuting and migration).

Nevertheless, partial models of labour market forecasting are useful for a deeper insight into the mechanisms and problems of specific labour market segments, in particular if substitution processes and interactions with other economic sectors are less important (e.g. health care, teacher’s labour market) or if regions have almost no interaction with neighbouring regions. The use of partial and ad hoc information may therefore be complementary to the top-down approach. As discussed in Borghans, de Grip and Hoevenberg (1994), partial information of particular labour market segments can be used to differentiate further labour market forecasts generated in the top-down approach. Specific expert knowledge can be used to detect valuable partial data sources, or to judge the plausibility of specific labour market forecasts. In particular for short-term forecasts, it may be useful to incorporate, for example, consensus of judgements of sector experts on particular forecasts.[18] However, for medium-term forecasts experts may attach too much weight to recent developments on the labour market.

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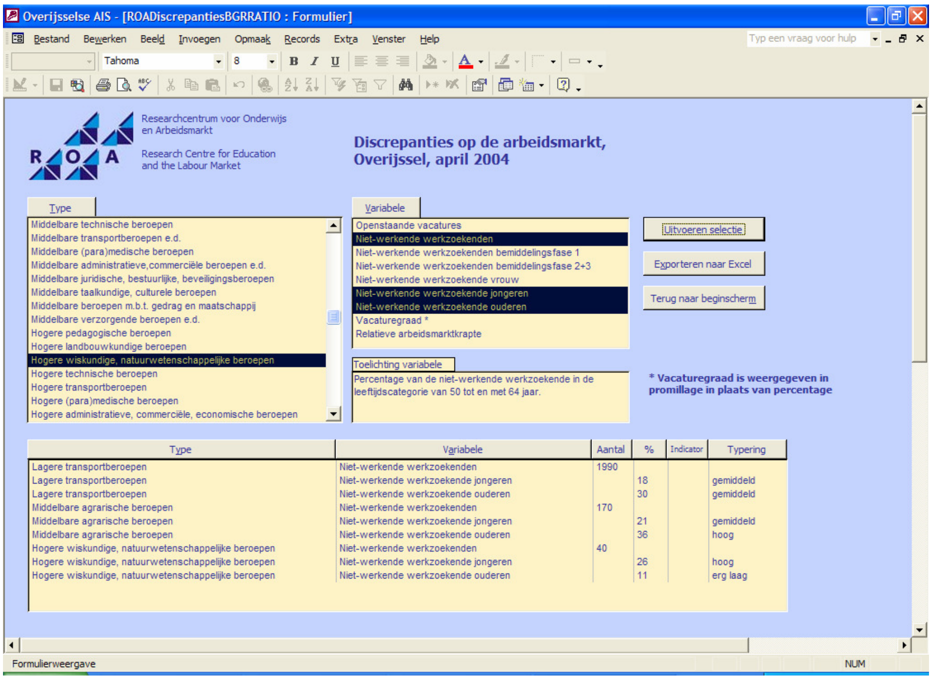
[17] Bottom-up approaches usually take partial labour markets or sector-specific sources. They can be quite useful for a deeper insight into the mechanisms underlying specific labour markets, while they are not easily integrated into a comparable picture of the entire labour market.

[18] See Batchelor (2001).

4 Use of the Data: RATIO II

Making labour market forecasts is not only a methodological problem. It also involves the cooperation of many interest groups on the labour markets, including labour market offices, representatives of the regional government – be it on the provincial or the local level –, and employer associations and labour unions. The setting in which the forecast is made, and experiences that have helped to improve the usability and the acceptance of our approach are mentioned briefly in this section.

Figure 4: The Labour Market Information System "AiS"



The independence of the research institution generating the forecasts is important for the credibility of the prognosis. The forecasts are thus independent from any political involvement or goals. However, it is important to embed the presentation and dissemination of the figures in the broader context of the users and policymakers. Therefore, a commission is always formed to participate in the discussion of the preliminary results, the decisions on the focus of attention of the biennial report, and to give continuous feedback from the users.

On the national level, the forecast is financed by the Ministry of Education, Culture and Science, the employment agencies, and partly by sector organizations. On the regional level, the commission consists of representatives from the province, counties, the labour office, schools and educational institutions, labour unions, and employer organizations. This represents the main target groups for using the information generated with the forecasts, but also with the focus chapter that investigate certain topics in depth.

The results of a regional forecast are published in two ways. There is a written report with the detailed outcome of the forecast, the situation in the province and several in-depth studies that the commission has agreed upon. Furthermore, the data of the current situation in the province and the prognosis are used to fill a database – called "AiS" – which allows the users to combine and compare different occupations with the data available (see Figure 4). The user can therefore make additional analyses and reporting on partial labour markets is simplified. These are tasks which are often done by the various users of the system.

Table 2: Forecasts for Overijssel: 2003-2008, Occupations

Occupation Level	% of labour force	5-year growth
Elementary occupations	34	6
Intermediate occupations	42	1
Higher occupations	24	8

Source: Ratio II

Table 3: Forecasts for Overijssel: 2003-2008, Education

Education Level	% of labour force	5-year growth
Elementary	7	-20
Lower vocational	22	-2
Intermediate vocational and higher secondary general education	47	9
Higher vocational training / College	18	10
University	5	14

Source: Ratio II

The report includes some overall comparisons and tables that make it possible to compare the situation over years, but also to get a quick overview over the expected economic situation of the province with respect to the labour market. While the appendices of the reports include the detailed occupational and educational forecasts, reporting is mainly done on a more aggregate level. The more aggregate level allows users to view trends over occupational groups or education levels.

In the forecasts for 2003-2008 of the province of Overijssel, we found that occupation growth was U-shaped. The elementary and higher occupations were predicted to have a higher growth, while the intermediate occupations were expected to show a lower than average growth (see Table 2)

Comparing this with the prospects for the education level yields an interesting insight. In terms of education levels, the prediction is that the expected growth in employment rises with the level of education (see Table 3). Combining this trend of education and occupation forecasts implies that the level of education in the occupation rises, and that several workers will be working below what used to be their occupation level. This does not necessarily imply that they are overeducated, because it could also indicate a shift in the demand for skills in several occupations classified as “lower” or “intermediate”.

An extension of the forecast of the aforementioned study was also to look into the influence of the business cycle on the forecast. This was done by simulating positive and negative shocks to the sector forecast and calculating the detailed outcome per occupation and education. The scenario analysis showed the fragility of the lower occupations with respect to the business cycle. This was even amplified for the lowest educational levels.

The focus chapters in the regional forecast deal with various aspects of the labour market: an analysis was made in the geographic, spatial situation of Overijssel and its implications for the province, which were detailed further with respect to the commuting behaviour of workers in the province. There was a chapter on the “potential labour force”, which represents the inhabitants who could potentially participate in the workforce. On the other extreme, the “lower end” of the labour market, has been a study in these chapters for the province of Overijssel.

5 Prospects and Outlook

Given the data situation and the constraint to report only those occupations with more than 2000 employees in a given region, the development of the model will most likely go towards a slightly less detailed level with respect to the occupations or education degrees analyzed. This will enable us to stabilize and regionalize more of the components in such a way that the regional effect and demography will play a more dominant role

Another aspect is that of regional interaction. When a forecast is made for a administrative unit - a province - this does not necessarily encompass the region in which the labour market of a given worker is perceived to be. Workers close enough to the (provincial) border will most likely consider the neighbouring province as part of their regional labour market. A model which allows for regional interaction, commuting across the regional borders and also migration, will cover this aspect much better, and hence present one of the ways in which problems on the labour markets can be solved. In principal this would mean that the national forecast is followed by forecasts for *all* regions, to then work out the interactions that might solve some of the discrepancies on the regional labour market. In this way we could integrate concepts that solve discrepancies on the labour market by, for example commuting between provinces, or by regional migration.

Another problem is the availability and level of detail of regional data. There is always a trade-off between detail and the degree to which purely regional data can be used. We have solved this problem here by combining elements from national forecasts with regional data and by using RAS procedures to establish a regional age distribution within occupations or educations. Another approach would be to move to a higher level of aggregation. For the future we consider to move to a system of 44 occupational groups and 34 educational directions as the main level of analysis. This allows us to use more region-specific data while it remains sufficiently disaggregated.

One of the crucial aspects of regional labour market forecasts is the contact with the users and the continuity of the project. The continuity is of importance to make results comparable over time. It also gives users the time to learn how the report or the labour market information system (AiS) can be used effectively for their needs. If the project is of a short duration, this investment may seem too high for the perceived benefits

Establishing regional commissions with members from the various interest groups of the users, including the labour office, schools, employers and trade unions, will increase the acceptance of the published results and analyses. But the commission also communicates the wishes and issues that are of primary importance to the region and which can be analysed in sections of the report that allow a more in-depth analysis of some topics.

The regional project in Overijssel is one of a number of projects with a duration of two years. They have been extended once, so that two forecasts and reports have been published. Especially within the context of Ratio II, the second report and set of forecasts, a great effort was made by the province of Overijssel to spread the information within the target population, but also to show different possibilities and applications. At this point it is – for budgetary reasons – still unclear whether a third round of regional forecasts will be done. Yet, we still receive requests for the data, interpretation of the data, and also updated information, two years after publication.

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IV Forecasting System for the Development of Employment and Qualifications in the Metropolitan Region Frankfurt/Rhine-Main

Claudia Knobel, Dirk Crass, Lioba Trabert

1 Introduction

Forecasting is not a matter of certainty but it shows actors where the journey might go. So it can be used to influence the way the future will develop. This means for the economy and, especially for the labour market, that the actors get useful information about the development of employment. This is important to the economic actors because they can see the economic process more clearly. Structural changes can be anticipated and possibly be converted into better directions. For this monitoring to be effective it is necessary to get the information in a timely fashion. Thus it is reasonable to conduct medium-term forecasts so that the actors have enough time to react.

The timely anticipation of regional restructuring creates improved opportunities for actions to prevent negative impacts and to enhance existing positive developments for enterprises and cities on a regional level. With the help of the early information, not only economic policy makers but also enterprises can better adapt to structural changes. Regional actors can also use this information to support others (e.g. the unemployed, enterprises) in their efforts to adapt such structural changes.

In the context of the European Union regions have became more important. The importance of regional policy has risen to maintain the competitiveness of regions. Regional Forecasting is a useful instrument to help to foresee tendencies in the development of employment, qualifications and occupations. This information can be used by labour market actors to prevent labour market shortages of skilled employees.

The aim of the model which is described here is the development of a forecasting system to deal with structural changes. This system anticipates the development of qualifications and employment structures in the Rhine-Main-Region. The Rhine-Main-Region is characterized as a metropolitan area with many flows of commuters. It is the middle of an agglomeration area and an important European international financial centre. The most important sector of the economy is the service sector. The airport is the biggest employer, not only in the Rhine-Main-Region but also in Hesse. So all occupations linked to the airport, such as occupations related to logistics, are very important, too. Some large enterprises in the production sector are located in the surrounding areas.

A medium-term forecasting system is understood as one which forecasts the development of the employment over five years. So we forecast the employment with an occupational and qualificational focus up until 2012. This gives enough time between recognition of developments and an opportunity to react properly.

Former studies showed that the demand side has a huge influence on the labour market and often influences many aspects of the supply side. But studies also showed that medium-term mismatches occur especially at a regional level.[1] Thus it is necessary to forecast not only the demand side but also the supply side of the labour market. As long as only the demand side is forecasted, it is possible to miss shortages of skilled personnel.

[1] e.g. Cörvers, Heijke, 2004.

Therefore the medium-term forecasting of structural changes developed here includes the supply and demand side of regional labour markets for specific occupational groups and qualifications. Together with local networks, medium-term risks arising from mismatches are identified and evaluated based on the medium-term forecasts.

The forecasting of occupational groups and qualifications provides information about possible future changes of employment across these two dimensions occupation and skills and also about mismatches in a region. This provides orientation for vocational training by enterprises, vocational training institutions and schools. A potential need for correction can be discussed with regional labour market experts. These experts can help to identify structural changes in the region and evaluate the results of the medium-term forecast. The experts are recruited from enterprises, labour market policy makers, representatives of regional economic development agencies, of chambers of commerce, of labour offices etc.

The benefits of this project are two-fold: First, enterprises and regional actors can handle structural changes better. Second, regional competitiveness is improved.

Partners of the project are the City of Offenbach, Frankfurt Economic Development GmbH, the District of Groß-Gerau, the Johann Wolfgang Goethe University, the Institute of Economics, Labour and Culture (IWAK), HessenAgentur, EWR Consulting and the Hessian Labour Office together with IAB Hesse. The project is financed by the Hessian Ministry of Economics, Traffic and State Development of the State and by the European Social Fund.

The article presents first the general concept of the forecasting model, then the methodology is described in detail. Afterwards one special feature of the forecasting process is discussed, respectively for the supply and demand side. In the last section the outlook for further research is given.

2 Concept

The medium term forecasting model combines demand and supply side projections. The projections of this model are presented to regional experts who evaluate and interpret them. The experts also add their views on future developments concerning new occupations, new branches or new qualifications. Beside the development of existing occupations and qualifications it is possible to show new developments, such as the emergence of new qualificational profiles on the labour market.

First of all the demand side of the labour market will be forecasted. This forecast provides information about structural changes concerning occupation and qualification in the region Frankfurt/Rhine-Main. To this purpose projections of the occupation and qualification structure are conducted.

From a methodological point of view, time series models are used. ARIMA-Models generate he most precise results in the forecasting process. The main idea of this model is that the time series are determined by their own dynamic structure. The choice of an adequate model depends on the characteristics of the time series itself. So the advantage of an ARIMA-Model is its flexible adaptation to the model specification.

The data needed for the time series analysis was provided by the „IAB Hessen" of "Regionaldirektion Hessen der Bundesagentur für Arbeit" (labour office of Hesse). The data used cover employees subject to social insurance contribution, the unemployed and commuters.

The most important data for the quantitative determination of the supply side of the labour market is the population of working age. Given some assumptions on typical behavior, e.g. retirement age or the duration of education, we can extrapolate the potential labour supply for the region. So In this manner aspects of demographic changes are represented medium to long term.

Parts of the supply side are described by the working population, the employed. Data about qualifications and occupations for this group are available. The unemployed are another part of the supply side. Third, graduates from school, universities and other education institutions form part of the supply of labour. Not all determinants of labour supply can be used for the medium-term forecasting of the labour supply side, because for some indicators there are no data available on a regional level. So for this forecasting model, determinants of medium term labour supply comprises basically demographical development and migration, retirement rates of the older employed and labour participation of the younger.

Commuters contribute further to the supply side on the labour market, especially in the Rhine-Main Region. Thus the projection of the supply side is corrected by the flow of the commuters from and into the region. Henceforth the labour supply will include also commuters.

Both results, the forecasted medium term labour supply and the forecasted medium term labour demand are compared to identify mismatches on the regional labour market. These mismachtes between the supply and the demand side provide information about opportunities for vocational training. For example, if there is a shortage in one occupation, vocational training in these occupations can be stepped up. If the supply exceeds the demand, the surplus of employees need incentives to change their occupation. This could be also in form of vocational training.

The results of the projection of the labour supply and labour demand are examined by regional labour market experts. These experts are labour market actors, such as employers and human resource managers of bigger enterprises. They are also actors in labour market policy such as representatives of labour offices, chambers of commerce, trade unions, entrepreneurs' association etc. For each occupational group and each region experts have been chosen. Across all regions and occupational groups, there are about 100 experts in the panel. First, the experts are asked by an internet based questionnaire how they forecast the trend of development of the occupational groups. Then they assess the results of the data model. In addition, their opinion of the development of new occupations and until now less important occupations are asked. If the opinions of the experts differ from the results of the forecast, workshops with these experts are held to discuss the different views of the development of these occupations. The results of the survey and the workshops are considered in the results of the mismatches of occupational groups.

3 Forecasting the labour demand

The demand on the labour market is twofold. The first part is the expansion demand which covers the structural changes and the development trend until the year 2012. The trend, which determines the expansion demand, can be an adverse trend by nature and therefore the expansion of the demand may be negative. That means that there is no expansion but a reduction of the first part of the demand side. The second part of the demand is the amount of employees which needs to be replaced because of retirements within the next five years. We call this part of the labour demand the replacement demand.

Together the replacement and the expansion demand represent the future additional demand until 2012. Before we describe our approach for the replacement demand in chapter 3.7, we present in a first step our more complex approach for the expansion demand.

3.1 Our approach for the expansion demand

Our focus for the project is the Rhine-Main-Region with the cities of Frankfurt/Main, Offenbach and the district of Groß-Gerau. One commonly used approach for this regional perspective is the shift-share analysis.[2] This method is usually used to predict the regional development of the total employment. A superior forecast is as essential for a shift-share approach as for every other top-down approach. For our forecast, a national forecasting system by occupational group would be highly needed. Unfortunately, such a forecasting system is not available for a regional approach. As a result of the increased importance and the increasing activities in the area of forecasting the development of occupations, a nationwide forecasting system will be established by the end of 2008.[3] Until this time it is necessary to use a bottom-up approach.

An advantage of the bottom-up approach is the ability to include specific regional factors in the model structure, and the results thus reflect the unique features of each region. The exact method of our bottom-up approach has to be established in so far that an easy implementation is allowed and, most of all, to make it possible to achieve results with the available limited regional data. We decided to use an econometric time-series analysis, in particular the autoregressive-moving-average (ARIMA) model. In this model the trend of each occupational group can be extrapolated and it is a straightforward way to account for historical trend-breaks. This is important because there were extraordinary but singular shocks like major relocation decisions of companies. These shocks are modelled by dummy variables in order to neutralize the shocks for the medium term forecasting. Therefore, the forecast model has been adjusted to these historical shocks as well as to the regional data available.

3.2 Data

Since employer hiring rates only show jobs which are occupied and not the amount of unfilled job vacancies, it is difficult to measure labour demand accurately. Usually labour demand contains all kind of employment relationships. Because we have to use the available regional data, local labour demand is defined as employees subject to social insurance contributions. We consider them as realised demand and this definition covers roughly 75 percent[4] of all employees.

The local labour demand is projected for the three regions Frankfurt City, Offenbach City and the district of Groß-Gerau. We use register data from the German Federal Employment Agency for the last twenty years in the three regions. The data is differentiated by the three local regions and the 10 most important (which means biggest)

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[2] Tassinopoulos 2000, p. 48 ff.

[3] Discussion with BIBB (Bundesinstitut für Berufsbildung) 2007.

[4] The other employees are: self-employed, civil-servants, marginally employed and unpaid family workers. See chapter 4.2. Statistisches Bundesamt 2007.

occupational groups.[5] The occupational groups are highly aggregated and consist of many different occupations. We use this aggregation level to get enough data on the regional level. A more detailed look on the occupations does not offer enough a big enough observations numbers for a forecast. Our employment data are available from June 1987 to June 2007. Thus, our forecasts for 2012 are based on data which end in June 2007, but first became available in March 2008. We tried to bridge this time lag at least partially with our approach.

For each occupational group there is a time series on a yearly basis with twenty-one observations (1987-2007) available. These twenty-one years are the time period ("Stützzeitraum") for our time series analysis, which exceeds the forecasting horizon of five years slightly more than four times. Hence, the quality criterion is fulfilled.[6] Unfortunately, the small amount of observations limits the efficiency of a set of statistical tests like the unit root test.[7]

In addition to the annual data we can revert to the same kind of data on employees subject to social insurance contributions on a quarterly basis. These time-series are available from June 1999 onwards and contain at least 33 observations. The additional information of the quarterly time series is needed e.g. to analyse structural shocks.

3.3 Graphical Analysis

We use a graphical representation for each occupational group as a first illustration of the data. It shows the past development and gives some helpful hinds for a future trend. We found different characteristics of the development of the occupational groups which can be seen via the graphical analysis. Some follow a stable inner trend, some depend strongly on the business cycle and several are without any identifiable structure.

Differencies in the dependencies of the development of occupational groups from business cycles are not consistent. Some occupational groups are very dependent, others are not. An example can be seen in figure 1. The development of an occupational group which is quite dependent on the business cycle is shown.

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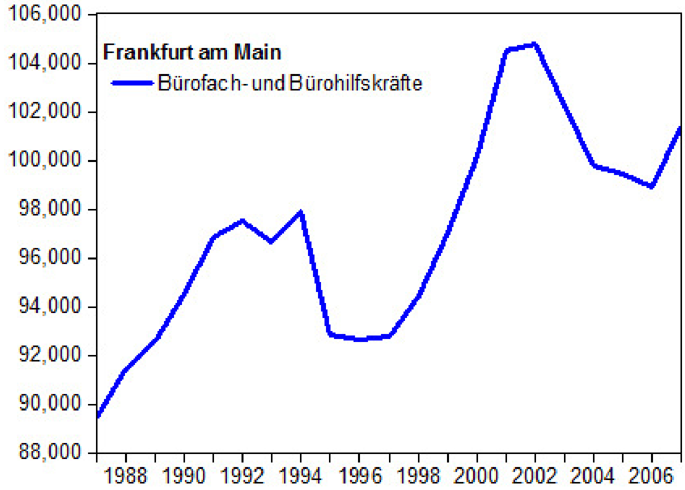
5 Official statistics of the German Federal Employment Agency. Occupational groups are highly aggregated data at the second level. There are a total of about 84 occupational groups and the selected ten covers roughly 54% (Groß-Gerau) to 64% (Frankfurt am Main) of total employment.

6 Rinne/Specht 2002.

7 The augmented Dickey-Fuller test requires a minimum of 20 observations and each differentiation requires one in addition. Hamilton 1994.

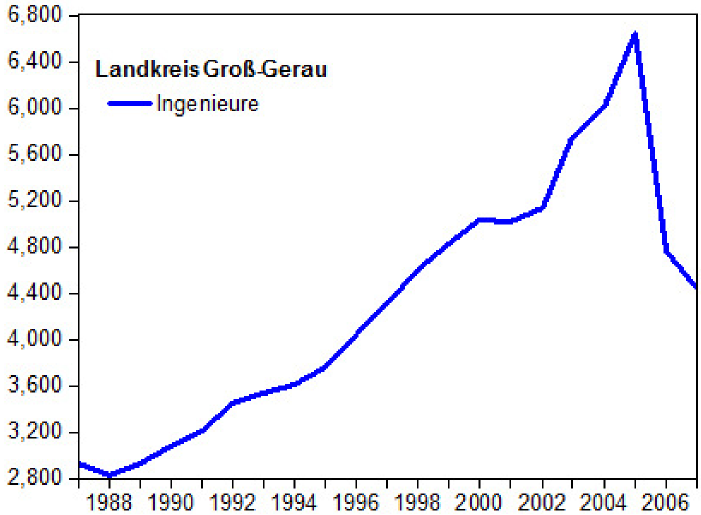
Figure 1: Example 1 of the correlation between development of an occupational group and business cycle



Source: Institute of Eonomics, Labour and Culture

The second example (Figure 2) shows structural shocks which cannot be easily modelized. It is difficult to predict the occupational groups which have no stable inner trend but shows a trend break. For this modelization experts are needed who can judge if it is a single event.

Figure 2: Example 2 of the correlation between development of an occupational group and business cycle



Source: Institute of Eonomics, Labour and Culture

The graphical analysis enables an intuitive understanding of the development of the occupational groups in the three analysed regions. The next step is the application of the statistical tools of the time series analysis to our data.

3.4 Methodology and model specification

The graphical analysis generated some insights about the time series. We use these and a set of statistical tools to specify one ARIMA model for each occupational group. The ARIMA model derives from the general form

$$(1) \qquad y_{bkt} = \phi_0 + \sum_{j=1}^{p} \phi_j y_{bkt-j} + \sum_{i=1}^{q} \theta_i \varepsilon_{bkt-i} + \varepsilon_{bkt}$$

where Y_{bkt} is the time series of occupation group b in the region k at a time t. The coefficient phi_0 is the constant, phi_j are the at j-years lagged value of the occupational group (AR-term) up to order p, and $teta_i$ are the at i-years lagged moving average components. The residual term $epsilon_{bkt}$ has to be white noise[8] with mean zero.

As mentioned above, we have to specify an ARIMA model for each of the occupational groups. In the graphical analysis we detected for some time series a structural shock. We handle these shocks by including a dummy variable in the ARIMA model specification. This way we neutralize the extraordinary events and avoid contamination of our forecasts by this irregular information.

The general equation (1) presents all possible lagged AR- and MA-terms. All these lagged values of the time series are possible candidates and could be included as coefficients in the model specification. We have to decide which coefficients to include and proceed step by step. Our aim is to include all coefficients whose explanatory character is needed and simultaneously to reduce the number of coeffients as far as possible.

All of the included coefficients are to be highly significant, which is tested through the t-test.[9] Whether further coefficients are needed is tested by residual tests. We therefore use the Q test and the Serial Correlation LM test.[10] Finally, the model specification will be accepted if the outcome of these residual tests proofs that the residuals can be treated as white noise.[11] In this case, there is no additional information from an additional coefficient.

It is possible that more than one model specification fulfils the request of this step by step procedure. In this case, the specification with the best content of information is chosen.[12]

So far our specifications of the univariate time series model have not included any additional time series as explanatory variable. This is adequate for the group of occupational groups with a stable inner trend without any correlation to the business cycle. For those groups with a significant correlation to the business cycle we include an economic indicator. We use the gross domestic product (GDP) of the state of Hesse as the explanatory variable. The advantage of this choice lies in the lag of both variables. Here

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8 For a definition of White Noise see Hamilton 1994, p. 47f.

9 Hamilton 1994.

10 Hamilton 1994.

11 Test: T-Test, Q-Statistik and Serial Correlation LM-Test; Hamilton 1994.

12 We use the Schwarz-Information-Criteria, see Hamilton 1994.

we use the lag between the GDP and its effect to the development of employment. It turns out that the inclusion of GDP is not significant for all occupational groups. Thus we include this variable only for those occupational groups which depend on the business cycle.

3.5 Solution to one specific problem of this regional approach

The ARIMA models above and thus our forecasts for 2012 are based on data which end in June 2007, but first became available in March 2008. As mentioned before, we try to overcome this time lag at least partially with our approach. Therefore, we use as explanatory variable the time series of total employment in the state of Hesse which is in comparison much sooner available, with a time lag of only three month.

The time series of total employment of employees subject to social insurance contribution in the state of Hesse is very useful because of the strong correlation of many of the occupational groups to this development.[13] Our regionalized data is a subset of the total employment. Hence, the correlation is much more powerful than the correlation to GDP.

Therefore, we modify the ARIMA approach described above as follows: The time series of total employment is included as an explanatory variable into the model. Unlike before, we use the quarterly data of the occupational groups from June 1999 until June 2006[14] and the quarterly time series of total employment (state of Hesse) which was already available up to June 2007. The real data for the year 2007 became available at a later date and has been used to evaluate the forecast. For the evaluation we needed a criteria to compare the estimated value with the real value. For this purpose, we have used the mean squared forecast error (MSFE).[15] With the modified forecasting approach we were able to improve the MSFE for the forecasts of the year 2007 for the city of Frankfurt on the Main, the city of Offenbach am Main and the district of Groß-Gerau.

The next update of the forecast can be done with the data of total employment in June 2008, which is becoming available in September 2008, i.e. half year before the same data becomes available for individual occupational groups. Our modified approach has many properties to commend it as the most effective way for our regional forecast at this point in time due to the availability of the regional data.

3.6 Integration of expert knowledge

The quality of this forecast depends on the stability of the development – in the past and in the future. Especially on a regional level the decisions of just one corporation can have a strong effect on the labour market This effect can be seen in the form of structural shocks. By using only past observations we are not able to include current expectations about extraordinary events, such as the relocation of a large number of jobs. Therefore, we use the knowledge of regional labour market experts to evaluate our findings and to add qualitative information about the regional development of the occupational groups.

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[13] There are still a few occupational groups with nearly no correlation to the total employment at all. Here we can not apply this approach. But because of the stable trend of these occupational groups, such an approach is never needed.

[14] The data for the year 2007 was at this time not available.

[15] See Rinne/Specht2002 p. 135.

3.7 Replacement demand due to retirement

As mentioned above, the expansion and the replacement demand together result in the forthcoming additional labour demand until 2012. The additional labour demand is driven by two factors, the development of the overall business activities [in the occupational groups] and the retirement of older employees. The replacement demand is the demographically caused component of the future labour demand and is driven by all persons who will end employment and retire.

The average age of real retirement in Western Germany is 63.[16] Women retire slightly earlier (at age 63.35) than men (at age 63.44). Between occupations we find slight differences: Male locksmiths, for example, retire at age 62.2 and guest attendants at age 63.3. But the differences are small, and we do not have information about all analysed occupations, therefore we use the average age of retirement of 63.

In order to predict/forecast the scope of the replacement demand, all persons are being added up who will reach their retirement age based on the average retirement age by 2012. This includes all employees subject to social insurance contribution. We add up the number of employees who are aged 58 in 2007 (basic values[17]) as they will reach the average retirement age in 2012 and leave their jobs.

4 Forecasting the regional labour supply

4.1 Bottom-up versus top-down approaches

To get an overall idea of the future labour market situation it is necessary to look at both the demand and the supply side of the regional labour market. The labour supply is defined as the potentially available labour force with place of residence in the analysed region. In reality the regional vacancies will be filled both with people having their residences in the same region and with people coming from other regions. Particularly the Rhine-Main-region is characterised by a huge number of commuters. This is a crucial aspect in respect of the equilibrium of the regional labour market and will be considered in the second step. In the first step, we will project the potential of labour supply for the main occupations and qualifications at the place of residence.

Regional or local projections on occupations and qualifications are a special challenge because many single inputs have to be considered and data at the highly disaggregated level is often not available. We tried to find a way to give a realistic picture of the future labour supply developments by using regional data and taking the main future trends into account.

One can chose between two different approaches: The projection can be made with so called “bottom-up”- or “top-down”-approaches.[18] With the “bottom-up”-approach the forecasting of labour supply is separated in its single components: The number of school-leavers with their decisions to start a vocational training or go to university etc needs to be

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[16] Hoffmann, 2007, p. 304.

[17] Basic values are defined as the sum of employees subject to social insurance contributions and registered unemployed. It is an average of three years.

[18] Our described definition of bottom-up and top-down slightly differs to the description used at Kriechel/Cörvers/Heijke in this volume.

integrated. To forecast how many people will supply their workforce in a specific occupation, the number of students is needed as well as their respective fields of study mapped to the analysed occupations. Bonin, Schneider et al. (2007) forecasted labour demand and supply until 2020 for Germany using this kind of “bottom-up-approach”.[19] It is one of the few long-term studies for Germany forecasting the labour supply at the level of qualification. The authors used the so called “Schulentwicklungspläne” (school development plans) from the Kultusministerkonferenz[20] to get information on the development of the number of pupils and students at the university. They published results for Germany and the eastern and western parts of Germany.

Our approach is based on a more disaggregated regional level. To use a approach similar to Bonin, Schneider et al., it would be necessary to get data for Frankfurt, Offenbach and the district of Groß-Gerau. But the Schulentwicklungspläne or similar datasets are not available for all the considered regions. For the medium-term projection of five years at the occupational level no reliable data-framework for regions exists. We could not revert on any preliminary work on the forecast of school-leavers and graduates on which our forecast could be based. Therefore we forbear to use a “bottom-up approach”.

The “top-down approach” in contrast is based on the regional development of labour force and breaks it down to single occupations. To estimate the development of labour force levels and participation rates, several factors like demography, migration, age of retirement etc. have to be considered. These factors have different consequences for the labour supply composition separated by age groups and gender. The future development of participation rates for example will strongly differ for men and women. Finally, the medium-term projection is deduced from the different structure of age and gender which varies in every occupation.

The main components of the “top-down approach” are the demographic trend and the behaviour-based development of the labour force. It provides results which are highly differentiated not only for regions, occupation and qualification but also for age groups and gender because age cohort/ and gender-specific differences of labour market participation are taken into account.

4.2 Data

The local labour force is projected for the three regions Frankfurt City, Offenbach City and the district Groß-Gerau. Usually the labour force contains employed and unemployed persons. The employed are the sum of unpaid family workers, self-employed and dependent workers which, in turn, are the sum of civil servants, marginally employed and employees subject to social insurance contributions. The unemployed are divided in registered unemployed and hidden unemployed.[21] Unfortunately not all the data is available in the required level of disaggregation. Our project-partner “IAB-Regional”

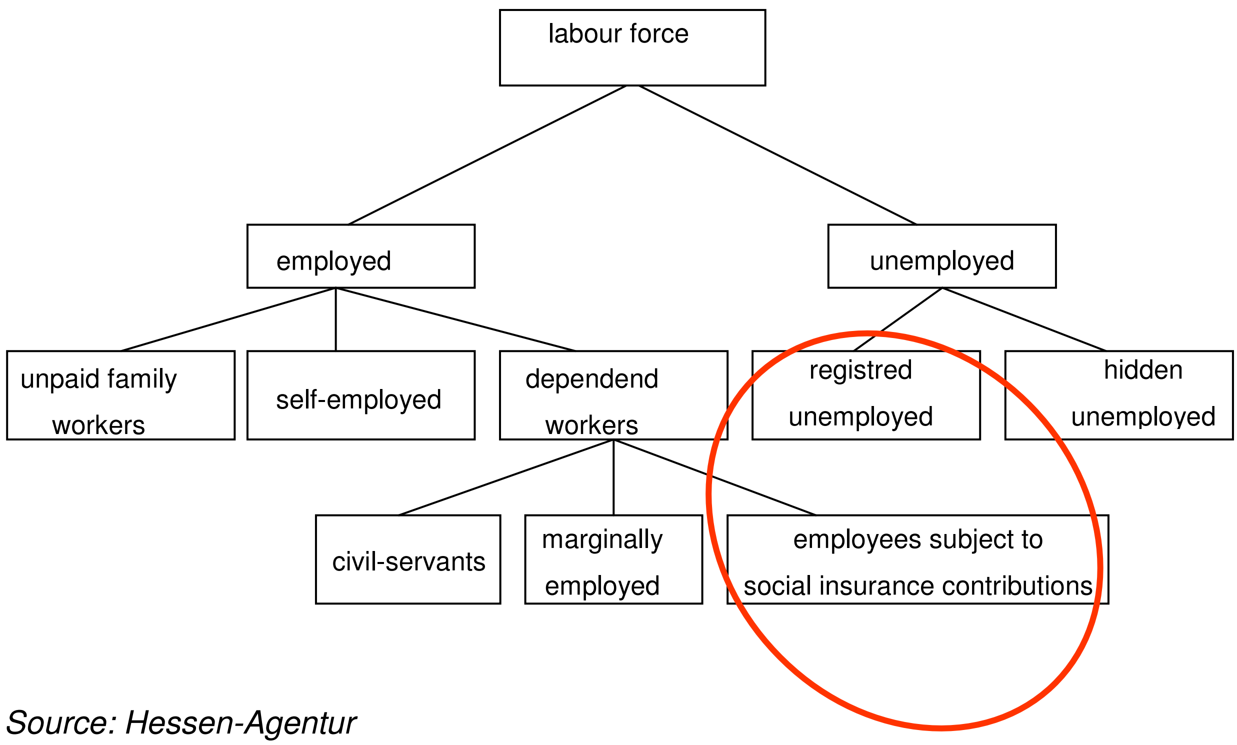
[19] Bonin/Schneider/Quinke/Arens, 2007

[20] The Standing Conference of the Ministers of Education and Cultural Affairs of the states (Länder) in the Federal Republic of Germany (abbr.: Kultusministerkonferenz - KMK) unites the ministers and senators of the states responsible for education, higher education and research as well as cultural affairs. It is based on an agreement between the states. (www.kmk.org)

[21] Hidden, or covered, unemployment is the unemployment of potential workers that is not reflected in official unemployment statistics

provides information on registered unemployed and employees subject to social insurance contributions. Crucial detailed data on self-employed, hidden unemployed etc. is not available. Therefore the sum of registered unemployed and employees subject to social insurance contributions is taken as an approximation for labour force. It covers with about 75% the major part of labour force. The following figure explains the choice of selected data.

Figure 3: The choice of selected data



Source: Hessen-Agentur

4.3 Calculation of basic values

In our forecast the basic values are defined as the sum of employees subject to social insurance contributions and registered unemployed. The data is differentiated on regions, age groups, gender, occupation and qualification. The basic values are not defined as a specific annual value, but as an average of three years to smooth any possible outlier.

For every single occupation in each region the basic value is calculated as follows:

$$\frac{\sum_{t}\sum_{j}\sum_{s}(ESIC_{t,j,s}+RU_{t,j,s})}{3}=LF_{Basic}$$

with

ESIC = employees subject to social insurance contributions

RU = registered unemployed

LF = labour force

t = number of years for building an average basic value (t = 2005, 2006, 2007)

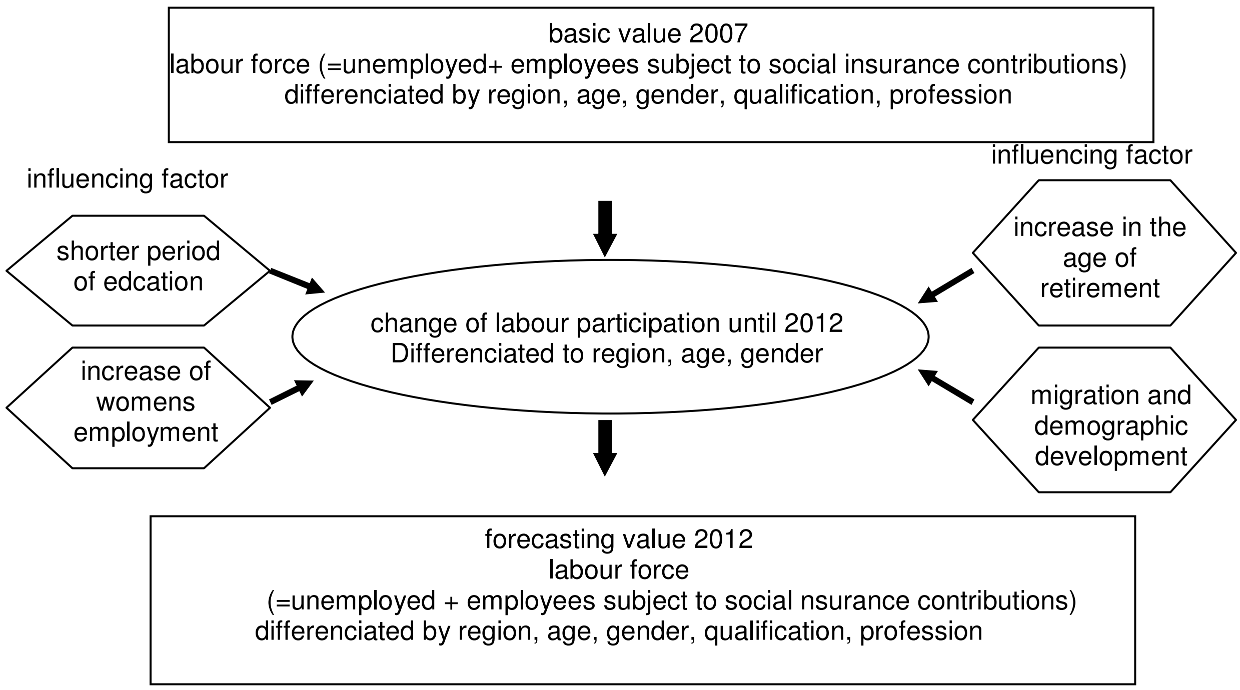
j = age groups (j = 9 age groups, five-year cohorts)

s = gender (s = male, female)

4.4 Calculation of projection values

The second step implies the matching of the basic values with the future labour force potential. On detailed data level we get the medium-term development of labour force potential, based on statistics of the employees subject to social insurance contributions plus registered unemployed combined with projected participation rates. The method is described in the following figure.

Figure 4: Approach of forecasting the labour force until 2012



Source: Hessen-Agentur

Figure 4 shows that in our approach the development of labour force participation is an important factor for the medium-term projection. The calculation is based on a set of different assumptions.

- Migration and demographic development
- Increase in the age of retirement
- Increase of women's employment
- Shorter period of education

The calculations are based on studies of the Federal Statistical Office and the Statistical Agency of Hesse. We adjust the data to the specific situation in Hesse, (e.g. to the high degree of migration) and disaggregate it to reflect the regional and local situation.[22] These calculations are published in the Hessen Agentur population forecast.[23]

4.4.1 Migration and demographic development

The projection of the demographic development is based on the assumptions of cases of birth and death published by the 11. Coordinated Prediction of Demographic Development from the Federal Statistical Office. Concerning migration, adjustments to the specific situation in Hesse are essential. Differences between the forecast of the Federal Statistical Office and the specific situation in Hesse exist both in the extent of migration and in the structure of age and gender. Our adjustments consider the actual observed regional migration and its long-term forecasting. All in all the future demographic development will differ from region to region. Offenbach will have the highest increase of population because of a young population structure. With an average age of 41.2 years is Offenbach the "youngest" region in Hesse.[24]

4.4.2 Increase in the age of retirement

In the 80s and 90s average retirement age was decreasing because many employers made use of broad arrangements of early retirement. Particularly the labour market participation of men became very low. Since few years a reversal of this trend can be seen. In 1997 47% of persons aged 60 years and older where pensioners, in 2002 the proportion falls to 31% and in 2006 to 26%.[25] This numbers show that the beginning of retirement occurs later than a few years ago. Concerning the projection we assume that in view of the rise of the retirement age from 65 to 67 this trend will continue. To be precise, in our forecast persons aged between 60 and 64 tend to have the highest increase of participation rates.

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[22] For the documentation of the results see van den Busch (2007a), Statistisches Bundesamt (2007), Nickel (2005).

[23] Van den Busch (2007b)

[24] Van den Busch, 2007b, p.9.

[25] Kruse, 2007, p. 726.

4.4.3 Shorter period of education

One of the political long-term aims is to increase the participation rate of younger people. To achieve this target several regulations to decrease the period of education have been established like the extension of bachelor study courses and the introduction of tuition fees. We take into account these trends which will enlarge the participation rates especially of people at the age between 20 and 29.

4.4.4 Rise of women's labour market participation

One of the key objectives of EU policy is to increase the employment of women and to eliminate inequalities and promote gender equality throughout the European Community (gender mainstreaming). With about 62%, the employment rate of women in Hesse exceeds the target value of 60%.[26] But gender equality at the labour market is not attained simply because a majority of women are working.[27]

More opportunities for increasing the participation of women will be offered with the future demographic trends. In the long run labour supply will decrease and the demand for qualified employees will rise. Taken these factors together, enterprises are likely to show more interest in employing qualified women in future time. It is therefore necessary for politics and business to promote work life balance policies. This includes an expansion of qualified child care and flexible employment opportunities. In our projection we assume that the process which has already started will be continued and women's employment rate will rise. Our projection is focused on the labour participation rate which is supposed to rise in all three regions.[28]

All these effects are relevant for the medium-term change of participation. We take the rates of change in highly differentiated form, i.e. by gender, nine age-groups and three regions. The basic values multiplied with the change of labour market participation give us the projection values. The projection of labour supply is based on the assumption that qualifications profiles and the occupational change for different birth cohorts will remain almost identical over the forecasting period. Interviews with experts based on anticipated changes to the qualification and occupational change will complement the empirical findings.

4.5 Labour supply projection of different age groups

Our projection is focused on two age groups: the first entrance of younger persons into the labour market and the entrance of persons in the middle-aged group. The young are defined as persons at the age between 15 and 24. Trainees and university graduates as well as unemployed are part of this group.

The new entrance of younger persons will be calculated similarly to the calculation of the number of persons retiring: Young persons at the age between 15 and 24 in 2012 will be

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[26] Considering that one third of all employed women are working in part-time, the indicator of employment participation tells only half the truth. In fact the volume of work is less than 62%, Trabert (2007) p. 22

[27] Regionaldirektion Hessen (2007), p. 9.

[28] The labour participation rate has in the numerator the labour force and is therefore higher than the employment rate which is relevant for the Lisbon-strategy.

reduced by the number of persons who are between 15 and 19 years old at the basic value, because they and will automatically grow into the next age cohort until 2012.

The calculation of the middle-aged group is analogous: Persons who will be between 25 and 63 years old in 2012 less the number of persons who are between 20 and 58 years old at the basic value.

The idea is to look at the medium-term dynamic process by taking the age group in 2012 and subtract the number of persons who will automatically grow into the relevant age group. The results show the net growth of every age-group during the projection period.

4.6 Integration of expert knowledge

With the top-down approach we tried to find a way to give a realistic picture of the future labour supply developments by using regional data and taking the main future trends into account. To augment the approach we have to gather relevant information about the future occupational trends. This could be e.g. information about the future order situation in the regional businesses or information about the future vocational training situation. By getting information from several occupational experts we try to get a more detailed picture of the future development in every region and every occupation. It is obvious that especially structural changes are not predictable, neither by the experts nor by the projection approach. In this respect every forecasting model is restricted. Despite this fact, it is useful to add expert knowledge to the projection and to update this information regularly. For the future it will be important to systematise the information input from the experts to increase the explanatory power of our projection.

5 Outlook

This regional early warning system is an instrument for enterprises and actors of the labour market policy to recognize structural changes on the regional labour market and to moderate this process of structural change for local government, employees, enterprises and other regional actors such as vocational training institutions. The results of the projections and the expert panels are discussed with regional networks of experts of the labour market policy and representatives of the enterprises.

The medium-term forecasts of occupations and qualifications provide information about future changes of employment and mismatches of occupations and qualifications in a region. This information can be used for developing adequate vocational training inside and outside of enterprises.

Sustainable development of the cooperation and the need of action are guaranteed by following structural, content related and methodological items: all relevant actors of labour market policy and representatives of the enterprises are involved in the project via the established expert panel. The information provided by the early information system is an important issue for the sustainable development of the information system. Publication and communication of the results lead to information mainstreaming of the methodology and know-how.

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V Regional Employment Forecasts with Spatial Interdependencies

Katharina Hampel, Marcus Kunz, Norbert Schanne, Rüdiger Wapler, Antje Weyh

1 Introduction

Due to large differences in the regional labour-market performance in Germany, the labour-market policy-mix is increasingly being decided on a regional level. This implies that the local institutions, i.e. the districts of the Federal Employment Agency (*Agenturbezirke*), have an increased need for regional forecasts as a guideline for their decision process. In this paper, we focus on employment forecasts for these 176 labour-market districts and compare the results amongst the districts for various model specifications.

Various authors have developed forecast models for single German labour-market regions (Bruch-Krumbein/Friese/Kollros 1994 for the South of Lower Saxony, Eltges/Wigger, 1994, for the district of Borken/Westphalia and Klaus/Maußner 1988, for 18 Bavarian regions). Others have applied one joint model for all German labour-market regions (Bade 1991, 2004, Blien/Tassinopoulos 2001, Longhi et al. 2005, and Patuelli et al. 2006, Tassinopoulos 1996, Longhi/Nijkamp 2007). These studies employ a large variety of methods for labour-market forecasting. On the one hand there are methods mainly based on labour-market theory, such as demand-oriented, supply-oriented and demand- and supply-oriented models. On the other hand, in the economic perspective a-theoretical, mathematical-statistical methods are used.[1] Here, we apply time-series models because adequate data, especially leading indicators on a small regional scale, are hardly available. To account for the regional heterogeneity, we adapt the models for each labour-market district separately instead of using one common model for all.

First, our focus is on three standard univariate methods: autoregressive integrated moving average (ARIMA) models, exponentially weighted moving averages (EWMA) according to the seasonal Holt-Winters method and structural-component (SC) estimators. All these methods use patterns in the time series and try to describe the data-generating process either deterministically or stochastically. EWMA-models (see section 3.1) calculate the forecast values by averaging past data and more recent data is incorporated with an exponentially higher weight. These and their simple forms of trend analysis and smoothing techniques perform surprisingly well (Satchell/Timmermann 1995, Chatfield et al. 2001). The ARIMA approach to analysing and forecasting time series is based on autoregressive (AR) as well as on moving-average (MA) components (see section 3.2). Forecasts can either only rely on past values of the dependent variable (univariate ARIMA models) as applied here, or include exogenous economic information (multivariate extension of ARIMA). Although the dynamic regression models (also known as transfer functions, see e.g. Weller 1989, Weller 1990) and multivariate vector autoregressive (VARMA) models (see e.g. Patridge/Rickman 1998; Lutkepohl 2006) have been more commonly used in labour-market forecasts, parsimonious ARIMA models or transfer functions can still outperform VARMAs, as Edlund/Karlsson (1993) show for Swedish unemployment rates. The third method used here are structural-component models (see section 3.3) which have not been widely applied as a forecasting tool for regional developments, mainly due to their limited explanatory power as deterministic models (cf. Ray 1989, Proietti 2000). However, we augment the basic structural-component model and show that it performs as well as or even better than the stochastic methods..

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[1] For detailed overviews see Jaeger (1996), Diebold (1998) or De Gooijer / Hyndman (2005).

We augment the basic SC model for autoregressive and spatial components. With the first augmentation, the pure deterministic SC model with the level, trend, seasonal and cyclical components that are described by various mathematical functions is enriched by information from the past. Our further extension is to include spatial elements into the SC model as we are performing forecasts for small spatial units whose development are likely to be influenced by neighbouring districts. It has been shown that neglecting spatial dependency can produce highly inaccurate forecasts (Giacomini/Granger 2004). Several recent studies have thus included spatial autocorrelation into VARMA models (cf. for example Arbia/Bee/Espa 2006, Beenstock/Felsenstein 2006). However, to the best of our knowledge, the only labour-market related study in this field is Hernandez-Murillo/Owyang (2006). As the number of labour-market districts in Germany exceeds 64, the incorporation of spatial elements is not feasible with VARMA estimation techniques (see Arbia/Bee/Espa 2006). Whereas spatial autocorrelation in the error term is considered by Longhi/Nijkamp (2007), the benefit of spatial lag components for regional forecasting has so far been neglected in German regional forecast studies. This gap is also filled by our paper.

Using simulated out-of-sample forecasts we compare the results of the augmented models with the other models. We find that the inclusion of spatial information improves the forecast quality in the structural-components model by estimating a spatial dynamic panel. The augmentation of the SC model by autoregressive elements leads on average to a higher forecast error compared to the other methods. However, all approaches perform very well, as can be seen by mean forecast error between 0.66 and 2.13.

The paper is organised as follows: After describing the data and the regional variation in employment in Germany, Section 3 describes the applied forecasting methods of our models. The presentation and discussion of our results follows, before a conclusion ends the paper.

2 Data and Regional Variation in Employment in Germany

Employment forecasts for the whole of Germany are relatively robust. However, such forecasts do not yield much information about the regional development within the country. Due to different industry structure, qualification, wage level, or other sources of local labour-market disparities, forecasts for a small spatial unit can differ from national forecasts and even predict opposite results. Considering regional distinctions, we forecast employment in the 176 German labour-market districts[2], which are, with the exception of Berlin and Hamburg, between NUTS 2 and NUTS 3 regions. First, we describe our data and the current labour-market situation in Germany particularly emphasising regional differences.

To analyse the current employment situation and to perform our forecasts, we use register data from the German Federal Employment Agency. This data covers all registered employees who are subject to obligatory social insurance in the German labour-market districts on a monthly basis. Our employment data at this level of aggregation starts in January 1996 and ends in December 2005. This relatively long time lag is caused by the time span necessary for deliverance and processing the data. Therefore, our employment

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2 With the exception of Berlin, all forecasts are at this regional level. In Berlin the labour-market districts were reorganised spatially several times in recent years so that the data here was not available for all districts for all periods. For this reason, the districts in Berlin were aggregated at all times to one district so that we forecast the regional employment levels for 176 and not for 178 districts.

forecasts for 2006 and 2007 are based on data which end in December 2005 but first become available in September 2006.

Figure 1 shows the average employment rate[3], the growth rate[4] and seasonal span[5] of employment. These represent the basic elements of a time series: level, trend and season.

The often emphasised East-West perspective only holds for the growth rate of employment (and even here only partially) which is negative in nearly all eastern labour-market districts. High negative growth rates in western Germany exist in Recklinghausen and Gelsenkirchen (both situated in the Ruhr area). High positive growth rates can be observed especially in middle Bavaria.

No East-West differences can be seen for the employment rate and the seasonal span. High employment rates but low seasonal spans can generally be found in urbanised labour-market districts. Cities tend to have higher employment rates than their neighbourhood. This can be seen particularly well in the triangle between Bremen, Hamburg and Hanover. This may be due to the commuters who live in the regions of the triangle and work in the three cities. Often touristy regions and those where agriculture is important have high seasonal spans. Both can be mainly found along the coast of the East and North Sea, in eastern German low mountain ranges and in Bavaria. A dichotomy between eastern and western Germany can be seen in the right map of Figure 1. Interestingly, this dichotomy does not correspond to the former inner-German border.

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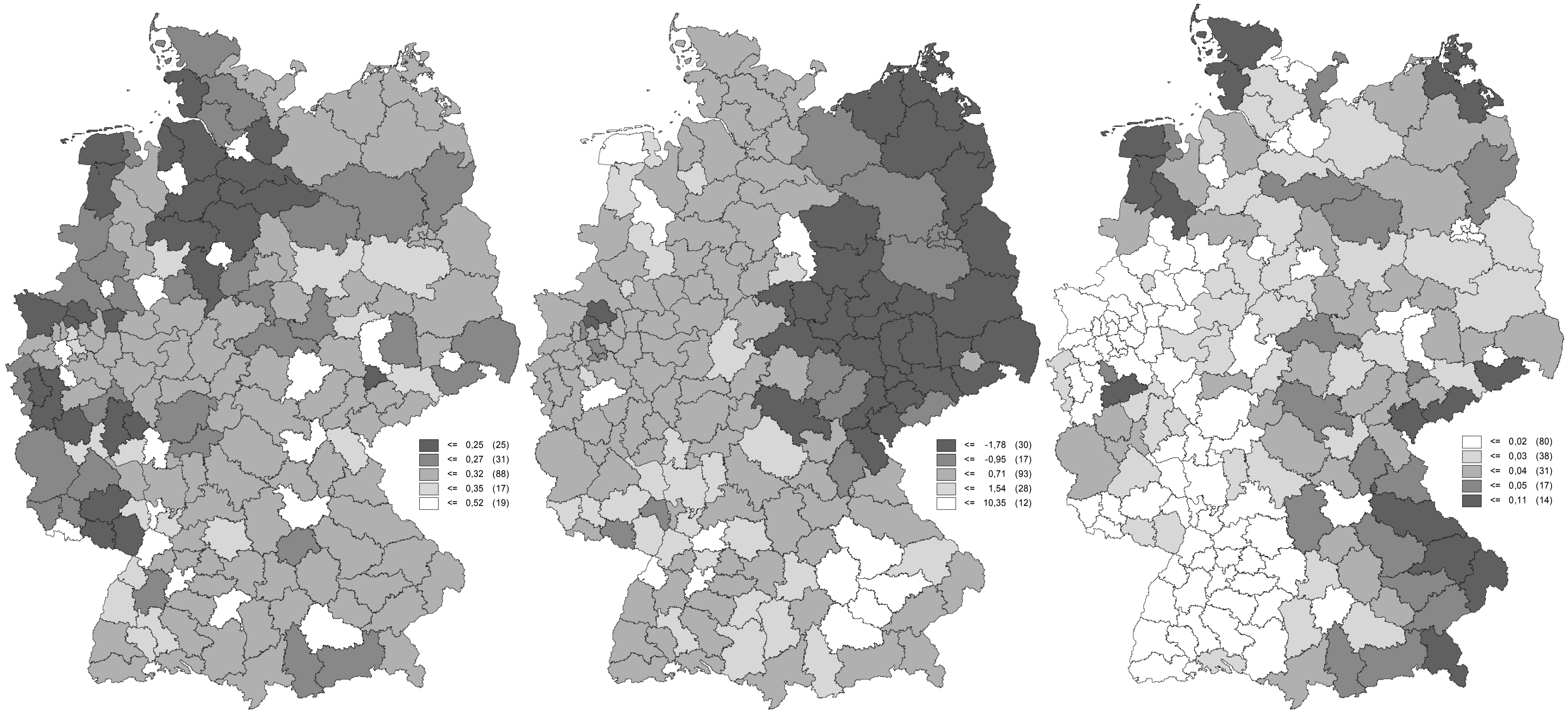
3 The average employment rate is defined as $\overline{Y}_{emp} / \overline{Y}_{pop}$, where $\overline{Y}_{emp}$ is the average number of employees registered at their place of work and $\overline{Y}_{pop}$ the average population in the year. This is not identical to the labour-force participation rate where both the numerator and denominator are counted at the place of residence. This measurement is the only one which can be calculated for all labour-market districts as the population is only available at this regional level. A better reference parameter than the whole population would be the employable population. However, one problem persists for both measurements: Our data for the employees count them at their place of work, whereas the population is counted at their residency. This leads to an overestimation of the employment rate in districts where a relatively large number of employees commute in and to an underestimation in districts where the employees commute out.

4 This is defined as the average of $(Y_{Dec,t} - Y_{Dec,t-1}) / Y_{Dec,t-1}$ for every year, where $Y_{Dec,t}$ is the number of employed in December of year *t*.

5 Defined as the average of $(Y_{\max} - Y_{\min}) / \overline{Y}$ for every year, where $Y_{\max}$ is the maximum, $Y_{\min}$ the minimum and $\overline{Y}$ the average number of employed in the respective year.

Figure 1: Average employment rate, Growth rate and relative seasonal span of employment in Germany from 1996 to 2004



Average employment rate | Growth rate of employment | Seasonal span of employment

Source: Federal Employment Agency

3 Applied Forecast Methodology

Despite the common critique that pure time-series decompositions neglect economic theory, we focus on them for three reasons. First, many variables which would be necessary to model economic relations are not available at the required regional level. Second, as the relevant future values of the economic covariates are not known at the time the forecasts are performed, they have to be approximated by their past. Third, if the same variables which currently influence the employment level also influenced it in the past, then this information is automatically included when using past values of the series of interest in order to forecast its future development. Moreover, focusing on lagged values of the series has the advantage that it uses past information efficiently in the statistical sense.

Therefore, we apply two univariate time-series models, exponentially weighted moving averages and ARIMA. These simple models often perform nearly as well as more complex methods. Here they are used as reference models against which more complicated models can later be tested. In a second step, we present a deterministic structural-components model and extend this basic model by including either autoregressive elements or spatial dependencies. Then, the results from the extended models can be compared with those from the simpler ones to test whether the forecast accuracy improves or not. In order to evaluate the models, we perform simulated out-of-sample forecasts for the last year where data is available.

To a large extent, the variable-selection procedure is automised. We test which variables have a systematic influence and improve the model fit in each agency and include only these variables in the final regressions. In a last step, we check the final specification for violations of the underlying assumptions of the respective models as described below in more detail.

3.1 Exponentially Weighted Moving Averages

As stated in the name, exponentially weighted moving average (EWMA) models base their predictions on a large number of previous observations of the endogenous variable where the weights of the previous values decline exponentially the further they are in the past. Hence, the basic structure of the model is given by:

$$E(y_{t+1} \mid I_t) = ay_t + a(1-a)y_{t-1} + a(1-a)^2 y_{t-2} + \cdots + a(1-a)^t y_0 \qquad (1)$$

where I_t is the information available at time *t* and *a* is the weight. The focus of these models is on the autoregressive structure and on an underlying stochastic process. They can be split into a level, trend and seasonal component. As employment follows a regular cyclical pattern, the seasonal Holt-Winters method is applied. Here it is assumed that the amplitude of the seasonal variance remains constant over time, hence the additive method is used.[1] The equation to be estimated is given by:

[1] If the multiplicative method had been used, then (2) would have been estimated as:

$$y_{t+\tau} = (a_t + b_t \cdot \tau)s_{t+\tau-L} + \varepsilon_t$$

However, this model is only justified if it is assumed that the seasonal variance increases with time. The model was tested here and it indeed turned out that the additive method delivered better results than the multiplicative approach.

$$y_{t+\tau} = a_t + b_t \cdot \tau + s_{t+\tau-L} + \varepsilon_t \quad (2)$$

where a_t denotes the level, b_t the trend and s_t the seasonal figure at time t. The level, trend and seasonal component are modelled stochastically. They are determined by the parameters α, β and γ which are simultaneously estimated using maximum likelihood. These parameters define the update equations for the components as:

$$a_t = \alpha\left[y_t - s_{(t-L)}\right] + (1-\alpha)(a_{t-1} + b_{t-1}) \ (3)$$

$$b_t = \beta\left[a_t - a_{t-1}\right] + (1-\beta)b_{t-1} \quad (4)$$

$$s_t = \gamma(y_t - a_t) + (1-\gamma)s_{(t-L)} \quad (5)$$

where *L* denotes the number of lags in months. Hence, with monthly data, *L=12* shows seasonal patterns.

3.2 Autoregressive Integrated Moving Averages

Autoregressive integrated moving average (ARIMA) models are a standard procedure when forecasting time series. Usually, these models are implemented according to the Box-Jenkins forecast method (cf. Box/Jenkins 1970 and Greene 2003) which proceeds in four steps:

(1) In order for ARIMA-models to yield consistent results, it must first be ensured that the autoregressive process is stationary.

(2) It is tested which previous periods are necessary to best explain the current observation. This is done using the autocorrelation (AC) function for error correlation and the partial autocorrelation (PAC) values for the lagged dependent variable.

(3) After determining the possible autoregressive structures, stepwise tests are performed to test whether inclusion of these lags or errors into the regression improves the model fit. Typically, for selection either measures of simulated forecast errors such as the mean squared error (MSE) or information criteria such as those of Akaike (AIC) or Schwartz (BIC) are used.

(4) When no additional lag diminishes the selection criterion, the residuals are tested for white noise (Portmanteau test), i.e., if the estimation has minimum variance. If the test is not rejected, the efficient estimate is used for the forecast.

To remove seasonal effects, we first use yearly differences of regional employment. The resulting data is tested for unit roots using the augmented Dickey-Fuller test (cf. Bierens 2001). If the test indicates the presence of unit roots with and without a trend, we first compute (monthly) differences of the regional series, test this again and differentiate further until stationarity is achieved. A detailed description of the sequential procedure is given by Hassler (2000).

Let *y* denote the stationary series related to the observed time series *Y*. Then the model can be described by the following ARMA equation:

$$y_t = \mu_t + \sum_{k=1}^{p} y_{t-k}\alpha_k + u_t \qquad \text{with } u_t = \sum_{k=1}^{q} u_{t-k}\rho_k + \varepsilon_t \quad (6)$$

In most applications, all lags up to lag *p* (*q*) are included into the regression, where *p* (the highest autoregressive lag) and *q* (the correlated error furthest in the past) are determined by an analysis of the correlogram. However, some lags might not provide relevant information about the development of the time series: One looses degrees of freedom without improving the estimation, and particularly small samples perform better if these coefficients are set to zero. Therefore, we rank the lags according to their absolute PAC and AC values respectively, and, starting with the highest, add them stepwise to the equation. This procedure is known as "simple-to-general".

Many studies conclude that lag selection based on information criteria performs better than other methods, see e.g. Inoue/Kilian (2006) or Stock (2001). Here, the decision whether a lag is maintained in the further estimations is based on the corrected Akaike information criterion (AIC_c):

$$AIC_c = \ln \sigma^2 + \frac{(T+k)}{T-k-2} \qquad (7)$$

where T is the number of observations, k the number of estimated parameters and σ the estimated standard deviation. This information criterion often yields a more appropriate parameter selection than those of Akaike or Schwartz: Typically the AIC leads to more variables than necessary while the BIC leads to an underfit (cf. Hurvich/Tsai 1989).

3.3 Basic Structural-Components Model

In the structural-components (SC) approach applied here, it is assumed that there is a deterministic process which explains the endogenous variable. To this end, the observations are decomposed into a level, trend, seasonal and business-cycle component (see Harvey 2004, Ch. 2), i.e.:

$$Y_t = \mu_t + \gamma_t + \psi_t + \varepsilon_t \qquad (8)$$

with

- Y_t the dependent variable (employment) in monthly differences
- μ_t level and trend component
- γ_t seasonal component
- ψ_t business-cycle component
- ε_t remaining stochastic error (irregular component)

Other components can be added if required.

Hence, this basic version of the model neither includes exogenous variables, nor, in contrast to the ARIMA and EWMA models, autoregressive processes (see Harvey 2004, Ch. 3 & 4).

Under the assumption that there is no damped trend, the system of level and trend component can be transformed into:

$$\mu_t = \mu_0 + \beta_0 t + \upsilon_t \text{ with } \upsilon_t \sim i.i.d.\left(0, \sigma_\upsilon(t)^2\right) \quad (9)$$

where μ_0 is the initial level, β_0 the slope parameter and υ_t the error term at time *t*. With a damped trend, the above equation becomes non-linear. Therefore, in addition to the linear trend, we also include a quadratic and cubic trend component.

The seasonal component can be modelled by adding dummies for each month (with the exception of one arbitrary month). Alternatively, in order to reduce the number of parameters which need to be estimated, it can be captured by various trigonometric functions whose length is defined by λ and amplitude by α and δ respectively (see Harvey 2004, Ch. 5.1):

$$\gamma_t = \sum_{j=1}^{[s/2]} \left(\alpha_j \cos \lambda_j t + \delta_j \sin \lambda_j t \right) \text{ with } \lambda_j = 2\pi j / s \qquad (10)$$

Once the level, trend and seasonal components have been included, a first regression is run. All subsequent regressions use the linear trend in addition to those variables which are significant at the 10 percent-level. However, if multicollinearity between the quadratic and cubic trend components arises either the quadratic or cubic term is kept depending on which is more significant.

Economic theory differentiates between short-, medium- and long-term business cycles. As the data for our simulated out-of-sample forecasts only covers eight years, we can at best capture short-term cycles.[2] Just like the seasonal component, business cycles are modelled by cosine and sine functions. As the duration of a cycle in a labour-market district is unknown, its length is determined by the peaks in the autocorrelation function of the residual in a regression without a cycle component. Thereby, we assume that the cycle length must be at least thirteen months to make sure that we are indeed capturing cycles and not just short irregular fluctuations. If it turns out that both cycle components are insignificant, we test for joint significance and if the test is not rejected include the one with the (in absolute terms) higher t-statistics. Once all (significant) components have been established, the full model can be regressed using standard OLS-regression techniques.

3.4 Structural Components with Autoregressive Elements

The aim of the structural-components method is to detect structural properties of time-series data. In contrast, autoregressive processes use the correlation structure of time lags. Both methods have their advantages: Especially for long stable time series, the structural-components method is appropriate when the aim is to capture recurring elements such as seasonal fluctuations or business cycles. Therefore, once a structure is detected, the forecasts are very robust and do not place much emphasis on short-term fluctuations. Autoregressive processes detect long-term structures differently. They represent time-series data by the special correlation structure observed in the past. By doing this, autoregressive methods do a good job in capturing short-term movements and are able to react quite flexibly to changes in the current data.

Both properties are important for our purposes as we perform short to medium term forecasts with moderate sample sizes. Therefore, the combination of both methods seems adequate for improving the short-term behaviour of the forecasts without losing the long-term properties of the data-generating process.

The integration of autoregressive elements into the basic structural-components model is straight forward. We denote this augmented model by SCAR. It can be written as:

$$Y_t = \mu_t + \gamma_t + \psi_t + \theta_t + \varepsilon_t, \qquad (11)$$

---

2 As we require roughly at least half the sample length to perform reliable estimations, the maximum cycle length is limited to 40 months.

where μ_t, γ_t, ψ_t and ε_t are defined as in Section 3.3 and θ_t represents the autoregressive component modelled as:

$$\theta_t = \sum_{s=1}^{S=26} \vartheta_s Y_{t-s} \; . \qquad (12)$$

where ϑ_s are the parameters to be estimated.

To work with a comparable lag-structure to the one chosen in the ARIMA approach and to capture at least influences of the last two years, the number of tested lags *S* is set to a maximum of 26. Obviously not all lags should be added in the final model. To guarantee parsimonious parameter usage, we apply the same lag selection procedure as in the ARIMA model. We sort the lagged values according to their absolute partial autocorrelation function (PAC) values, include them stepwise while maintaining the components of the basic SC model as well as all previously tested lags which have improved the AIC_C (cf. Section 3.2).

3.5 Structural Components with Spatial Interdependencies

Particularly when forecasting on a small regional scale, it seems plausible that the development of the dependent variable in neighbouring regions has an impact on the region being analysed (cf. Section 2). This relationship between neighbours can be described as a spatial autoregressive process. To model the spatial relationship between regions we use a row normalised contiguity matrix. Because the simultaneous spatial lags are unknown in the forecast period, it is only possible to include the spatial lags of previous periods in the estimation (cf. Giacomini/Granger 2004).

Due to the reciprocal connections between regions, it is necessary to regress and forecast with panel techniques. To keep up the basic idea of the structural-components model, i.e. to account for the regional heterogeneity, the data is written in block diagonal form. This "seemingly unrelated regression estimation" (SURE) form allows for specific coefficients for each labour-market district and the spatial process parameters.

Hence, the structural-component model with spatial autoregressive elements (which we abbreviate by SCSAR) can be written as:

$$\vec{Y}_t = \vec{\mu}_t + \vec{\gamma}_t + \vec{\psi}_t + \vec{\xi}_t + \vec{\varepsilon}_t \, , \qquad (13)$$

where $\vec{Y}_t = (Y'_{1,t}, ..., Y'_{N,t})'$ denotes the vector of employment at time *t* over all regions, and the components are defined analogously to Section 3.3. The spatial component in region *i*, ξ_{it}, is defined as:

$$\xi_{it} = \sum_{\tau} \sum_{j=1}^{N} w_{ij} Y_{j,(t-\tau)} \kappa_{i\tau} \, , \; \tau \in \{1,...,13\}, \qquad (14)$$

where w_{ij} is the spatial weight defined by contiguity, i.e. $w_{ij} = 1$ if a region *j* shares a border with region *i* and 0 otherwise. $\kappa_{i\tau}$ are the parameters to be estimated. We maintain all components that were significant in the basic structural-components model. In addition, we include up to thirteen months lagged values of the neighbours' average. Note that in contrast to most estimations of spatial autoregressive processes, we allow for individually specified parameters of spatial dependence for each region.

We rank the thirteen lagged vectors of the spatial elements according to their correlation to the residual measured by a partial spatial autocorrelation function, PSAC, similar to the PAC function in time-series analysis. Then, we apply a sequential two-step selection procedure. In the first step we add all elements of the vector of τ month lagged spatial lags to the estimation, in order to receive their t-statistics. In the second step, we test whether the inclusion of the significant elements of this vector improves the AIC_C as compared to the previous estimation.

To sum up, for each labour-market district we estimate five different models: EWMA, ARIMA, SC, SCAR and SCSAR. In order to evaluate the model performance, we check the quality of the forecast results by running simulated out-of-sample forecasts using the last twelve months in which data is available (01/2004-12/2004). By doing this, we are able to calculate several error measures, on which the discussion of the results in the following section is based.

4 Results and Discussion

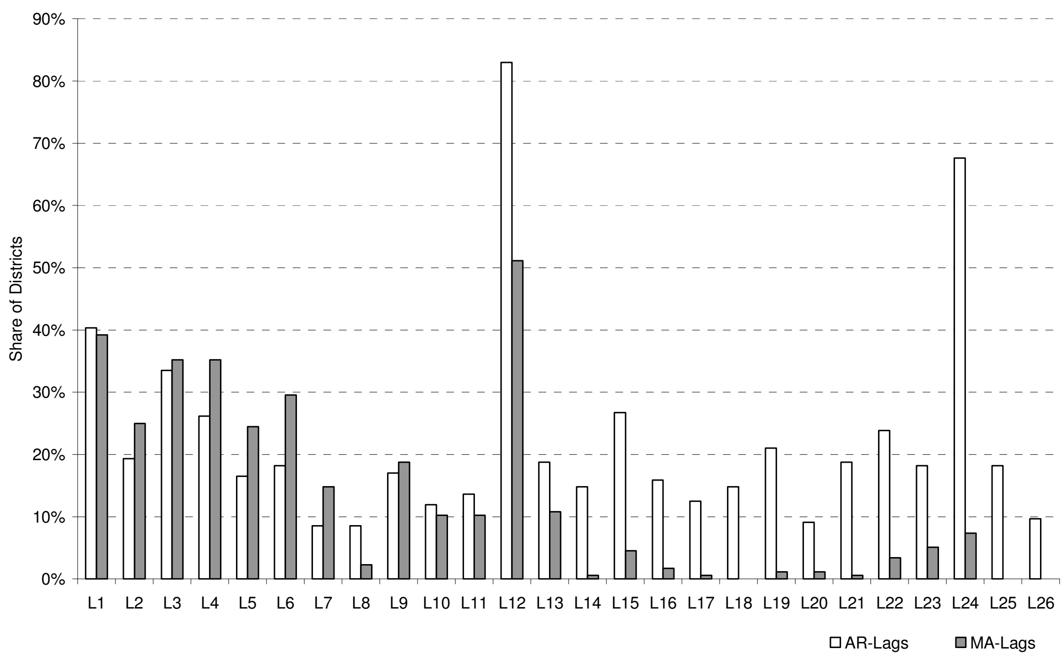
Whilst the mean square forecast error (MSFE) is a suitable accuracy measure to compare the forecast performance of the models for the same region, we are also interested in comparing the quality of the forecasts of the individual models amongst the different labour-market districts. When doing this, it is important to explicitly account for the size (in terms of the absolute number of employed) of the districts. Therefore, we need a relative accuracy measure. To this end, the focus here is on the mean absolute percentage forecast error (MAPFE). This measure is calculated as the difference of the forecasts with the observed values relative to the observed value for each month and labour-market district and then averaging over the twelve months of the simulated forecast period. We compare the model forecasts using this accuracy measure as well as a discussion of the models' strengths and weaknesses.

4.1 Results of the Models

The EWMA model forms its predictions by estimating three labour-market district specific parameters for the level, trend and seasonal influences. As described above in Section 3.1, the values for the smoothing parameters have to be between 0 and 1. High smoothing parameters attach a high value to current observations of a time series and lead to a fast adaptation, whereas low values consider past observations as important and signify a slower adjustment. The level parameter α shows an average value of 0.90 and ranges between 0.63 and 1.00. For the trend, the smoothing parameter β takes on values between 0.00 and 0.23 with an average of 0.07, and the seasonal smoother γ covers the complete interval from 0.00 to 1.00 with a mean value of 0.51. The EWMA model shows a mean MAPFE of only 0.66 percent. The minimum MAPFE was calculated for Goeppingen with 0.08 percent, the maximum value of 3.52 percent resulted in Helmstedt. The standard deviation is 0.55 percentage points. In general, the EWMA method produces good forecast results especially for many labour-market districts in the North-East and the South of Germany. Some labour-market districts in Mecklenburg-Western Pomerania, Saxony and Saxony-Anhalt have relatively high MAPFEs.

In our standardised ARIMA model selection, the time series are first differenced annually. This new time series is tested for stationarity. If it is not stationary, we further difference on a monthly basis and again test for stationarity. In nearly all labour-market districts (173), both differences are needed and only in three labour-market districts is the seasonal difference sufficient. The stepwise lag selection first of autoregressive and subsequently of moving-average terms follows. On average, nearly six (5.86) AR lags and slightly more than three (3.36) MA lags are included to obtain the final estimation model. Despite the differentiation, the most frequently used autoregressive lags are the typically seasonal lags of 12 and 24 months (see Figure 2). The one-year lag is selected in 83 percent and the two-year lag in 68 percent of all cases. The next most common lags of 1 and 3 months have frequencies of 40 percent and 34 percent, respectively. With the exception of four lags, all other autoregressive elements are selected in more than 10 percent but less than 30 percent of the ARIMA estimations. Moving-average terms are added afterwards if they further improve the model fit. Thus, the moving-average terms add information that is not captured by the autoregressive elements. Here, the twelve period lagged error dominates the other lags and is chosen in nearly half of all cases. The lags which capture the one-month till the six-month errors, still occur in more than 20 percent of the districts.

Figure 2: Frequencies of the Selected AR and MA-Lags in the ARIMA Estimates

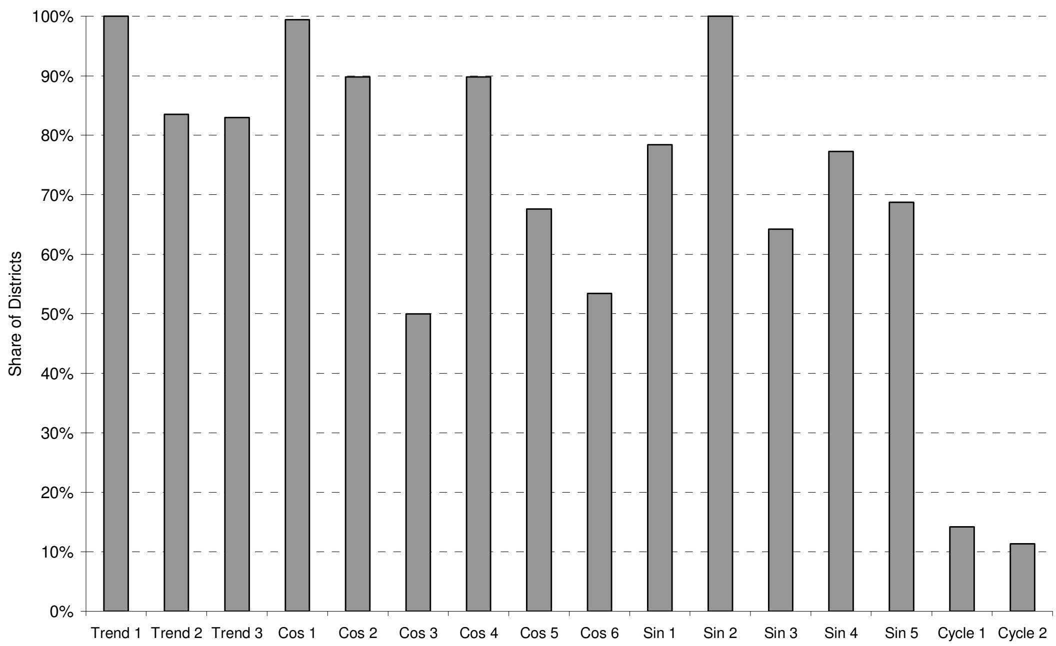


Lt: t month lagged values of the dependent variable

As shown in Table 1: Results of the Simulated Out-of-Sample Forecasts on page 83, our ARIMA-models have an average MAPFE of 0.90 percent across the 176 labour-market districts in the simulated out-of-sample forecasts. The best result is achieved for the labour-market district of Bremen which has a MAPFE of only 0.09 percent. By contrast, the prediction for Zwickau deviates from the actual figures by 5.66 percent. The standard deviation as a measure for the variation is 0.75 percentage points and can be used as a further indicator when comparing the accuracy of the predictions. Interesting is also the spatial distribution of the forecast errors. Geographically concentrated patterns of lower (higher) MAPFEs indicate that the model fits better (worse) for these regions. The ARIMA predictions have relatively low MAPFEs e.g. in central Bavaria. High prediction errors mainly occur in Rhineland-Palatinate and Mecklenburg-Western Pomerania.

The basic SC model contains trend, season and business-cycle components. Due to the unique behaviour of the time series in each labour-market district and our automised selection of only significant components, the composition of the selected components differs between the labour-market districts. However, some components are more frequently used than others (see Figure 3).

Figure 3: Frequencies of the Selected Components in the Basic Structural-Components Model



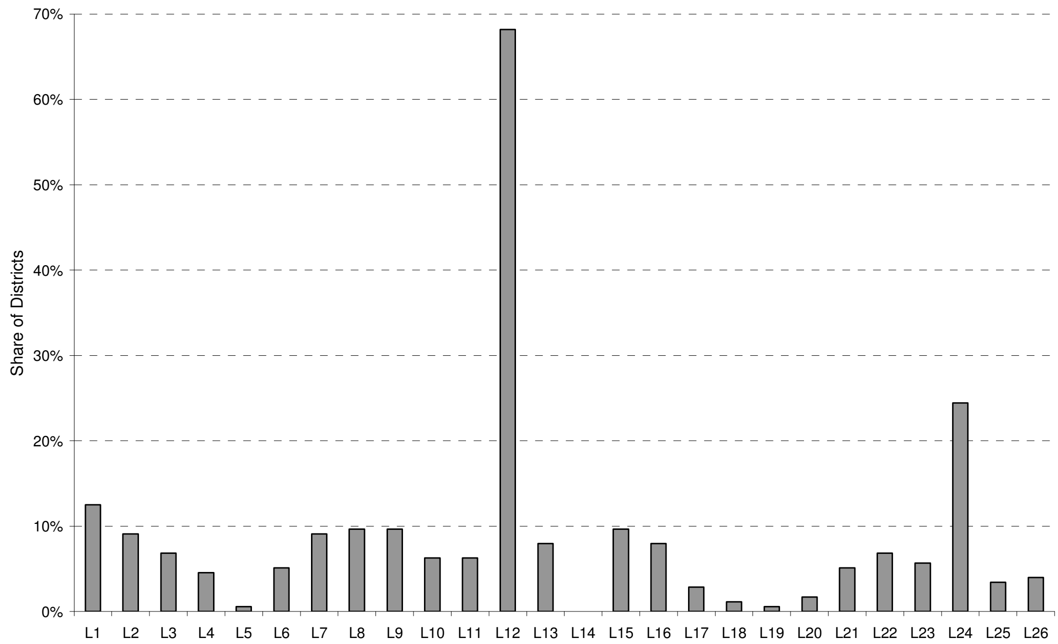
Trend 1: linear trend; Trend 2: quadratic trend; Trend 3: cubic trend; Cos t: year/t cycle; Sin t: year/t cycle; Cycle 1: cosine business cycle; Cycle 2: sine business cycle

The most important component is the linear time trend, which is kept by definition in every labour-market district. Also the quadratic and cubic trends are kept in more than 82 percent of the final estimations. Every sine and cosines function is included at least in half of all cases. The most commonly used seasonal components are the full year cosines and the half year sine function, which are kept in nearly all districts. The length of the business-cycle component is modelled individually for each labour-market district and captures cycles with a length of at least 13 months. In only 16 districts is the cycle length affected by the censoring (see Section 3.3) and is hence limited to 40 months. In 53 of 176 regions the cycle length is 23 or 35 months. The average length is 27 months. Two different types of business cycles are used: one is modelled as a sine and the other one as a cosines function. Hence, they are shifted in time but do not differ in length and amplitude. The sine cycle is included in nearly 14 percent and the cosines cycle in about 11 percent of the 176 simulated out-of-sample estimations.

The evaluation of the basic SC model for the simulated out-of-sample forecasts shows a mean MAPFE of 1.73 percent. The results also show a wide range in the calculated MAPFEs. The best fit was achieved in Celle with a MAPFE of 0.12 percent, the highest value was observed in Gotha with 8.81 percent. The standard deviation over the 176 labour-market districts is 1.09 percentage points. There are also differences in the spatial distribution of the MAPFEs. Basic SC models perform better in most parts of North Rhine-Westphalia and Saxony-Anhalt, whereas in Thuringia the predictions are fairly poor.

As described in Section 3.4, we augment the basic SC model for autoregressive elements to improve the short-term adjustment of the time series. Starting point is the full set of significant components used in the basic model. The results of the sequentially added autoregressive elements clearly show the importance of the one-year lag which is used in 120 labour-market districts, and the two-year lag, added in about 24 percent of all agencies (see Figure 4). On average, 2.29 AR lags are included in addition to the basic components.

Figure 4: Frequencies of the Selected AR-Lags in the Structural-Components Model

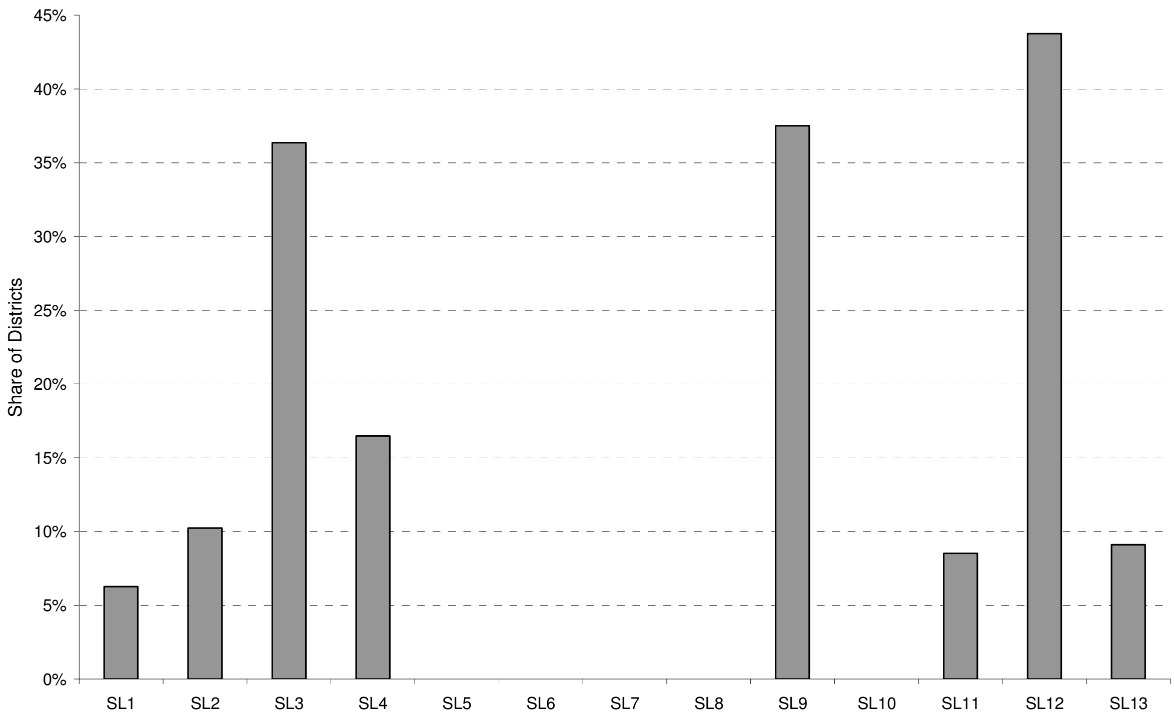


Lt: t month lagged values of the dependent variable

Surprisingly, the inclusion of the autoregressive elements leads to an increase in the mean MAPFE of 0.40 percentage points in comparison to the basic model and results in a MAPFE of 2.13 percent. The fits range from 0.31 percent in Freising up to 5.50 percent in Gotha. In the forecast for Freising, the commonly used structural components as mentioned above and additionally the lag 6 are used, whereas for Gotha only the twelve-month lag and the 25-month lag are included. The standard deviation over the 176 labour-market districts is with 1.01 percentage points a little lower than in the basic model. Geographically, the SC model with autoregressive components seems to fit better for most of the eastern federal states of Germany, but worse for most regions in Mecklenburg-Western Pomerania and Lower Saxony. Compared with the results of the basic estimations, the MAPFE of the autoregressive approach is lower in only 25 (14 percent) labour-market districts and higher in 151 (86 percent) cases. For those districts where the SCAR-model is better, the MAPFE improves by 0.92 percentage points. If the results are poorer, the MAPFE increases by 0.62 percentage points on average.

As described in Section 3.5, we also augment the basic SC model to account for spatial interdependencies across labour-market districts. Therefore, a panel approach needs to be applied. Thus, the following results have two sources of variation in comparison to the basic model: the change of the estimation technique and the addition of the spatial lags. To calculate the effect of the change in the estimation procedure, we also estimate a panel model with only the significant components used in the basic model. The results for the panel approach show a mean MAPFE of 1.02 percent, implying that the change of the estimation technique causes an average reduction of the forecast error of 0.71 percentage points. Compared to the forecast estimated with the panel approach, the average MAPFE of the SC model with spatial interdependencies is again 0.03 percentage points lower and amounts to only 0.99 percent. The most commonly selected spatial lags are the twelve-month, the nine-month and the three-month lag, which are included in nearly 44, 38 and 36 percent of the labour-market districts, respectively (see Figure 5).

Figure 5: Frequencies of the Selected Spatial Lags in the Structural-Components Model



SLt: t month lagged values of the spatially lagged dependent variable

By including a geographical component in which the employment forecast in one labour-market district also depends on its neighbours' development, the forecasts and thereby the calculated MAPFEs should become more even across the regions. This is confirmed by the results where the standard deviation of the MAPFE decreases from 1.09 percentage points in the basic model to 0.68. The results in the spatial model range from 0.12 percent deviation in Freiburg to 3.48 percent in Riesa. Districts with high MAPFEs are dispersed over the whole of Germany. Low MAPFEs are found in the city states Hamburg, Berlin and Bremen as well as in Brandenburg. In comparison to the basic model, the results are better in 142 (80.7 percent) labour-market districts. A worsening of the MAPFE can be found in 34 (19.3 percent) cases. The mean improvement of 0.45 percentage points is nearly as high as the worsening of 0.46 percentage points.

4.2 Comparison of the Models

According to the accuracy measures of the prediction, at least within the SC models a ranking seems obvious, with SCSAR as best and SCAR as worst: In contrast to the inclusion of autoregressive elements, the introduction of spatial elements leads to an improvement of the prediction measure in form of a lower average, minimum, quantiles and maximum MAPFE as well as a lower standard deviation of the prediction measure compared to the basic model. A comparison of SCSAR with the ARIMA and EWMA models shows that their prediction accuracies do not deviate by much. EWMA has the lowest average, minimum and quantiles MAPFE, as well as the lowest standard deviation. However, the lowest maximum MAPFE is obtained in the SCSAR model which again demonstrates the compensatory effect of the spatial component.

However, looking at each district separately shows the heterogeneity of the results. Figure 6: Spatial Distribution of the Best Models shows the model with the best forecast (lowest MAPFE) for each labour-market district. In total, the EWMA model fits best in 85 labour-market districts, i.e. in nearly half of all cases. ARIMA performs best in 45 cases (25 percent), followed by SCSAR in 36 labour-market districts (20 percent). The SCAR model is best in only four districts and the basic SC model in six cases. Hence, the SC model in its different variations has the lowest MAPFE in 46 labour-market districts (26 percent). The labour-market districts where the spatially augmented model is the best are primarily situated in central Bavaria, in Mecklenburg-Western Pomerania and Brandenburg on the border to Poland and in Lower Saxony on the border to Saxony-Anhalt. In Baden-Wuertemberg, Rhineland Palatinate and Saarland, SCSAR is rarely the best model.

Table 1: Results of the Simulated Out-of-Sample Forecasts

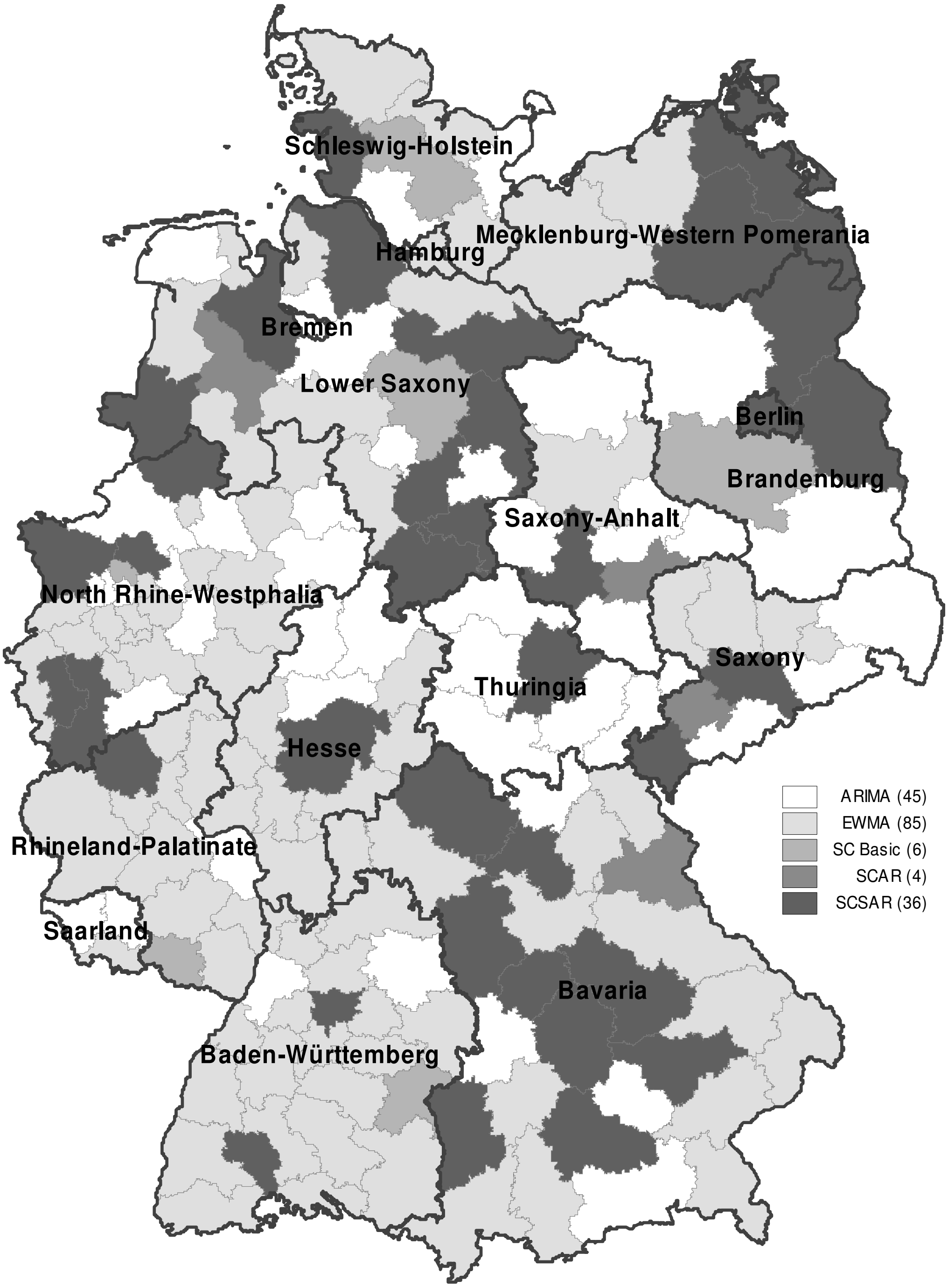
Statistics of MAPFE		ARIMA	EWMA	Basic SC	SCAR	SCSAR
Mean		0.90	0.66	1.73	2.13	0.99
Standard deviation		0.75	0.55	1.09	1.01	0.68
Minimum		0.09	0.08	0.12	0.31	0.12
50 %-Quantile		0.71	0.49	1.50	2.15	0.81
75 %-Quantile		1.21	0.82	2.22	2.79	1.31
95 %-Quantile		2.06	1.77	3.49	3.83	2.31
Maximum		5.66	3.52	8.81	5.50	3.48
Comparison with ARIMA	Better than ARIMA		121 (68.75 %)	28 (15.91 %)	17 (9.66 %)	77 (43.75 %)
	Worse than ARIMA		55 (31.25 %)	148 (84.09 %)	159 (90.34 %)	99 (56.25 %)
Comparison with EWMA	Better than EWMA			21 (11.93 %)	17 (9.66 %)	56 (31.82 %)
	Worse than EWMA			155 (88.07 %)	159 (90.34 %)	120 (68.18 %)
Comparison with basic SC	Better than basic SC				25 (14.20 %)	142 (80.68 %)
	Worse than basic SC				151 (85.80 %)	34 (19.32 %)
Comparison with SCAR	Better than basic SC					153 (86.93 %)
	Worse than basic SC					23 (13.07 %)

Figure 6: Spatial Distribution of the Best Models only shows the geographical distribution of the “best” model, no matter how small the gap between the “best” and the “second best” model is. However, we want to systematically analyse the quality of all models to be sure not to loose any information. Therefore, tests on the structures of the calculated MAPFEs of all models need to be applied.

4.3 Statistical Analysis of the Forecast Performance

To confirm our findings, we perform further statistical tests on the forecast errors (MAPFEs). First, we check the similarity of the forecast performance yielded by the various models in the same region. A second test analyses the independence between the MAPFEs and the basic time-series elements which are discussed in Section 2.

Figure 6: Spatial Distribution of the Best Models



All models applied in this paper are pure time-series estimations, i.e. they only include the past values to gain information. Hence, patterns found in the past should be reproduced well and can be extrapolated into the future. On the other hand, structural breaks and turning points due to economic trend reversals can hardly be captured. If these presumptions are correct, the forecast performance of the models in a region should be positively correlated. The pairwise correlation of the MAPFEs is shown in Table 2.

Table 2: Correlation of the MAPFE between the Models

	MAPFE ARIMA	MAPFE EWMA	MAPFE SC	MAPFE SCAR
MAPFE EWMA	0.4384***			
MAPFE SC	0.2119***	0.3413***		
MAPFE SCAR	0.2729***	0.1926**	0.6995***	
MAPFE SCSAR	0.1347*	0.2931***	0.0538	-0.0512

**** Significant at the 1 %-level, ** significant at the 5 %-level,* significant at the 10 %-level*

As the significantly positive correlation indicates, the models perform poorly or work well in the same regions. Noticeable is the high correlation between the basic SC and the SCAR model, as well as the one between EWMA and ARIMA. These pairs of models tend to cover the same structures and consecutively produce similarly precise forecasts. However, the correlation coefficients are clearly smaller than one, i.e. the models are not close substitutes to each other. In contrast to the correlation between SCSAR and the two moving-average models, the MAPFE of SCSAR is not significantly correlated with the other SC models, although they partly incorporate the same components. This difference reflects the additional information that is provided by the recent development of the neighbouring labour-market districts.

The test on independence of the forecast performance is carried out by regressing the MAPFE of each model on variables representing the basic time-series elements. The forecast error does not depend on these elements if the coefficients are insignificant. However, if they have a significant impact, the information provided by the time series is not exploited completely. Hence, in this case there is potential to improve the forecast performance. The hypothesis that the model error (MAPFE) does not depend on a time-series component is only rejected in two cases. First, the seasonal component shows a significant positive sign for the EWMA, i.e. the EWMA model performs less well the higher the seasonal span which implies that the seasonal figure could be captured better. Second, the growth rate of employment has a negative influence on the MAPFE in the basic SC model. The higher the employment losses are, the higher the MAPFE. The losses tend to be extrapolated further on, even if the trends reverse (as happened in several parts of Germany at the end of 2004). The gap between the real value and the forecast can be reduced by including temporally lagged elements if the turning point is observable at the end of the data.

Summing up, the tests indicate that the time-series structures, i.e. level, trend, and season, are modelled properly. We exploit the provided information to a large extent, and develop improvements such as the augmentation of the basic SC model by autoregressive and spatial autoregressive elements. Only in the EWMA model there seems to be some potential to improve the seasonal adjustment. Nonetheless, it turns out to be the best model with respect to the number of regions where it performs best as well as the distribution of the MAPFEs. Even the other models applied in our paper perform well, as can be seen by the average MAPFE which is smaller than 2.2 percent for all, and smaller than 1 percent in three models.

Table 3: Regression of the MAPFE and Possible Determining Factors for Each Model

	MAPFE ARIMA	MAPFE EWMA	MAPFE SC	MAPFE SCAR	MAPFE SCSAR
Growth rate of employment	0.0028	-0.0386	-0.1189*	0.0141	-0.0355
	(0.04)	(0.51)	(1.95)	(0.28)	(0.89)
Seasonal span of employment	4.2530	13.3695***	8.3382	4.7221	1.2518
	(1.38)	(4.52)	(1.58)	(0.77)	(0.48)
Average employment rate	0.3585	-0.3260	-0.7443	0.2400	0.7141
	(0.29)	(0.51)	(0.53)	(0.16)	(0.65)
observations	176	176	176	176	176
F-Value	0.64	9.06***	2.61*	0.22	0.37
r-squared	0.0077	0.1678	0.0532	0.0057	0.0095

**** Significant at the 1%-level, ** significant at the 5%-level,* significant at the 10%-level*

5 Conclusion

In this paper we estimate employment with different time-series models for all (176) labour-market districts in Germany. As the conditions in these districts are very heterogeneous, we employ individually specified models which capture the local labour-market conditions. We do this by testing which variables have a systematic influence and improve the model fit in each labour-market district. Only these variables are included in the final regressions. Although we specify the models parsimoniously, it turns out that the selection of components greatly varies between the labour-market districts. This confirms the importance of modelling each labour-market district individually.

We evaluate the models using simulated out-of-sample forecasts for 2005 and calculating different accuracy measures for this time period. Overall, we find that the forecast quality of all our models is very high. Three of our models have a mean average percentage forecast error of less than one percent and the other models of around two percent. Additionally, we find a great variation in the best model across the regions. Therefore, it is not sufficient to run a forecast with only one model for all labour-market districts. Instead, better results can be achieved by forecasting with a number of models and subsequently seeing which performs best in which region.

Our results clearly show that the inclusion of spatial information improves the forecast quality in the structural-components model by estimating a spatial dynamic panel. Ideally, the information on spatial co-development should be included in all models. Theoretically, the inclusion of spatial lags in the autoregressive models has been developed; unfortunately this is not technically possible in the ARIMA model with 176 labour-market districts at present. For the EWMA model the theoretical and practical integration of spatial elements remains work for future research.

Although all our models have a high forecast quality, we still see potential for improvements by individually combining the different model results for each region using appropriate pooling techniques. First results indicate that this is indeed the case. However, we leave this work for a planned subsequent paper.

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VI Forecasting Regional Employment by Time-Series Modeling

Franz-Josef Bade

«voir pour prévoir,
prévoir pour prévenir »
A. Comte

1 Introduction

Theoretically, regional policy like other areas of politics should principally be based on explicit estimations of the future perspectives of regions. Actually, in Germany like in many other countries it is just the opposite. One of the few exceptions is the coordination of regional policy by the so called "Gemeinschaftsaufgabe 'Verbesserung der regionalen Wirtschaftsstruktur'". This institution is a joint committee of the Federal state and the 16 states ("Länder") and has the task to coordinate the rules of regional assistance in order to avoid an unfair competition between rich and poor states and to prevent collusive behavior of firms applying for regional subsidies.

Among others, this coordination is done by the decision about the assisted areas, thus about those areas where subsidies for firms are possible. The selection of the assisted areas is based on few indicators one of which is a forecast of regional employment change. In this article we report how these forecasts are done, what its main results are and last but not least, how reliable the results have been in the past. Since the current forecast 2001 – 2010 is the most recent part of a series of forecasts[1] it offers not only the possibility of ex-post-control but, perhaps more importantly, it also allows to learn from the errors made in the previous estimations.

In the following, we first give a short outline of the forecast methodology. As the approach consists of developing, testing and forecasting a large number of time series models we concentrate on the philosophy of the approach. After that, we show some selected results of the expected changes of spatial structure of Germany. The report ends with a look back at the accuracy of previous forecasts. In principle, it is not a necessary objective of forecasts that they match the real development at the end; especially in socio-economic policy areas forecasts are often an instrument in order to prevent the continuation of the status quo development. Nevertheless, precision in the past is an essential precondition for trust in the future; that is why at the end of our report the previous forecasts are compared to the real changes.

2 Methodology

2.1 The Basic Principles

The forecasts have a mid-term perspective of about 9 years which is a compromise between the wish for a long-term estimation of regional perspectives and the limits due to the forecast methodology. Due to its political purposes, a hierarchy of future regional competitiveness, the forecast may be restricted to a comparative view of regional development. Analyzed and predicted is the relative change of regional employment, i.e. the regional growth rate in relation to the federal average rate. It is

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1 Bade (1999); Bade (1996); Bade (1994); Bade (1991).

identical with the change of the regional share of national employment and is therefore sometimes referred to as "regional elasticity".

Let b_0 and b_1 be	the employment of a particulier region in t=0and t=1 and
B0 and B1	the respective variables for the national employment,

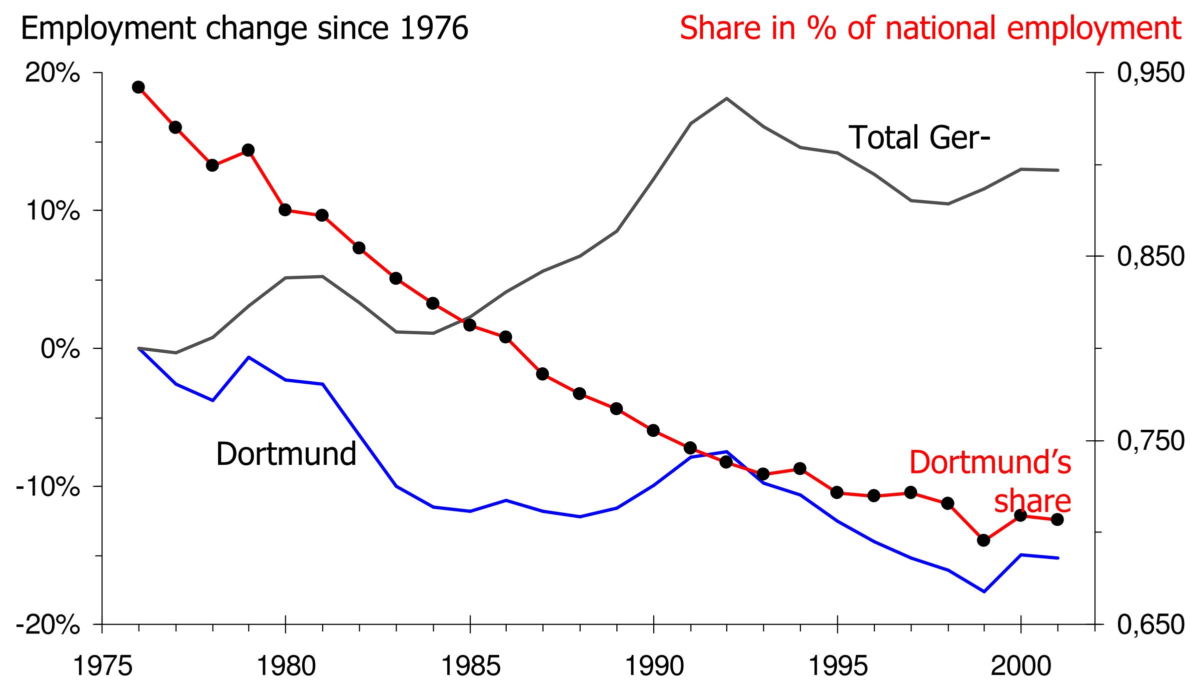
then the *'relative'* change of employment is $= \frac{b_1}{b_0} / \frac{B_1}{B_0}$.

As the regional share of national employment is defined as $r_t = \frac{b_t}{B_t}$

the *'relative'* change of employment share is identical with the change of regional share

$$\Delta r = \frac{r_1}{r_0} = \frac{b_1}{B_1} / \frac{b_0}{B_1} = \frac{b_1}{b_0} / \frac{B_1}{B_0}$$

Figure 1: Relative Change of Employment of Dortmund



Source: Statistical Offices; own estimations

As illustrated in figure 1, the restriction to relative changes has one essential advantage: By the standardization to national employment, the perspective focuses on regional particularities and disregards those influences which are more or less effective in all regions such as the business cycles or other nation-wide longer-term tendencies. Although the city of Dortmund shows a distinctly below-average performance, it although reflects the business ups and downs. By standardization, however, it can be recognized that Dortmund's economy behaves in rather stable way compared to the national growth, i.e. the annual change of Dortmund lies continuously about 1% rate under the national change.

The concentration on "relative" changes does not exclude the estimation of "absolute" changes. The only precondition is a forecast of the national employment. National predictions have their own complexity which is, theoretically as well as empirically, mostly independent from regional estimations. Furthermore, as national economic forecast are rather frequently offered by other organizations, the restriction to relative changes allow to benefit from a division of labor by using external expertise for those parts of the prognosis which are not in the primary focus of regional interest. Given the externally forecasted size of national employment, the predicted regional share can be transformed into the size of regional employment by multiplying it with the number of national employment.

The forecasting procedure is founded on two basic hypotheses concerning the forces of spatial change.

(1) Firstly, it is assumed that spatial structural change is characterized by strong inertia, i.e. the change of region's share in the total national employment is characterized by a great stability as shown in figure 1. The example of Dortmund is an typical example which stands for many other regions.

The stability of spatial structural change is primarily an empirical finding. Although its theoretical reasons are not yet clearly understood, the finding can be observed in many countries for a long time[2]. Beyond that, in other areas of economy, too, structural change reveals secular stable tendencies, e.g. the expansion of the service sector or the shifts of qualification structures[3].

In spite of the empirical unambiguousness, the hypothesis is sometimes misunderstood. The thesis of stability refers to the course of spatial structural change, not to the structure itself. Similar to sectoral structural change for example, the spatial distribution of work places experience large shifts: employment growth varies a lot between regions and produces related changes in the regional shares of national employment. For Germany for example, on long-term average over 1% of all work places are annually "redistributed" over the districts (NUTS III level) of West Germany – measured by the "total turnover", the sum of (absolute) changes of regional share. Including the East Germany, this number has increased to over 1.5% p.a. in the 90s.

Thus, the thesis of stability is restricted to just direction and speed of structural change. Not the spatial structure, but "only" the course of change is regarded as being stable in the sense that abrupt deviations are less likely. As it can be seen in figure 1 where the annual loss of Dortmund has decreased since the midst of 90ies, course changes may happen, but, in general, they happen rather slowly. Metaphorically, we may speak of tanker which cannot abruptly change the ongoing direction. Are direction and tempo of its past course known, its future location can predicted rather reliably. Applied to regional structural change the past course of regional share should reliably indicate the future development of employment in a region compared to the federal average.

(2) The second hypothesis refers to the forces that determine the changes of spatial structure.

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2 Salin (1928); Blanchard, Katz (1992); Hohls, Kaelble (1989); Tsionas (2000); Pehkonen, Tervo (1998); Keil (1997).

3 See for example: Mertens (1980) or Heckman (1997).

Due to the inertia of regional development processes, it is assumed that strong and lasting influences are necessary for changing the regional trend. Expressed in the metaphor of the tanker, great forces (and long ways) are needed to be able to change the direction of the course once it has been taken. Based on empirical analyses that have been made in connection with the previous forecast we postulate as second thesis that a (longer-term) change of direction is only possible when it is carried by the *growth poles* of the regional economy.

The growth pole theory[4] was among the first regional approaches pointing out that, in principal, there are two different ways how a industrial sector may influence total regional economy respectively employment. The direct influence consists of the employment which is created within the regional industy itself, namely the in- or decrease of employment within the respective industry. In fact, most sectoral analysis of regions is restricted on this direct impact, for example the frequently used shift-share-method.

In addition, however, indirect influences are also possible which are created via buying intermediate goods (backward linkages) as well by selling their own products which may give rise to further processing (forward linkages). The essential characteristic of both backward and forward linkages is that they need other economic partners in order to get effective. Indirect influences are not only possible, but probable, too. Some evidence for their significance for example is the “sectoral parallelism of regional development”[5] which can be observed in many regions: Regions which are growing in total, are not only characterized by a special increase in growth industries, but they generally perform on above-average even in those economic lines of business with nation-wide decrease. Likewise, lagging regions show their particular weakness in both nationally growing as well shrinking sectors. Obviously, there must be some links between them influencing the regional sectors in the same direction.

Due to various possibilities of indirect influences there is yet no simple answer to the question which industrial sector belongs to the growth poles of a region. In principle, most sectors could act as driving force; whether they really do depends on a number of circumstances which may vary from region to region. Due to pragmatic restraints such as data restrictions and the necessity of investigating each region individually we will concentrate on three characteristics in our analysis: Firstly, the branch must be principally capable of giving the first impulse, for which – at the least to some extend – it has to be autonomous, i.e. independent of the regional demand. This autonomy can be given in a variety of ways, an extreme case are governmental transfers. Presumably, the most frequent case however is a national or international market area[6].

The primary impulse only has an effect if the branch is ’motorique’. The branch must be integrated into the regional economy in order to be able to transmit growth impulses to the regional economy through its various relationships inside and presuma-

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4 E.g. Perroux (1950); Schilling-Kaletsch (1976).

5 See for example Molle (1997), Bade (1986).

6 Other reasons for autonomy could be interregional transfers of income which are of benefit to a particular industry. Likewise, the governmental sector appears to be quite independent from the regional economic development.

bly outside business. At short term, multiplicator processes[7] on the (intermediate and final) demand side appear to have the greatest effect. The supply side influences do usually work more indirectly. Their effects can be noticed at longer term only, for example the products of a branch may initiate a further processing in other firms of the region or, by some economies of scope, they make the subsequent production more competitive; consequences which are particularly stressed by the growth-pole theory.

Thirdly the primary impulse has to have a certain minimum size in order to be noticed in total regional development. The interplay of different branches produces al lot of "white noises" which may overlay many impulses. Only branches of a certain size are able to break through this layer and to influence the course of regional development in a significant and noticeable way. Of course, in a long term perspective, small firms, too, may reach this influence. But because of the mid-term frame of this forecast we postulate that above all the largest branches of a region come into question as growth-poles provided that they fulfill the other two criteria mentioned above.

2.2 The Forecasting Procedure

2.2.1 Univariate Analysis of Total Employment

Both basic hypotheses imply a forecasting procedure which goes bottom-up. At the beginning, it focuses on the development of each single region. At the end, however, after having made predictions for all regions the total consistency of the individual estimations is checked due to the trivial, but very severe restriction that the sum of regional shares must sum up to 1.

The forecast procedure of a single region consists of two modules corresponding to the two basic hypothesis. Using the tanker metaphor, the first set of methods concentrates on the course of the tanker: Its past way is analyzed in order to detect stable tendencies which can be extrapolated into the future. In other words, we hypothetically assume at this stage that all relevant information for forecasting is contained in the past time series.

Formally spoken, univariate time series are analyzed by applying the ARIMA model which predicts a value as a linear combination of both its past values and past 'errors' or shocks[8].

7 See for example Kampmann (1988).

8 All calculation are done with the SAS Software package, V. 8.02.

$$W_t = \mu + \frac{\theta(B)}{\phi(B)} \alpha_t$$

where

W_t is the response series of $\boldsymbol{Y_t}$ or
a difference of the response series $W_t = (1-B)^d Y_t$

μ is the mean term,

B is the backshift operator; that is, $B X_t = X_{t-1}$

$\theta(B)$ is the moving-average operator, represented as a polynomial in the back shift operator

$\theta(B) = 1 - \theta_1(B) - \ldots - \theta_Q(B)^Q$

$\phi(B)$ is the autoregressive operator, represented as a polynomial in the back shift operator:

$\phi(B) = 1 - \phi_1(B) - \ldots - \phi_P(B)^P$

α_t is the independent disturbance, the random error.

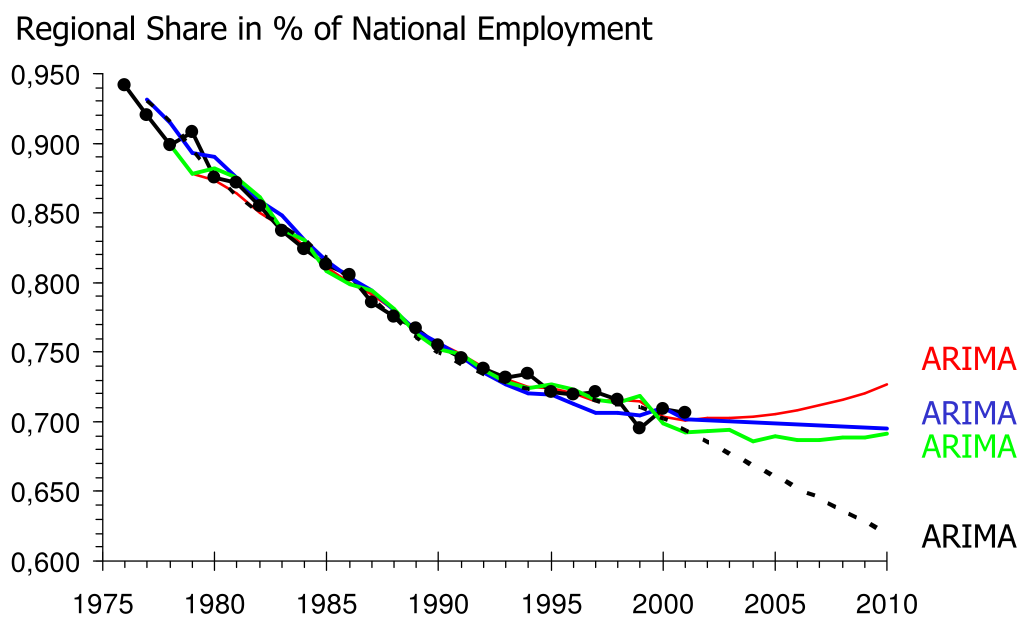
The ARIMA model integrates the two main types of probabilistic processes: autoregressive (AR) and moving average processes (MA). The latter assume that the current time series is related to the random errors from previous time periods. In contrast, autoregressive models estimate a process where the current time series value is related to the actual time series values from previous time periods. As the autocorrelation functions of both processes behave dualistically to each other, the identification of ARIMA-processes is rather complex. Usually, the autocorrelation function of MA(q)-processes is finite, i.e. it stops after lag q. Whereas the autocorrelation function of autoregressive processes is infinite and behaves exponentially.

Because of its complexity, which increases with the order of processes, the model analysis is usually separated in three steps: As firstly disseminated by Box and Jenkis[9] the first task is to identify the underlying model of the time series process. Then the model parameters are estimated and the diagnostics are checked before finally the future behavior of the process is forecasted. One important element of the identification phase is to guarantee the stationarity of the time series i.e. that the mean and the variance is constant over time. This necessary precondition for (most of) the probability theory of time series is usually by transforming the time series either within the ARIMA model (by differencing) or outside by using log or sinusoidal transformation.

The ARIMA model is applied individually for each region. Since both processes may have different orders and the backshift may cover different time lags, the usual connotation is ARIMA(p, d, q) with p for the order of the autoregressive process, q for the order of the moving-average-process and d for the order of differencing.

9 Box, Jenkis (1976).

Figure 2: Univariate Forecasts of The Relative Change of Employment of Dortmund



Source: Statistical Offices; own estimations

Table 1: Univariate Models of The Relative Change of Employment of Dortmund

Model	Diff. Lag	Auto-reg. Ord.	Mov. Av. Ord.	Error variance	AIC	Share 2010 of national employment
ARIMA (1,2,2)	2	1	2	0,00009	-146,645	0,72658
ARIMA (1,1,1)	1	1	1	0,00010	-149,873	0,69490
ARIMA (2,2,0)	2	2	0	0,00010	-143,441	0,69168
ARIMA (2,1,2)	1	2	2	0,00007	-152,124	0,62057

At the end of the first module, the question which model is the best is decided by the goodness of fit. As criteria, beside the standard error estimate, the Akaike's Information Criterion[10] is used. It differs to the standard error by taking the number of model parameters into account i.e. it prefers lower order models by including a "punishing" term to the error variance.

Usually, for most regions, the result of the first module is a corridor of forecast functions. Although several models attain an equivalent goodness of fit, their forecast may differ more or less strongly, as illustrated in figure 2. Consequently, the question which model has the highest plausibility can not formally be answered on the basis of the estimation parameters. A good fit to the past development is a necessary condition, but some forecast functions deliver such extreme values for the future that they are obviously unrealistic - what may be interpreted as a further argument to the general skepticism about the extrapolation of trends. In our example Dortmund, those models which tend to underestimate the recent change of direction such as ARIMA (2,1,2) attain a very good fit but their forecast appear as rather too pessimistic.

2.2.2 Sectoral Analysis

The objective of the second module is to concentrate the corridor of formally determined forecasts to a smaller spectrum of plausible changes. Its theoretical basis is given by the second thesis mentioned above that strong and lasting changes in regional employment are mostly caused by a small number of industries. However, which industry is fundamental for the development of a region may vary over the regions according their size and their intraregional linkages. Therefore, we have firstly to investigate which economic sectors could be regarded as growth-poles of the region in question. This investigation is done for each of the regions.

Theoretically, as presented above, a growth pole is characterized by it autonomy, its intraregional linkages and its size. Empirically, however, only employment data is available at the regional level. Therefore, a two-step procedure is applied to identify the relevant industries. Firstly, employment figure as well as localization coefficient are used to select a broader group of sectors (around 15 out of a total set of 66 lines of business) which could potentially have a significant influence on the growth of that particular region. Employment is taken as proxy for size whereas the localization coefficient is used as criteria for autonomy. The larger the size (employment) of the analyzed sector – compared to the federal average –, the higher its regional over-representation. In the sense of the central place theory, this indicate the 'significance surplus' due to a large market area and, by that, the independence from the regional total demand and its future development.

Secondly, time series regression is used is to test their influence on total regional development. This regression is an extension of the above-mentioned ARIMA model insofar an additional term for exogenous "input" time series is included.

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10 Akaike, H. (1976): The AIC is defined as $\ln\hat{\sigma}^2 + 2\frac{(p+q)}{T}$.

$$W_t = \mu + \frac{\theta(B)}{\phi(B)} \alpha_t + \sum_i \omega_i(B) B^{ki} X_{i,t}$$

where

X_i is the i[th] input series (or a difference)

k_i is the pure time delay for the effect of the i[th] input series

$\omega_i(B)$ is the (numerator) polynomial of the transfer function for the i[th] input series

In principle, time series regression follow the same procedure as the univariate analysis before. The first precondition is to guarantee the non-stationarity of both the endogenous and the exogenous variables. Consequently, the error process has to be identified and estimated before the regression can be calculated and the significance of the different exogenous variables is estimated[11].

Table 2: Parameter Estimates of the Time Series Regression: The Influence of Selected Industrial Sectors on the Employment Change of Dortmund

Statistics of Fit

Root Mean Square Error	0,0076
R^2	0,9499
R^2 adjusted	0,9110

Parameter Estimates

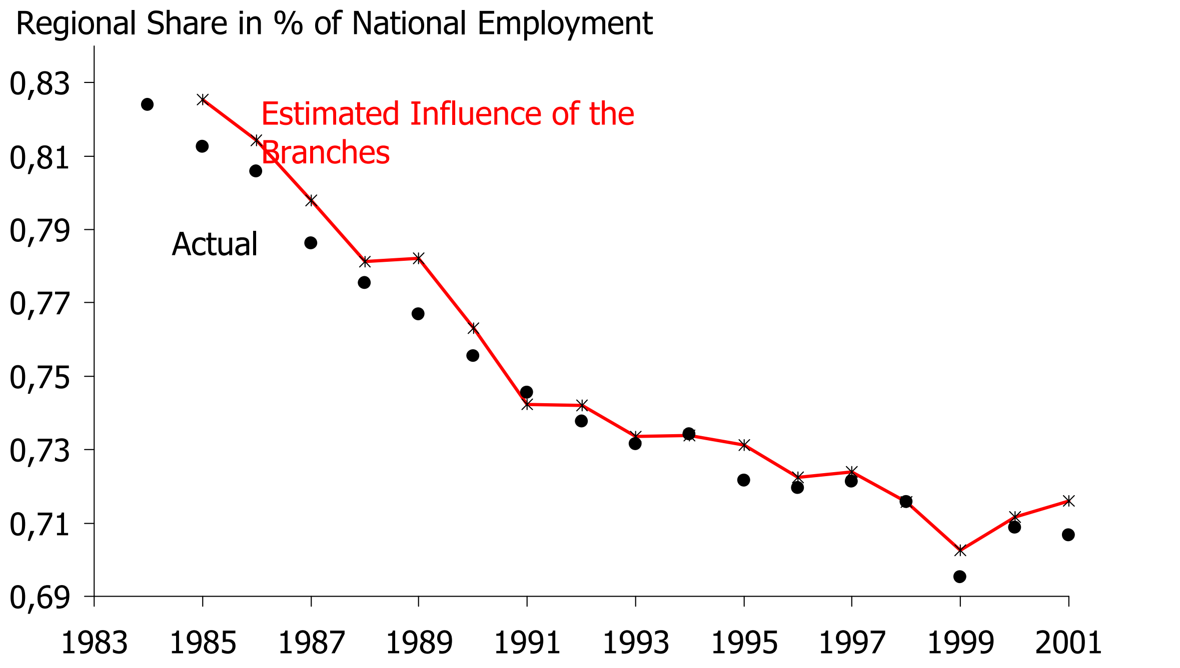
Branches	Estimate	Std. Error	t-value
Machinery	0,0640	0,0234	2,74
Electrical	0,0111	0,0079	1,41
Motor Vehicles	0,0884	0,0363	2,43
Brewery	0,0441	0,0188	2,35
Insurances	0,2435	0,0192	12,67
Consulting	0,0532	0,0111	4,78
Other business services	0,0481	0,0094	5,11
Research, Education	-0,0813	0,0163	-4,97

The outcome is a group of regional industries, individual for each of the regions, which appear to be influential to the total regional development in the sense that their time series are significantly correlated with the change of total employment of the region in question. As example in Table 2 are shown the selected industries for Dortmund. Interestingly, as most calculations are characterized by a lot of fuzziness such as the above mentioned parametrization of the multivariate model, it may happen that some regional industries are negatively related to the change of total employ-

11 For all calculations PROC ARIMA is used, see above.

ment. Therefore, the final group of industries is rather broadly defined. In total, however, as measured by test statistics such as the root mean square error in table 2 as well as shown in figure 3, this group of selected branches appears to be most decisive for the development of Dortmund.

Figure 3: Influence of Selected Branches on the Change of Employment of Dortmund

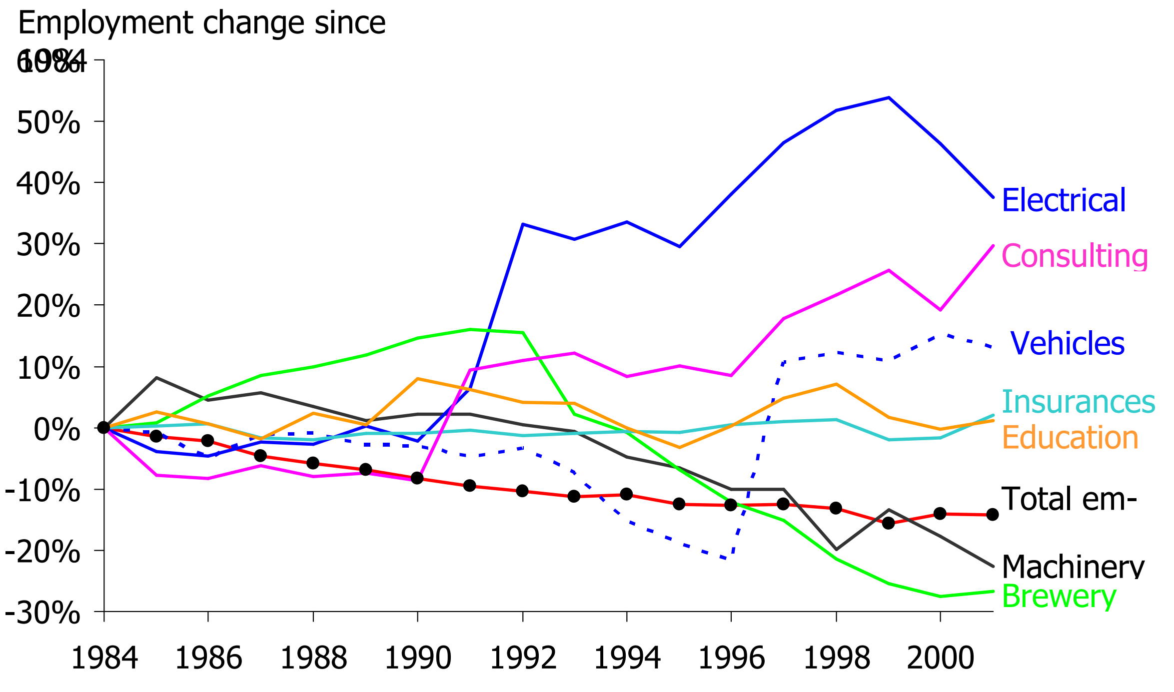


Source: Social Security Data; own estimations

The next step is to estimate and to forecast the future development of the selected industries and to integrate them into the estimation of total regional development. One way consists of using the same procedure as for total employment, namely an univariate time series model. However, most sectoral time series are rather unstable (see figure 4 as example); thus, their forecasts show much more variance.

That is why additional information are used in order to get a broader impression of their future competitiveness. Essentially, these are the productivity of a branch and its research and development intensity. With both indicators the focus is given to the temporal change during the last years. Especially in the case of research and development the change is regarded as indicator for the companies' subjective evaluation of their competitiveness. The base of this argument is that a company which has an above-average investment in research and development obviously expects to get the return on investment. Since investment in research and development has more long than short term results, it can be concluded that the company should have an optimistic view of its future, in principle.

Figure 4: Change of Employment in Selected Branches of Dortmund



Source: Social Security Data; own estimations

The last step is to integrate the sectoral assessments into the forecast of total regional change. Formally, this is done by using the multivariate time series regression model mentioned above and introducing the sectoral forecasts as future values of the exogenous variables, called input time series[12].

However, given the high uncertainty of the sectoral forecasts (in addition to the original uncertainty of the multivariate model) these formal calculations can only give a tentative orientation. Consequently, the last fine tuning has to be done "by hand": there is no formal model which allow to integrate the various information in an uniform way for all regions[13].

2.3 Consistency Check

Beyond the complexity and uncertainty of information there is another reason for the iterative ("handish") forecasting process which results from to the bottom-up-structure of the forecast: The two modules – the estimation of the development corridor and the analysis of regional growth-poles – are applied to each individual region. Since the forecasted values are regional shares of national employment, at the end,

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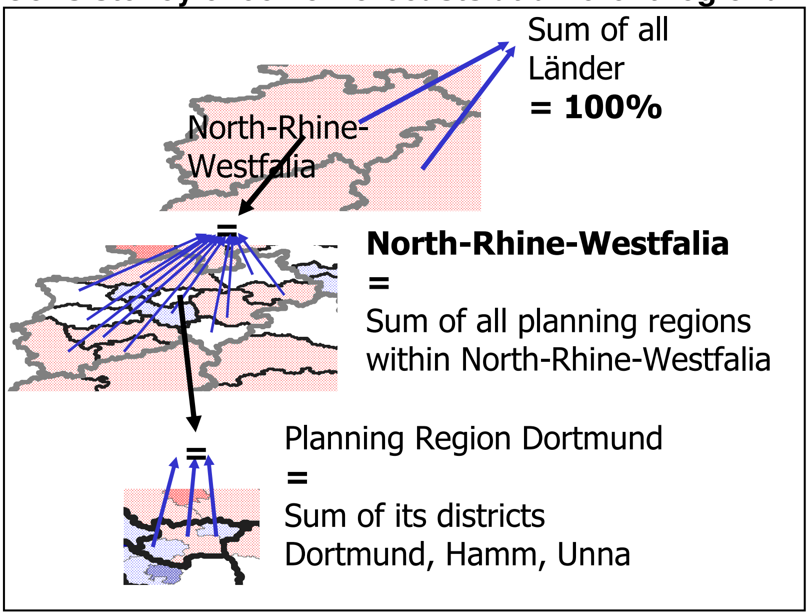
12 In this case, the ARIMA model is also called Transfer Function Model *Granger, Newbold (1986)*. About the possibilities and limitations of such models see for example *Jäger (1995)*.

13 he use of formal and econometric methods as well as subjective evaluations of various contexts at the same time is labeled "iterative-analytical" in literature about economic situation forecasts. Most forecasts today – for example, of the National Economic Council ("Sachverständigenrat") – are based on this method (see: *Weidmann (2002)* and *Nierhaus, Sturm (2003).* A more formalized alternative is proposed by *Blien, Tassinopoulos (2001)* who integrate heterogeneous information as constraints in a matrix model.

the sum of all regional forecasts must equal 100%. In practice, however, the first round of estimations doesn't fulfill this condition. Consequently, the regional forecasts have to be reexamined and to be adjusted.

As the consistence check is possible for different regional aggregations, it gives the chance for further investigation and understanding of regional change. For example by grouping districts to greater regions the influence of spatial autocorrelation may be taken into account. Given the bottom-up procedure, there is no possibility to integrate formal autocorrelation methods in the calculation for an individual region. Altogether four different regional levels are used for forecasting: the states ("Länder")[14], 38 large areas (according to the old „Bundesraumordnungsprogramm"), 97 planning regions ("Raumordnungsregionen") as well as the 440 districts ("Kreise") as base unit.

Figure 5: Consistency check of forecasts at different regional level



In total, about 600 single regional forecasts are produced (including all analytical steps described above). The separate forecasts on the various levels are compared to the according sub-aggregates as shown in figure 5. The sum of Dortmund and its two surrounding districts must equal the forecast for the planning region Dortmund; the sum of all planning regions in North-Rhine-Westfalia must equal the forecast of North-Rhine-Westfalia; and the sum of all states must add up to 100%. This adjustment can only be done "by hand" since each single forecast of the entire region and its sub-regions has to be checked for plausibility and to be made congruent.

2.4 Data Base

Data are drawn from two different sources: Total employment is estimated by the Statistical Offices of Länder[15] and is used here to determine regional employment in the base year of forecast.

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14 Hamburg, Bremen and Berlin are aggregated with their respective surrounding state (Hamburg with Schleswig-Holstein).

15 See: Arbeitskreis "Erwerbstätigenrechnung des Bundes und der Länder".

The second source is the social security statistics that are used for the time series analyses. The additional use of employment statistics offers three important advantages. Firstly, social security data is available back till 1976 (for East Germany till 1993). Secondly, the data are highly differentiated by industrial branches, which is necessary for identifying and analyzing the regional growth-poles. And thirdly, in addition to the sectoral structure of regions, the social security data provide other information such as occupations of employees or the sum of wages, which are used to investigate the competitiveness of growth-poles.

The disadvantage of these data is that they only cover about 75 to 80% of all employed persons in a region[16]. However, since the changes in direction and tempo of such a large subset should strongly correlate with the entire set, this under-representation is not regarded as essentially harmful. Evidently, the temporal change of total employment considerably corresponds to the change of social security employment at the regional level[17].

3 Regional Employment Development 2001 - 2010

A first overview on the expected employment development for the planning regions is given by figure 5. A clear result is the West-East-decline of growth rates. Although a lot of direct and indirect transfers are still going from West to East as well as industrial locations in East Germany are highly subsidized[18], all Eastern regions have to expect change rates clearly below federal average. The highest loss (-19.3%) is estimated for the Oberlausitz-Niederschlesien region; not much better is the development of its neighboring region Lausitz-Spreewald (-15.7%) or Halle (-17.8%). Only in a few regions, the estimated losses make up less than 10%. Berlin with a loss of 5.1% looks well off in comparison.

Compared to the early 90s, the perspective of East Germany has declined significantly. The assessment is even worse when taking into account that the East Germany experienced a rather favorable upswing in the midst of 90s. The loss of employment till the end of the millennium has been so large that meanwhile, employment has fallen under the initial level of the early 90s which is usually regarded as the minimum forced directly by the transformation process after the destruction of the Berlin Wall. The detailed investigations of this forecast can hardly give any hope that this development will become significantly better in the coming years.

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16 See: Wermter, Cramer (1988).

17 What is actually not so surprising, since social security data are used for the estimation of total regional employment.

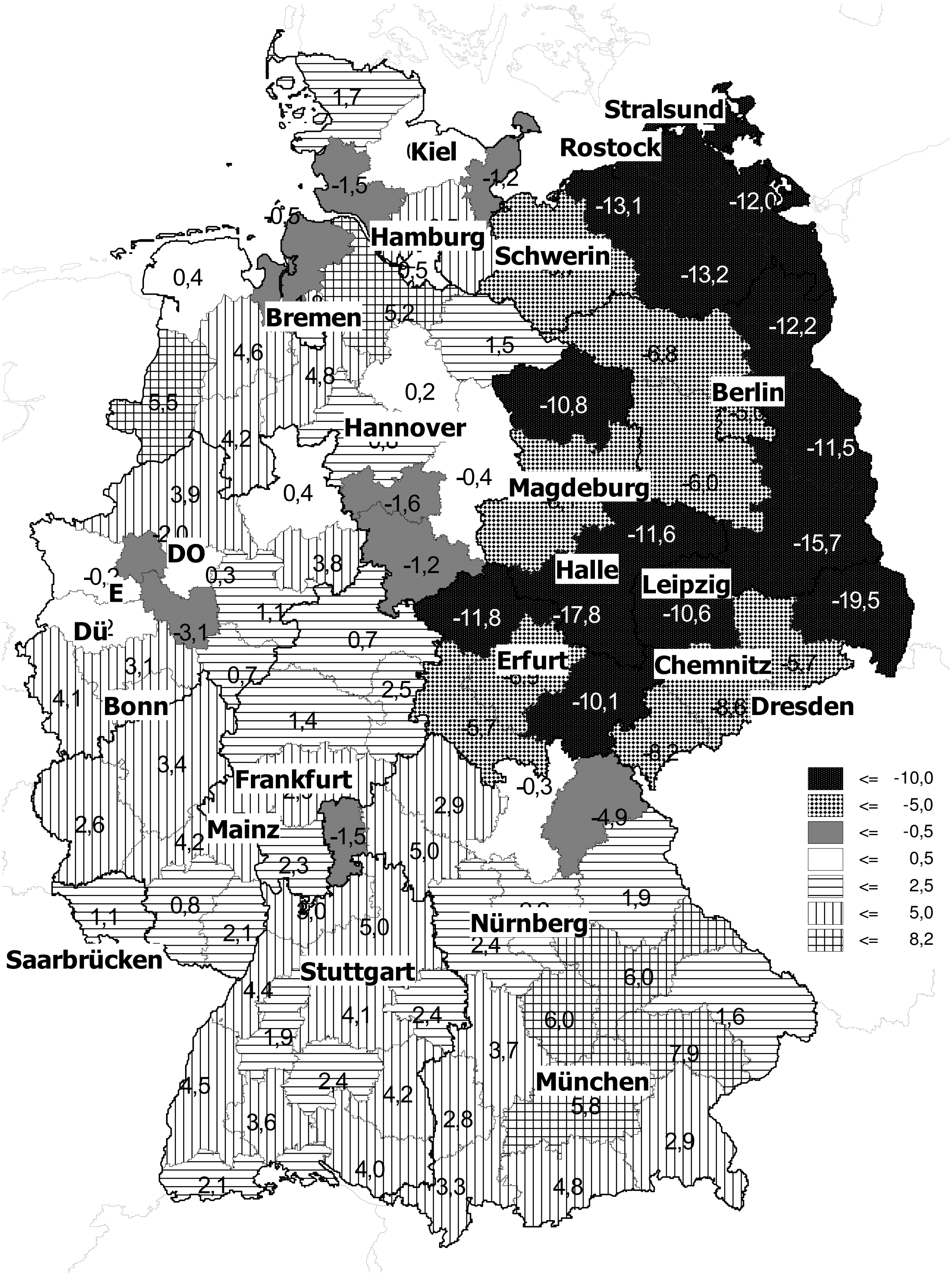
18 Presently, the net amount of public transfer (including social security) is still about 83 bill. € p.a. All Eastern areas belong to the Objective-1-category of European Structural Funds.

Table 3: Employment Change in East and West Germany 1992 – 2001 - 2010

	Employment Mio.			Share of national employment %			Forecast 2010	
	1992	2001	Change	1992	2001	Change	Share %	Change
West	28.4	29.2	+2.9%	79.0	80.3	+1.7%	82.1	+2.3%
East	7.5	7.2	-5.1%	21.0	19.7	-6.2%	17.9	-9.2%
Germany	35.9	36.4	+1.2%	100.0	100.0		100.0	

Sources: Statistical Offices; own estimations

Figure 6: Forecast of Employment Change 2001 – 2010: Planning Regions
Regional Change Rate 2001 to 2010, related to the Federal Average, in %



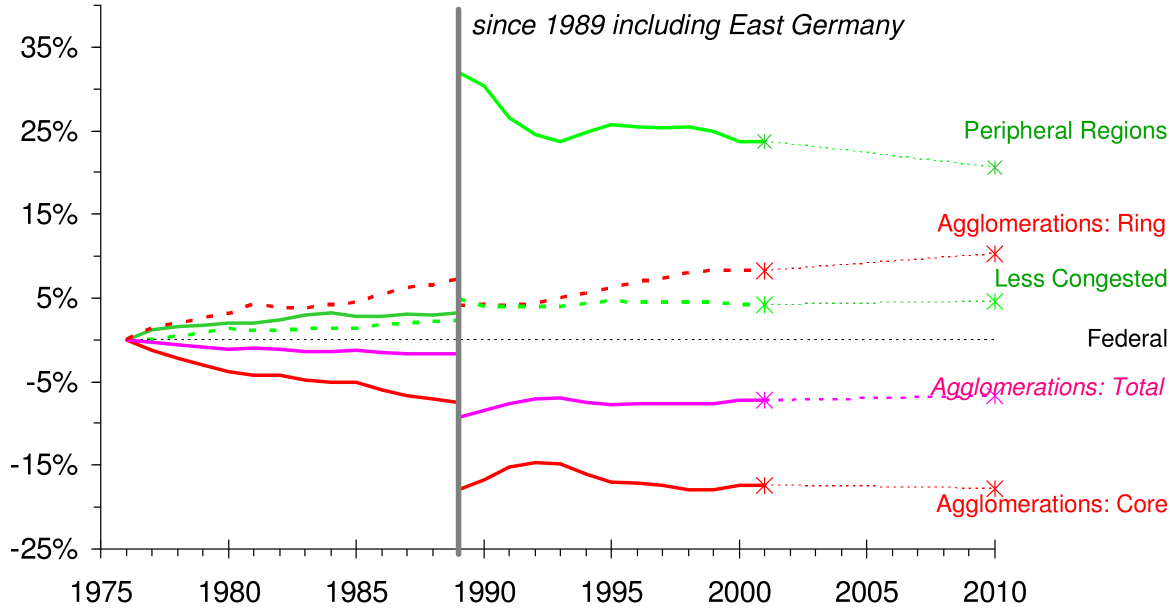
Since this forecast refers to relative changes, the loss of East Germany in national employment does not necessarily stand for a decrease in employment. However, to compensate the loss of share without loosing employment would mean that the national employment of Germany has to increase by 4.6% to 38.1 Mio. what is hardly probable[19]. According to the latest forecast (*Lutz, Meyer, Schnur, Zika 2002*) employment in Germany will increase by only 1.1% by 2010. For East Germany a further (continued) decrease in employment is rather likely[20].

The expected losses in the East correspond with a share increase in the West which amounts to +2.3%. Figure 5 shows only a few regions (Bremerhaven and Southwest Schleswig-Holstein, parts of the Ruhr Area and Eastern Lower Saxony as well as Oberfranken-East), which are expected to have a (for the most part slight) under-average development. At first glance, this result appears quite favorable for some regions in West Germany which are traditionally regarded as weak economies. Eventually, the favorable perspective is not the least due to the expected decrease in the East. Indeed, taking the average of West-Germany as basis, the growth rate differences vary between +7.9% (Landshut) and –4.5 (Oberfranken-East) und -3.0% (Bochum/Hagen).

Figure 7: Regional Employment Development 1976 - 2010

Change of total employment, related to federal average

˜ Change of share of national employment



Sources: Statistical Offices; own estimations

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19 See for example *Lutz, Meyer, Schnur, Zika (2002)* or *Fuchs, Schnur, Walwei, Zika (1998).*

20 Interestingly *Lutz, Meyer, Schnur, Zika (2002)* project a much smaller share loss for Eastern Germany than this forecast; see table 2 in their publication. Apart from the different forecast approaches a possible cause might be that they project an overall employment *increase* for

The last forecasts already indicated that the South-North-decline which had been discussed intensively at the end of the 80s has weakened significantly. Some differences are still visible, especially the former border areas in the North do not show much growth while Baden-Württemberg and Bavaria may expect a stable over-average development. In general, however, the northern half of West Germany is characterized by a belt of strongly growing growth regions, which reaches from Paderborn and Münster over Osnabrück to the southern environs of Hamburg. In the South, exceptional growth rates are expected for the regions between Munich, Regensburg and Landshut.

Other main tendencies of the spatial structural change become visible when the results are differentiated according the agglomeration structure. For the sake of simplicity, we may classify the districts in four spatial categories according to their centrality. On the one hand, we have centers the main agglomerations of Germany which are further divided in center and ring. From the other part of Germany, we select those regions which can be classified as peripheral because of their low accessibility and density. The remainder part of Germany (as third category between peripheral regions and agglomerations rings) is a more mixed group of various which are neither peripheral nor the do belong to a larger agglomeration. Here, we call this category as "less congested areas".

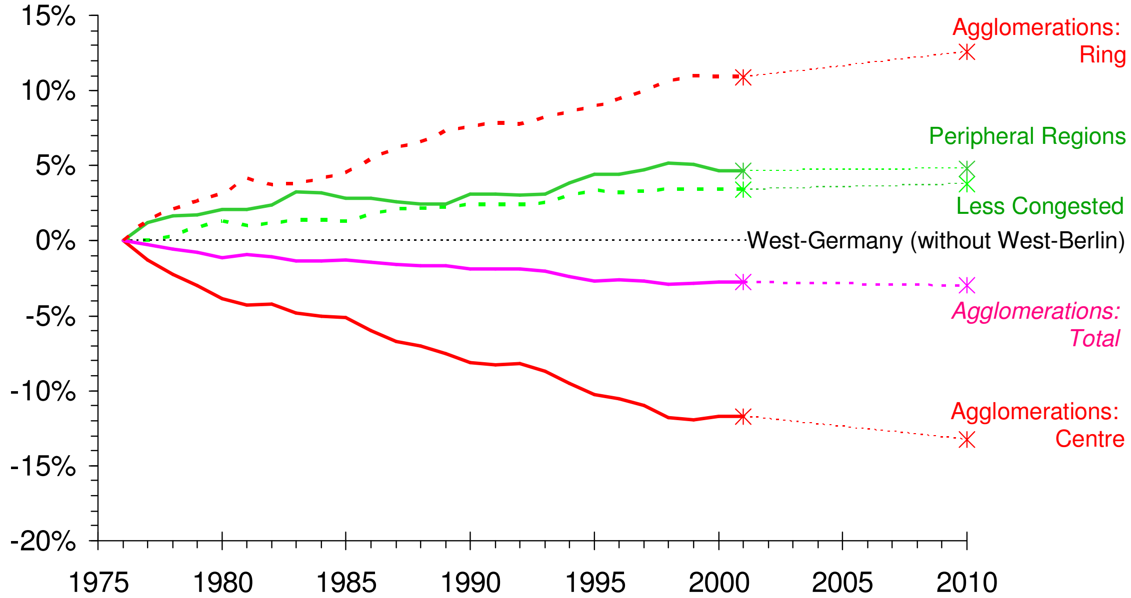
At first glance figure 1 might imply a turning away from the spatial deconcentration characterizing the change of spatial structure of Germany in the past. This change of direction is discussed in literature under the keyword „urban revival"[21]. However, the figure reveals too that change of deconcentration is tied up with the reunification of Germany. The following figure 2 therefore focuses exclusively on the West Germany (without West-Berlin) with its average as standard of comparison.

Berlin of 4.5% and a share increase of 3.4%. Based on the analysis used here this development (for Berlin) can be excluded with high plausibility.

21 Lately for example Geppert, Gornig (2003).

Figure 8: Regional Employment Development in West Germany 1976 - 2010

Change of total employment, related to federal average
˜ Change of share of national employment



Sources: Statistical Offices; own estimations

Evidently, the process of deconcentration is still going on although we observe a slowing down. According to the forecasts, spatial deconcentration will continue in the West, most strongly by suburbanization and somewhat reduced by the gains of peripheral areas (+0.2% versus +0.8% from 1992 up until now).

The average forecast for the West German agglomerations is not necessarily typical for each agglomeration since the overall results are dominated by the size of the Ruhr Area and its losses. Actually, winners and losers are about even in numbers. At the top is the agglomeration of Munich (with +3.4% in comparison to West Germany and +5.8% in comparison to total Germany) as well as Karlsruhe (+2.1% resp. +4.4%). The largest loss is expected for Wuppertal-Hagen (-5.4%, West resp. -3.2%), followed by the Ruhr Area (-3.4% resp. -1.2%). Even if the eastern states are included in the data pool, these two agglomerations (as the only ones within West Germany) have to expect a growth rate below the federal average.

In East Germany instead, the tendencies of spatial structural change are turned upside down: Favorable chances are seen for the agglomerations while “favorable” means a relatively small share loss compared to the total average of Germany. This is caused mostly by Berlin which is – as mentioned above – expected to have a share loss of 5% and dominates the average of all Eastern agglomeration centers by its size.

Especially interesting is the development in the rings of Eastern agglomerations. According to table 2 they performed much better than the agglomeration centers, they could even surpass the national average. In fact, the suburbs of Leipzig even exceed the average growth of all agglomeration suburbs in West Germany (s. Table 4). In the last years however, their perspective has seriously worsened: Since the mid 90s the loss of employment has increased seriously so much that we have to expect a continuation of that process for the next years.

Table 4: Employment Change by Spatial Types of Area1992 – 2001 - 2010

	Development 1992 - 2001						Forecast 2010			
	West Germany			East Germany			Fed. Share in %		Change	
	1992	2001	Change	1992	2001	Change	West	East	West	East
Total	79.0	80.3	+1.7%	21.0	19.7	-6.2%	82.1	17.9	+2.3%	-9.2%
Agglomerations	43.5	43.9	+1.0%	10.2	9.7	-4.4%	44.9	9.0	+2.1%	-6.8%
- Centers	23.2	22.8	-1.9%	6.5	6.0	-7.7%	23.0	5.7	+0.7%	-5.7%
- Rings	20.2	21.1	+4.3%	3.7	3.7	+1.3%	21.9	3.4	+3.7%	-8.7%
Non Agglomeration Areas	35.5	36.4	+2.5%	10.8	10.0	-7.9%	37.3	8.8	+2.4%	-11.6%
- Less Congested Regions	25.3	25.9	+2.2%	6.0	5.5	-7.5%	26.6	4.9	+2.5%	-10.2%
- Peripheral Regions	10.2	10.5	+3.0%	4.9	4.5	-8.3%	10.7	3.9	+2.2%	-13.4%

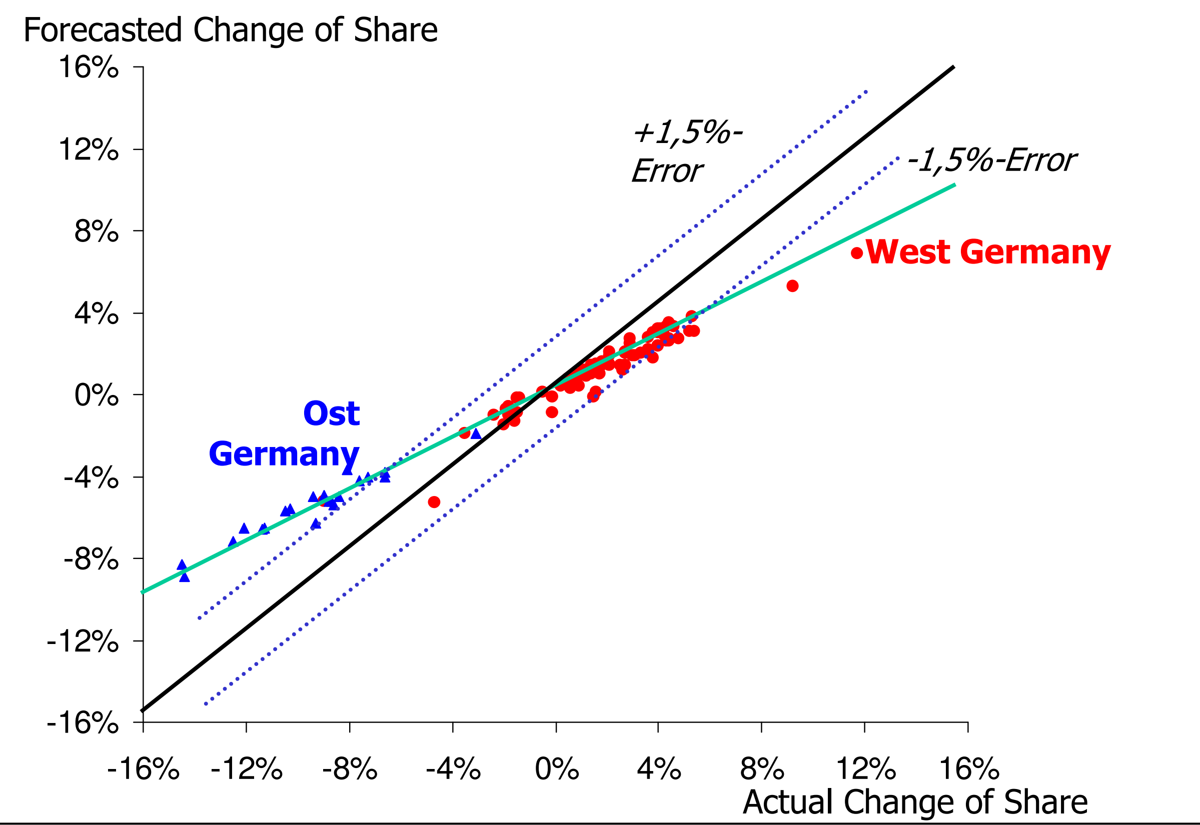
Sources: Statistical Offices; own estimations

The worse perspective among all types of areas is for the peripheral regions of East Germany, their share is expected to decrease by -13.4%. Compared to the agglomeration rings, this loss does not surprise so much, since most of the peripheral regions already suffered a large decrease in the 90s (-8.3%).

4 Forecast Errors

Although forecaster may have a principal right to be wrong (*Tietzel 1989)*, it is out of question that the precision of previous forecasts is an essential precondition for the credibility of a new forecast. Finally, despite all efforts to achieve a consistent forecasting methodology, the success of a forecast is measured by the match with the actual change rates. Since the forecasting methods have been applied several times in the past, the previous forecasts offer an opportunity for an ex-post control.

Figure 9: Forecasted and Actual Change Rates 1997 to 2001



Source: Bade (1999); Statistical Offices; own estimations

In figure 4 the change rates which were estimated in the 2004 forecast are compared to the actual changes until 2001[22]. Every point marks one of the 97 planning regions differentiated between East and West Germany. Evidently, there is a very close correlation between the estimated and actual change; consequently, the regional hierarchy of growth rates are captured quite well by the forecasts.

Less satisfactory is the frequency of forecast errors: calculating a regression between forecasted and actual change rates – which is sometimes called Mincer-Zarnowitz-Regression[23] –the square of correlation (r^2=.98) as well as the intercept (α=0,001) is quite close to the optimal value. However, the gradient of β=0,60 is pretty far from the optimal value of β=1 which would imply a perfect concurrence of forecast and actual values.

By the 1.5%-error interval for each forecast figure 4 reveals two main reasons for the forecast errors. While in the mid-range the change rates differ from the actual changes by less than |1.5%| the errors continuously increase in the lower range. More concretely, the employment growth of East Germany had been estimated far too optimistically. The recovering tendencies until the mid-90s were actually not con-

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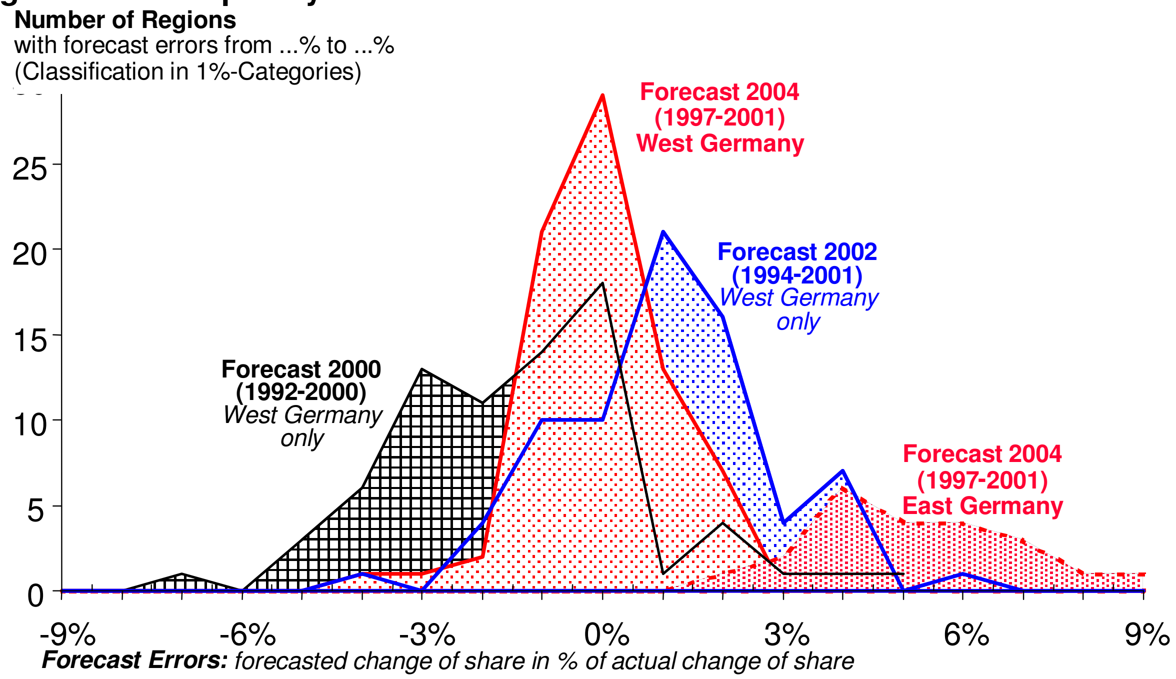
22 The estimated share for 2001 was calculated by a linear interpolation between the base year 1997 and the forecast for 2004.

23 See for example: Weidmann (2002:744).

tinued but turned down in the reverse direction, instead. The decline was so drastic that many regions are now below the initial level of the beginning of the 90s (not taking account the transformation losses from 1989 to 1992!).

The second reason can be observed in both parts of Germany: the stronger the absolute value of the actual change rate, the higher is the forecast error what can be observed for instance for the two outlayers Ingolstadt and Munich in West Germany. This regularity as source of error has already been identified in the previous forecast and will presumably be avoided in the future: Actually, for both regions the highest increase (of all regions) had been forecasted, but, nevertheless, the prognosis was too “careful”. The explanation lies in some more or less obvious psychological limits: Normally the attitude prevails to rather underestimate the speed of changes than to overestimate it. Extreme changes in the future are estimated as being less plausible, thus they are checked once again and in most cases corrected (not the least in the consistence check as mentioned above).

Figure 10: Frequency of Forecast Errors



Sources: Bade (1994);Bade (1996);Bade (1999);Statistical Offices; own estimations

The underestimation of the East German decline can also be observed in figure 5 showing the frequency of forecast errors. Here, the Eastern regions are found in the positive field (overestimation) and range from 1.2% (South Thuringia) to 8.4% (Lausitz-Spreewald). Figure 5 also shows the error frequency in previous forecasts 1994 - 2002[24] and 1992 - 2000, that are exclusively covering West Germany. Evidently, at least for West Germany, the precision of the forecast has been improved from forecast to forecast: the marked areas are not only getting slimmer, but are also concentrated more around zero.

24 The estimated share for 2001 was calculated by a linear interpolation between the base year 1994 and the forecast for 2004.

Finally, the improvement of the error frequency (for West Germany) can be shown by the mean forecast error (MAPE), the mean of all absolute percentage errors[25]: for the 1992-2000 forecast the mean lies at 1.7%, for 1994-2001 at 1.4% and for 1997-2001 a 1.0% (West Germany only).

Comparing these errors with other economic forecasts has only limited significance since the forecasting conditions (as well as the expectations of precision) vary a lot depending on the economic areas. One possibility to consider the different difficulties of forecasting is to take into account the variance of the actual change rates – following the idea of the so-called "Theil Projection Coefficient" (*Andres, Spiwoks 1999)*. The "standardized forecasting error" for the forecasts presented here has a value around 30 which is much below the values (65 and more) *Grömling (2002:9, table 2)* or *Hinze (1996:75, table 6)* calculated for short-term forecasts of business cycles.

25 $\mathrm{MAPE} = \frac{1}{n}\sum_{i=1}^{n} \hat{e}_i \text{ with } \hat{e} = (\hat{r} - r)/r.$

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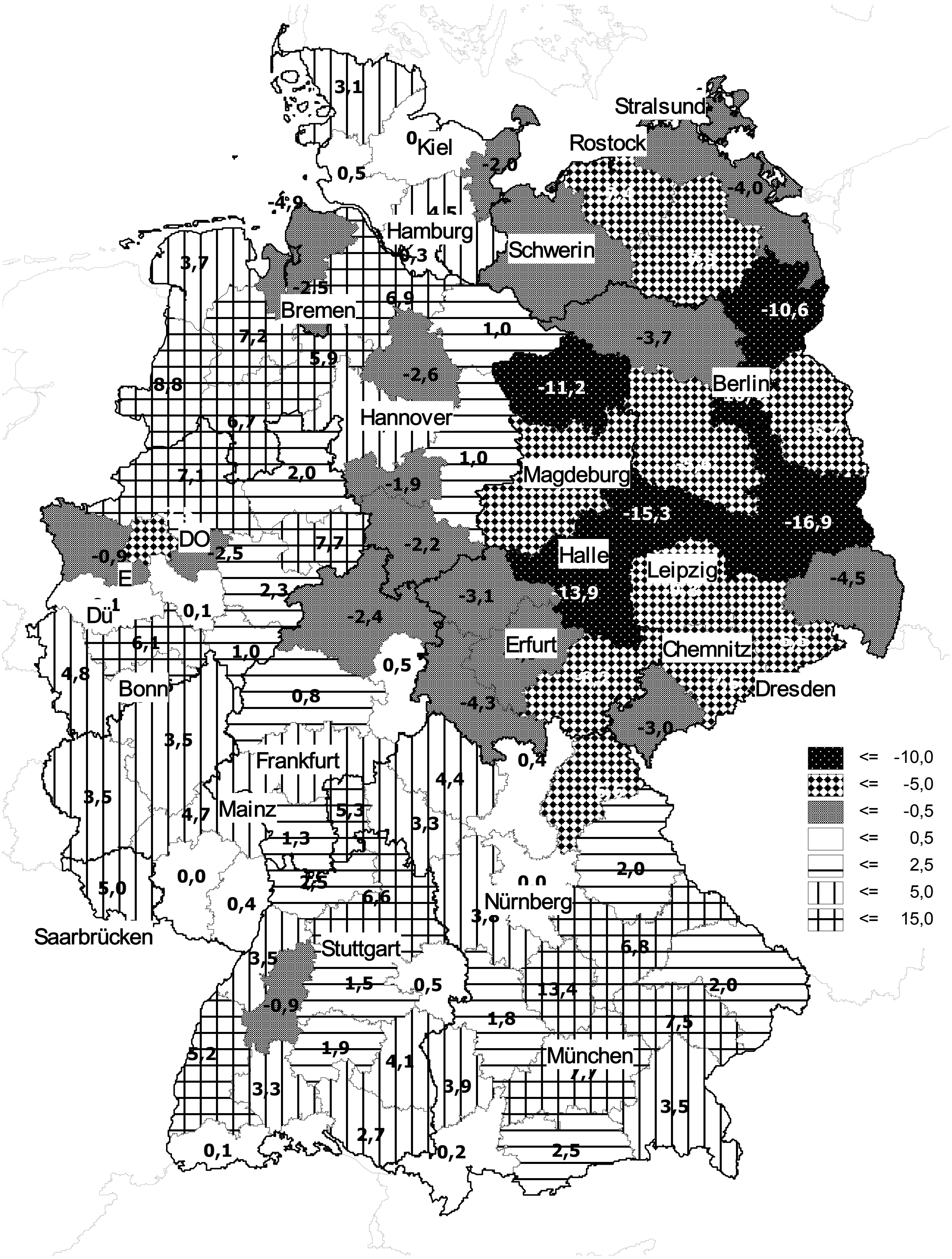
Appendix

Employment Change 1994 to 2001: Planning Regions

- Regional Change Rate 1994 to 2001, related to the Federal Average, in % -



VII A Two-Step Approach for Regional Medium-Term Skill Needs Forecasting

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1 Introduction

High dynamism of modern economic systems, due to free movement of capital, international competition, new information technologies, transition from an industrial economy to one based on services (Castells, 2002), has extremely transformed labour markets. During a conference taken on February 28th, 1998 which was entitled "New labour scenarios: which role for the person?", Marco Martini[1] identified in advance a crucial problem of modern labour markets, i.e the research of an equilibrium between two different tendencies: the need of secure employment and the high number of transitions.

In the past, secure employment depended on organization stability, and, moreover, the worker usually developed his/her career within the same organization or, at least, within the same economic sector. Nowadays, a "linear career path" has been substituted by a "multidirectional career path" (Baruch, 2003), which consists of a high number of transitions along different organizations and economic sectors, different types of contracts, and also different duties. "In the past, people expected to serve their organization for their entire working life. Even if this was not the actual case, this was the desirable development. Now people expect the organization to serve them, and the time span for the relationship to last could be easily reduced to very few years" (Baruch, 2003).

A recent research (Mezzanzanica and Lovaglio, 2008), carried out on data extracted from the labour market (LM) data-warehouse for the Province of Milan[2], confirms the tendency of an increasing job mobility; moreover, the research reveals that education, training and lifelong learning are the main variables which positively influence the improvement of the career. This suggests the introduction of new labour market policies oriented to the development of the human capital, such as training and retraining activities, vocational guidance and job placement. "From the organizational point of view it is mostly moving from offering careers of secure employment for all, to opportunities for development" (Baruch, 2003).

Within the dynamic nature of modern labour markets, regional policy makers require instruments which, given the data at disposal, enable to get a deeper knowledge of the different scenarios and measure their evolution. Various attempts have been made in order to construct skill needs forecasting systems at both European (Cedefop, 2008), national (Neugart and Schömann, 2002) and regional level (Crass *et al.*, 2007). Many are also the statistical methodologies proposed for national employment forecasting (Pfann, 2001; Shoesmith, 2005; Wong *et al.*, 2005; Rapach and Strauss, 2008) and regional employment

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[1] Marco Martini was Full Professor of Economic Statistics at the University of Milano-Bicocca. His research was especially devoted to labour market. He died before his time on 4th October, 2002.

[2] The LM data-warehouse for the Province of Milan has been developing within a research project of the Department of Statistics at the University of Milano-Bicocca, co-ordinated by B. Zavanella (Full Professor of Economic Statistics) and M. Mezzanzanica (Associate Professor of Informatics). At the moment, the LM data-warehouse consists of two data-bases obtained from a deterministic linkage of different administrative archives: the Public Employment Services (PES) data-base and the Internal Revenue Service (IRS) data-base.

forecasting (Sarantis and Swales, 1999; Blien and Tassinopoulos, 2001; Mayor *et al.*, 2007).

At the moment, we are working to the construction of a permanent labour market observatory-system in Lombardy Region consisting of: 1) a regional information system based on the integration of different data sources, like the LM data-warehouse; 2) a two-step methodological approach based on the combination of Martini-Pasinetti's model (which enables to interpret and anticipate the dynamics of regional employment at sector level) and time-series forecasting models (in order to forecast regional skill needs at sector level).

The paper is organized as follows. Section 2 illustrates the two-step methodological approach proposed. Section 3 describes the data involved in a recent study regarding the Milan area (corresponding to around the 50% of the labour market in Lombardy region) and an example of the main results on two sectors of interest. Section 4 gives some conclusions and future developments.

2 A Two-Step Approach for Regional Medium-Term Skill Needs Forecasting

2.1 The Martini-Pasinetti's Model

In the late '90s Marco Martini had the idea to employ Pasinetti's (1993) model of structural dynamics[3] as a descriptive and interpretative instrument of the labour market at sector level (for this reason we will refer to Martini-Pasinetti's model).

The equilibrium solution of the model in question implies, in fact, that the dynamics of the sector-specific employment rate can be decomposed through joint dynamics of the amount of labour used for the production and the amount of demand, that is

$$e_i\,(t) = c_i(t)\cdot l_i(t), \qquad (2.1)$$

where $e_i(t)$ is the employment rate of sector i (i = 1,…, n) at time t (t = 1,…,T), $c_i(t)$ is the per-capita demand coefficient at time t (t = 1,…,T), representing the demand of the physical output produced in each sector i at time t divided by the size of the population at time t, while $l_i(t)$ is the labour coefficient of sector i (i = 1,…, n) at time t (t = 1,…,T), representing the number of units of labour required to produce one unit of output in sector i at time t and is determined by technology (for a detailed explanation please see Pasinetti, 1993).

Moreover, the dynamics of overall system employment rate can be interpreted by means of the sector-specific employment rates, since:

$$e(t) = \sum_{j=1}^{n} e_j(t) = \sum_{j=1}^{n} c_j(t)\cdot l_j(t)\,. \qquad (2.2)$$

In particular, the dynamics of overall system employment rate can be expressed by the corresponding index number (i.e the ratio between time t and time t_0):

$$\frac{e(t)}{e(t_0)} = \sum_{j=1}^{n} c_j(t)\cdot l_j(t) \Big/ \sum_{j=1}^{n} c_j(t_0)\cdot l_j(t_0)\,. \qquad (2.3)$$

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[3] Here you will refer to a simplified version of the model, based on the assumption that the production is carried out work alone, without the use of any intermediate goods production; it can be shown that this simplification does not affect the results but aims to highlight the structural dynamics considered.

Therefore, the dynamics of overall system employment rate is determined by the composition of the different dynamics that characterize the employment rates of specific sectors; in other words, the dynamics of the system is a "structural dynamics", namely determined by the changes in its structure.

In fact, the increase in demand coefficients, causing an increase in production, affect in a positive way employment, raising employment rates; while the decrease in demand coefficients cause the decrease of employment. In contrast, when new products are introduced, with new methods of production for which productivity is still relatively low, the labour coefficients increase and this has a positive impact on employment; alternatively, when productivity increases and labour coefficients decrease, it is needed less work to get the same amount of product, and this has a negative impact on employment rates, causing their decrease.

Therefore, Pasinetti's results allow us to measure and interpret the dynamics of employment rate, providing simple and intuitive indicators on the demand for labour mobility, which is needed to support the development of the system and maintenance (or improvement) of the overall system employment rate. In fact, we can have three different situations:

a) The sector-specific employment rates $e_i(t)$ remain constant if:

1) the labour and demand coefficients remain constant;

2) the labour and demand coefficients move with a dynamic which is exactly reverse and hence the increased demand exactly offsets the reduction of labour coefficients: $\frac{c(t)}{c(t_0)} = \left[\frac{l(t)}{l(t_0)}\right]^{-1}$.

b) The sector-specific employment rates $e_i(t)$ increase if:

1) the demand coefficients increase at a rate greater than that with which the labour coefficients decrease (this is the best case, which indicates an area in good shape, with expanding productivity and demand);

2) the two coefficients increase both (case shortly frequent, indicating a booming business which has recently innovated products or needs to rationalise because wasting resources);

3) the labour coefficients increase at a rate greater than that at which the demand coefficients decrease (rare and unusual case, which indicates a very problematic sector, with demand falling).

c) The sector-specific employment rates $e_i(t)$ decrease if:

1) the labour and demand coefficients decrease both (this is an area intending to decline, because demand is not interested in greater production which would be possible due to the increase in productivity);

2) the demand coefficients increase at a rate less than that with which the reciprocal of labour coefficients reduce (often the case, which indicates an area with potential for growth, which would need interventions in support of demand);

3) the demand coefficients decrease at a rate greater than that which the reciprocal of labour coefficients increase (indicating an area in great suffering).

Despite its potentiality in interpretation, Pasinetti's model of structural dynamics has been scarcely applied, because suitable data are very difficult detectable in reality. The only known attempts for adapting the model to real data from national economic accounts have been made by Zavanella (2004), Hölzl and Reinstaller (2007) and Zavanella and Minotti (2008) (see Section 3.1.1).

2.2 Time-Series Forecasting Models

Traditionally, economic forecasts were based on large scale econometric models, usually managed by central banks. The informative content of these huge econometric models is relevant for the evaluation of fiscal and monetary policies, but the forecasting experience of the last thirty years has shown that smaller models have usually better performances when the goal is predicting time series. Indeed, univariate or small multivariate models have shown to be much more effective at this goal. The motivations may be ascribed to the excessive parameterization of large scale multivariate models that implies a high volatility of the estimates and the modelling of noise instead of valuable information. In statistics this problem is sometimes referred to as the *curse of dimensionality*.

Although a recent literature on dynamic factor models is trying to deal with the curse of dimensionality by an efficient extraction of information from large datasets with a relatively parsimonious parameterization (see the survey article by Stock and Watson, 2006), in this work we will stick to small scale models. Particularly, we will compare the forecasting performance of classes of classic models as ARIMA and VAR/VECM to the less popular class of *unobserved components models* (UCM), also referred to as Structural Time Series Models (STSM) (refer to Harvey, 1989 and Durbin and Koopman, 2001 for thorough treatments and to Commandeur and Koopman, 2007 for an introduction).

2.2.1 ARIMA and VAR/VECM models

After the popular book by Box and Jenkins, whose first edition was published in the year 1970, the *autoregressive integrated moving average* (ARIMA) class of models seemed to be the panacea for all the forecasters. The Box-Jenkins methodology requires competent analysts that in a craftsman-like manner try to build the ARIMA model that seems to best approximate the data generation mechanism. In the Box-Jenkins methodology data are let "speak" and no other information is exploited. This strategy may be winning when the time series are long and time-homogeneous, but situations, as ours, in which few years of observations are available, finding and estimating a "good" model could be a problem.

The popularity of ARIMA processes among practitioners is also supported by a theoretical result known as Wold's theorem. This theorem states that any (non-deterministic weakly) stationary process may be well approximated by a finite order ARMA process. Weak stationarity is a homogeneity property which requires the first two moment of a process to be time-invariant: a random sequence Y_t is weakly stationary if for all t

$$\mathrm{E}(Y_t) = \mu,$$
$$\mathrm{Cov}(Y_t, Y_{t-k}) = \gamma(k).$$

Since real economic time series usually show trends, seasonality and heteroscedasticity, they do not meet the stationarity property, but some transformations of them may seem reasonably stationary. Logarithms are often used as variance stabilizing transforms, but, for making the long run mean of a time series constant, differences are in general the right tool. The difference operator Δ is defined as the operator that transforms a time series into its increments: $\Delta Y_t = Y_t - Y_{t-1}$. Usually no more the two applications of the difference operator are necessary, and, when the series shows seasonality, the seasonal difference operator can take care both of trends and seasonal variations at ones: $\Delta_s Y_t = Y_t - Y_{t-s}$, where *s* is the seasonal period (e.g. 12 for monthly data, 4 for quarterly data). A process which is stationary after *d* differences is said to be *integrated of order d*, and is usually indicated with the notation $Y_t \sim \mathrm{I}(d)$.

The simplest version of a *stationary ARMA* process Y_t, the ARMA(p,q), is defined by the difference equation

$$Y_t = \kappa + \phi_1 Y_{t-1} + \ldots + \phi_p Y_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \ldots + \theta_q Y_{t-q}, \qquad (2.4)$$

with ε_t zero-mean independent identically distributed (i.i.d.) random sequence. The coefficients are constrained to guarantee the stationarity of the process. An ARIMA(p,d,q) process is a process that is stationary ARMA(p,q) after *d* applications of the difference operator defined above.

An ARIMA process may be generalized to a *seasonal ARIMA* (sometimes SARIMA) in order to model seasonal features (within-year periodicities) of the data. The theory and the application of ARIMA models may be found in many excellent texts, such as the original volume by Box and Jenkins or the introductory text by Brockwell and Davis (2002), the very accessible book of Chatfield (2003) or the mathematically more challenging treaties by Brockwell and Davis (1991) and Pollock (1999).

The multivariate version of the ARMA family is the vector ARMA class (VARMA), but due to the excessive number of parameters in these models and to identification problems, in most applications only the sub-class of VAR processes is taken into consideration. A VAR(*p*) process $\mathbf{y}_t$ is defined by

$$\mathbf{y}_t = \mathbf{k} + \mathbf{A}_1 \mathbf{y}_{t-1} + \ldots + \mathbf{A}_p \mathbf{y}_{t-p} + \boldsymbol{\varepsilon}_t, \qquad (2.5)$$

where we used the convention of indicating column vectors with bold small (Latin or Greek) letters and matrices with bold capital letters. In a VAR model a time series in the vector $\mathbf{y}_t$ is let depend on its own past and on the past of all the other series. VAR models are may be seen as reduced form econometric models, where no directions in the contemporaneous causations are imposed. This may be a limitation when the goal is testing the validity of certain economic theories, but it is irrelevant in forecasting.

For inferential reasons VAR models should be estimated only on (jointly) stationary time series. As we have already mentioned, economic time series are frequently integrated of order 1, and sometimes even of order 2. So, it seems intuitive to use VAR models on differences of the original series. However, if the series in the vector $\mathbf{y}_t$ share common trends they are said *cointegrated*, and estimating a VAR on difference is sub-optimal, especially when mid- and long- range forecasts are concerned (Engle and Granger, 1987). Suppose that all the series in the vector $\mathbf{y}_t$ are integrated of order 1. If there exists at least one vector of real coefficients $\boldsymbol{\beta}_1$ such that the linear combination $\boldsymbol{\beta}_1' \mathbf{y}_t$ is a stationary sequence, then the series are said *cointegrated*. Suppose now that $\mathbf{y}_t$ is a $n \times 1$ vector; if *r* is the maximum number of linearly independent vectors $\boldsymbol{\beta}_1, \ldots, \boldsymbol{\beta}_r$ such that $\boldsymbol{\beta}_1' \mathbf{y}_t, \ldots, \boldsymbol{\beta}_r' \mathbf{y}_t$ are all stationary sequences, then the time series in $\mathbf{y}_t$ are said *cointegrated of order r*. An intuitive way of reading cointegration is by common trends: if the series in $\mathbf{y}_t$ are all I(1), but cointegrated of order r, then there are only $n-r$ integrated processes driving all the n time series. Since the series $\boldsymbol{\beta}_1'\mathbf{y}_t,\ldots,\boldsymbol{\beta}_r'\mathbf{y}_t$ are stationary, than the series in $\mathbf{y}_t$ cannot deviate for a long time from the relations implied by the cointegrating vector $\boldsymbol{\beta}_1,\ldots,\boldsymbol{\beta}_r$.

When the vector $\mathbf{y}_t$ is composed by integrated processes, the first thing to do is testing for the number of cointegrating relations through some tests such as Johansen's (1995). If no cointegration is found, then a VAR model on the differences of the series is estimated. If $0<r<n$ is the number of independent cointegrating vectors (cointegration rank), these are imposed through the vector error correction mechanism (VECM, sometimes VEqCM for equilibrium correction), which is equivalent to a VAR with cointegration rank constrains on the coefficients:

$$\Delta\mathbf{y}_t = \mathbf{AB}'\mathbf{y}_{t-1} + \boldsymbol{\Gamma}_1\Delta\mathbf{y}_{t-1} + \ldots + \boldsymbol{\Gamma}_{p-1}\Delta\mathbf{y}_{t-p+1}, \tag{2.6}$$

where $\mathbf{B}=[\boldsymbol{\beta}_1,\ldots,\boldsymbol{\beta}_r]$ is a $n\times r$ matrix containing the cointegrating vectors, $\mathbf{A}$ is a $n\times r$ matrix which contains coefficients related to the speed of adjustments of each series to disequilibria with respect to each cointegrating relation.

The theory and practice of VAR, cointegration and VECM models may be found in the texts such as Hamiton (1994), Lütkepohl (2005), Juselius (2007) or in the more formal treaty by Johansen (1995).

2.2.2 Unobserved Components Models

While in the ARMA world data are let speak and no particular structure is imposed, in an *unobserved component model* (UCM), a (possibly vector valued) time series is additively decomposed into components such as *trend*, *cycle*, *seasonality* and *noise*. Every component is specified as a stochastic version of deterministic functions of time, and the deterministic component may be seen as a special case of the stochastic one. For example, the trend is modelled as a stochastically evolving linear function of time, the cycle as a stochastically evolving sinusoid while the seasonality is obtained as sum of different stochastic cycles at predetermined (seasonal) frequencies.

2.2.3 Univariate UCM

Let y_t be the time series we want to forecast. The time series is decomposed into four components (not all the components need to be present in the model):

$$y_t = \mu_t + \psi_t + \gamma_t + \varepsilon_t, \tag{2.7}$$

where μ_t is the trend, ψ_t is the cycle, γ_t is the seasonality and $\varepsilon_t \sim \text{NID}(0,\sigma_\varepsilon^2)$, with NID indicating a sequence of independent normally distributed random variables with specified mean and variance.

The trend component is usually specified as a *local linear trend*:

$$\begin{aligned} \mu_t &= \mu_{t-1} + \beta_{t-1} + \eta_t, & \eta_t &\sim \text{NID}(0,\sigma_\eta^2),\\ \beta_t &= \beta_{t-1} + \zeta_t, & \zeta_t &\sim \text{NID}(0,\sigma_\zeta^2). \end{aligned} \tag{2.8}$$

Since every linear function $m(t)=a+bt$ with $t\in\mathbb{Z}$ (integer numbers) may be written as difference equation as

$$
\begin{aligned}
m(t) &= m(t-1) + b(t-1) \\
b(t) &= b(t-1)
\end{aligned}
$$

with initial conditions $m(0) = a$ and $b(0) = b$, the local linear trend (2.8) is a stochastic version of it with a disturbance added to the intercept (first equation) and a disturbance added to the slope (second equation). The local linear trend embeds many possible typical specifications of a trend, which are listed in Table 1.

Table 1: Trends embedded in the local linear trend.

σ_η^2	σ_ζ^2	β_0	Order of integration	Process type
$=0$	$=0$	$=0$	0	No trend, the mean is α_0
$=0$	$=0$	$\neq 0$	0	Deterministic linear trend with intercept α_0 and slope β_0
$\neq 0$	$=0$	$=0$	1	Random walk
$\neq 0$	$=0$	$\neq 0$	1	Random walk with drift β_0
$=0$	$\neq 0$	any	2	Integrated random walk (very smooth trend)
$\neq 0$	$\neq 0$	any	2	Local linear trend

The cycle component is defined by the element ψ_t in the difference equation

$$
\begin{bmatrix} \psi_t \\ \psi_t^* \end{bmatrix} = \rho \begin{bmatrix} \cos\lambda & \sin\lambda \\ -\sin\lambda & \cos\lambda \end{bmatrix} \begin{bmatrix} \psi_{t-1} \\ \psi_{t-1}^* \end{bmatrix} + \begin{bmatrix} \kappa_t \\ \kappa_t^* \end{bmatrix}. \tag{2.9}
$$

where

$$
\begin{bmatrix} \kappa_t \\ \kappa_t^* \end{bmatrix} \square \, \mathrm{NID}\left(\mathbf{0}, \mathbf{I}\sigma_\kappa^2\right),
$$

and **I** is an identity matrix.

The cycle is the stochastic version of a sinusoid of the type $s(t) = a\cos(\lambda t) + b\sin(\lambda t)$ with t integer. In fact, using trigonometric identities or geometric arguments it straightforward to check that $s(t)$ may be written in difference equation form as

$$
\begin{bmatrix} s(t) \\ s^*(t) \end{bmatrix} = \begin{bmatrix} \cos\lambda & \sin\lambda \\ -\sin\lambda & \cos\lambda \end{bmatrix} \begin{bmatrix} s(t-1) \\ s^*(t-1) \end{bmatrix},
$$

with $s(0) = a$ and $s^*(0) = b$. If we add independent disturbances to each equation we let the phase and the amplitude of the sinusoid vary randomly, getting a non-stationary stochastic cycle. Since business cycles are generally held stationary, we may achieve this properties by constraining the parameter ρ in equation (2.9) to lay in the open interval $(0,1)$. The frequency of the cycle is λ and the period is given by $2\pi/\lambda$.

A deterministic seasonal component may be defined as a periodic function $g : \square \mapsto \square$ of period s whose sum over s consecutive periods is zero. In formulas, for all t

$$
\begin{aligned}
& g(t) = g(t+s), \\
& \sum_{i=0}^{s-1} g(t+i) = 0.
\end{aligned}
$$

Such a function has a representation as linear combination of sinusoids at the Fourier frequencies $\lambda_j = j2\pi/s$ for $j = 1,\dots,\lfloor s/2 \rfloor$, where $\lfloor x \rfloor$ denotes the greatest integer not larger than *x*:

$$g(t) = \sum_{j=1}^{\lfloor s/2 \rfloor} a_j \cos(\lambda_j t) + b_j \sin(\lambda_j t). \tag{2.10}$$

We have already seen how to turn sinusoids into stochastic cycles, thus we can build a stochastic version of the seasonal component, which in economic time series is a non-stationary component:

$$\begin{aligned} \gamma_t &= \sum_{j=1}^{\lfloor s/2 \rfloor} \gamma_{j,t}, \\ \begin{bmatrix} \gamma_{j,t} \\ \gamma_{j,t}^* \end{bmatrix} &= \begin{bmatrix} \cos\lambda_j & \sin\lambda_j \\ -\sin\lambda_j & \cos\lambda_j \end{bmatrix} \begin{bmatrix} \gamma_{j,t-1} \\ \gamma_{j,t-1}^* \end{bmatrix} + \begin{bmatrix} \xi_t \\ \xi_t^* \end{bmatrix} \end{aligned} \tag{2.11}$$

with $j = 1,2,\dots,\lfloor s/2 \rfloor$, and ξ_t and ξ_t^* independent normally distributed sequences of random disturbances with common variance σ_ξ^2. The stochastic seasonal component does not sum to zero over *s* periods, but the expectation of that sum is zero:

$$\mathrm{E}\left[\sum_{i=0}^{s-1} \gamma_{t-i}\right] = 0$$

for all *t*. This way the seasonal component may change over time and the speed of its evolution depends on the magnitude of the variance σ_ξ^2.

The model may be easily cast in state-space form and the unknown parameters and unobserved components estimated through the joint use of Kalman filtering and numerical maximum likelihood (Harvey, 1989; Durbin and Koopman, 2001).

2.2.4 Multivariate UCM

When the analyst believes that there may be interaction among a number of time series, the multivariate version of unobserved components model may be employed. The extension of the univariate UCM to multivariate is straightforward from a theoretical point of view, even though computational problems may arise when too many time series are simultaneously modelled.

Suppose that the $\mathbf{y}_t$ is an observable *n*-vector valued time series. The observation equations are

$$\mathbf{y}_t = \boldsymbol{\mu}_t + \boldsymbol{\psi}_t + \boldsymbol{\gamma}_t + \boldsymbol{\varepsilon}_t \tag{2.12}$$

where $\boldsymbol{\mu}_t$, $\boldsymbol{\psi}_t$ and $\boldsymbol{\gamma}_t$ are *n*-dimensional unobserved components representing, respectively, the trends, the cycles and the seasonalities, while $\boldsymbol{\varepsilon}_t \sim \mathrm{NID}(\mathbf{0}, \boldsymbol{\Sigma}_\varepsilon)$.

The trend components are defined by

$$\begin{aligned} \boldsymbol{\mu}_t &= \boldsymbol{\mu}_{t-1} + \boldsymbol{\beta}_{t-1} + \boldsymbol{\eta}_t \\ \boldsymbol{\beta}_t &= \boldsymbol{\beta}_{t-1} + \boldsymbol{\zeta}_t \end{aligned} \tag{2.13}$$

where the disturbances $\boldsymbol{\eta}_t$ and $\boldsymbol{\zeta}_t$ are serially and mutually independent, normally distributed with covariance matrices, respectively, $\boldsymbol{\Sigma}_\eta$ and $\boldsymbol{\Sigma}_\zeta$.

In order to reduce the number of parameters in a meaningful way business cycles are modelled through *similar cycles*, that is, stochastic cycles that share the same damping factor ρ and the same frequency λ:

$$\begin{aligned}\boldsymbol{\psi}_t &= \rho\cos\lambda\cdot\boldsymbol{\psi}_{t-1} + \rho\sin\lambda\cdot\boldsymbol{\psi}^*_{t-1} + \boldsymbol{\kappa}_t \\ \boldsymbol{\psi}^*_t &= -\rho\sin\lambda\cdot\boldsymbol{\psi}_{t-1} + \rho\cos\lambda\cdot\boldsymbol{\psi}^*_{t-1} + \boldsymbol{\kappa}^*_t\end{aligned} \tag{2.14}$$

where $\boldsymbol{\kappa}_t$ and $\boldsymbol{\kappa}^*_t$ are sequences of independent and normally distributed random n-vectors with common covariance matrix $\boldsymbol{\Sigma}_\kappa$.

Since the seasonal component adds many unobserved components and unknown parameters to the system, it may be opportune to work on previously seasonally-adjusted time series. However, if the system is not too big (i.e. n is not too large), then the multivariate seasonal component may be used:

$$\begin{aligned}\boldsymbol{\gamma}_t &= \sum_{j=1}^{\lfloor s/2\rfloor}\boldsymbol{\gamma}_{j,t} \\ \boldsymbol{\gamma}_{j,t} &= \cos\lambda\cdot\boldsymbol{\gamma}_{j,t-1} + \sin\lambda\cdot\boldsymbol{\gamma}^*_{j,t-1} + \boldsymbol{\xi}_{j,t} \\ \boldsymbol{\gamma}^*_{j,t} &= -\sin\lambda\cdot\boldsymbol{\gamma}_{j,t-1} + \cos\lambda\cdot\boldsymbol{\gamma}^*_{j,t-1} + \boldsymbol{\xi}^*_{j,t}\end{aligned} \tag{2.15}$$

where λ_j are, again, seasonal (Fourier) frequencies. The disturbances $\boldsymbol{\xi}_{j,t}$ and $\boldsymbol{\xi}^*_{j,t}$, for $j = 1,2\ldots,\lfloor s/2\rfloor$, are independent sequences of random n-vectors, and usually they are all assigned the same covariance matrix $\boldsymbol{\Sigma}_\xi$.

Through the rank of the covariance matrices of the disturbances, common features among the various time series may be captured. If the matrices of the trend components $\boldsymbol{\Sigma}_\eta$ and $\boldsymbol{\Sigma}_\zeta$ are not full-rank we have common trends and, thus, forms of cointegration (Engle and Granger, 1987). If $\boldsymbol{\Sigma}_\kappa$ is reduced-rank, we have common cycles. In particular, if we are modelling a pool of macroeconomic variables end $\text{rank}(\boldsymbol{\Sigma}_\kappa) = 1$, than there is one common cycle that may be easily identified as the overall business cycle.

Also for the multivariate case, the model can be cast in state-space from and the Kalman filter may be exploited for the joint estimation of unknown parameters and unobserved components.

3 An Example of Skill Needs Forecasting in the Milan Area

3.1 Martini-Pasinetti's Model Results

3.1.1 The Data

As already mentioned in Section 2.1, Pasinetti's model of structural dynamics has been scarcely applied, because suitable data are very difficult detectable in reality. Due to the absence of data at a more detailed level of territorial disaggregation[4], we refer to the proposal by Zavanella and Minotti (2008) of adapting Martini-Pasinetti's model to data from Lombardy region economic accounts (1995-2006).

The demand coefficients are approximated by the following formula:

$$\tilde{c}_i(t) = \frac{\tilde{q}_i(t)}{N(t)} = \frac{\sum_{j=1}^{m_j} p_j(95) q_j(t)}{N(t)},$$

where $\tilde{q}_i(t)$ represents the added value of sector *i* at prices of 1995 and *N(t)* represents the population. The use of $\tilde{q}_i(t)$ as an approximation of the physical quantity of sector *i* is realistic from the dynamic point of view, because the dynamics of $\tilde{q}_i(t)$ does not depend on the prices, but only on the quantity produced.

Therefore, every demand coefficient $\tilde{c}_i(t)$ indicates the impact of demand on market of sector *i*. This is consistent with the concept of demand in the version of Pasinetti's model considered, which coincides with the sole use of production, including all its destinations (final consumption, intermediate consumption and exports).

The labour coefficients are approximated by the following formula:

$$\tilde{l}_i(t) = \left(\frac{\sum_{j=1}^{m_j} p_j(95) q_j(t)}{ULA(t)} \right)^{-1},$$

which coincides with the reciprocal of productivity of sector *i* and where $ULA_i(t)$ are the units of work (i.e. 8 hours of work) employed in sector *i* (*i* = 1, …, n). Through this concept is possible to measure the volume of employment in the economy, accounting for the amount of work given by individuals in the year.

The sum over all sectors of the product of the two coefficients defines the overall employment rate:

$$\tilde{e}(t) = \sum_{j=1}^{n} \tilde{e}_j(t) = \sum_{j=1}^{n} \tilde{c}_j(t) \tilde{l}_j(t).$$

[4] An attempt of utilising the financial accountings of companies from AIDA data-base (Bureau van Dijk Edizioni Elettroniche S.p.A.) is in progress.

3.1.2 The Results

In order to illustrate the interpretability of Martini-Pasinetti's model, we present a comparison between the average dynamics of employment in Lombardy region and the dynamics of employment in the most important economic macro-sector in the Milan area, i.e. macro-sector K[5] (which includes services like real estate, leasing, information technology, research, and other business services)[6].

Indeed, in 1995 macro-sector K employed the 9.4% of the total hours worked in Lombardy region and produced the 17.2% of the total added value in the region; in 2006 total hours worked in macro-sector K reached 13.6% and the added value produced rose to 18.4%, assessed at 1995 prices, and to 23%, assessed at 2006 prices. In 2006 the macro-sector in question was, in fact, the second most important in Lombardy region (the first one is industrial activities) and the first one in the Milan area.

Figures 1 and 2 report the natural logarithm[7] of index numbers (1995 base) for employment rates $e_i(t)$, labour coefficients $l_i(t)$ and demand coefficients $c_i(t)$ for Lombardy region and macro-sector K, respectively.

Figure 1: Lombardy region – average

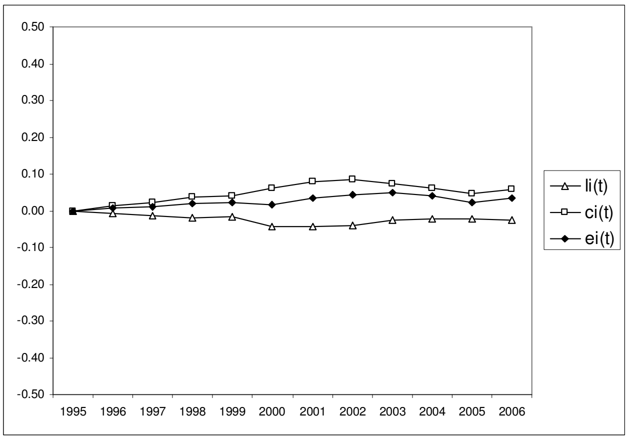
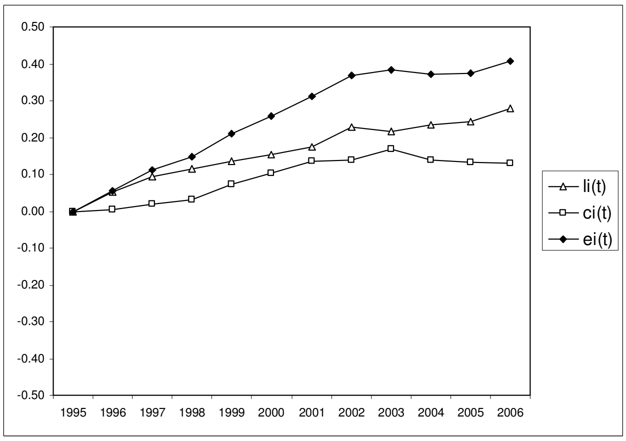


Figure 2: Lombardy region – macro-sector K



The results highlight that macro-sector K shows a different pattern with respect to the general regional context. In particular, in the period 1995-2006 the increase of the employment rates in the macro-sector K is considerable (50%), while at regional level is very low (3.4%). However, it is the composition of that growth that deserves consideration: the regional context is characterized by a slight decrease in labour coefficients (-2.5%), which is compensated by the increase of per-capita demand (6%). On the contrary, in macro-sector K occurs a significant increase in demand (14%) going to add to the increase of labour coefficients (32%). This means that productivity is in sharp decline (probably due to the continuous entering of companies in the area, typically of small size and therefore with a less efficient organization of work than large companies) with positive effects on the level of employment, but negative effects on the economic performance of the macro-sector,

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[5] ATECO classification – level I.

[6] For a complete analysis of economic sectors in Lombardy region please see Zavanella and Minotti (2008).

[7] The choice of logarithms is due to their properties to make the ratios symmetric with respect to zero.

which has declining margins. In conclusion, this area is growing, but the decline in productivity could have negative influences on its future development.

Nevertheless, it is to be noted that macro-sector K includes very different economic activities; it is high probably that the results feel the effect of real estate services. Unfortunately, the regional economic accounts data are aggregated and not enable to get a more detailed level of sector disaggregation. The data from Public Employment Services (PES) data-base, nevertheless, provide more detailed information and, therefore, can provide more precise indications on employment in this macro-sector, and appropriate statistical models can provide valuable guidance on the evolution in this area in the future.

3.2 Forecasting Models Results

3.2.1 The data

The data utilised for skill needs forecasting are extracted from the labour market (LM) data-warehouse of the Province of Milan, and more specifically from the Public Employment Services (PES) data-base.

PES data-base is an integrated system linking information from different administrative archives regarding: labour market (registry of employees, registry of employers, management of obligatory communications of labour relations – hirings and firings –, etc.); education (registry and management of training requirements); training (management of vocational training and apprenticeship). Starting from 2000, this data-base is updated by means of the obligatory communications (available from 2000 to 2007).

Table 2: Rolling estimation-forecasts sample scheme.

	Estimation start	*Estimation end*	*Forecast start*	*Forecast end*
1	January 2001	June 2005	July 2005	June 2006
2	January 2001	July 2005	August 2005	July 2006
…	…	…	…	…
12	January 2001	May 2006	June 2006	May 2007

PES data-base represents a precious instrument for policy makers and various partecipants in the labour market, because it provides data characterized by a detailed level of disaggregation, not available from national economic accounts or labour force surveys (LFS). More specifically, PES data-base enables to disaggregate data by economic sector (ATECO classification – level II) and qualification type (ISTAT classification – level I).

3.2.2 The Results

In order to select the best performing models for forecasting the monthly number of new contracts in the Milan area, we consider as an example the two sectors *Business Services* (BS) and *Information Technology* (IT) (which are included in macro-sector K previously analysed), and the three skill groups *technical staff*, *clerical staff* and *sales force*.

In the first step of our analysis we set up 16 forecast experiments for each sector, where we simulate the actual use of each model for the prediction of the number of new contracts. For all but two models, we use the time series from January 2001 to June 2005 and forecast the next 12 months; then we add the next month and forecast 12 months and so on until the end of our data sample is reached. Since the last reliable observation in our sample is May 2007, the longest sample on which we estimate the models for forecasting 12 months ahead is January 2005-June 2006. Table 3.1 shows the updating scheme of the sequence of 12 estimation/forecast samples.

3.2.2.1 Forecasts for the two sectors

For both sectors BS and IT we estimate a total number of 16 models following the updating scheme shown above. Four of them are univariate, and the rest multivariate of three kinds:

1. the new contracts of one sector are modelled simultaneously with the number of expired contracts of the same sector;
2. the new contracts of one sector are modelled simultaneously with the number of new contracts in the other sector;
3. the new contracts of one sector are modelled simultaneously with the Italian industrial production index.

For case 3. the sample of the Italian industrial production index (IP) starts in January 1992 and the values of the new contracts are treated as missing values. Since UCM are able to deal with missing values without problems, while VAR/VECM cannot, only the former are estimated in case 3. Using a longer sample for the IP, we hope that the cyclical features of this series may help forecast the eventual business cycles in the new contracts series. Indeed, the estimation of business cycles is meaningful only when a sufficiently long sample is available and, while for the new contracts series this was not possible, the IP series was long enough. The date January 1992 was chosen on the base of previous experiences of one of the authors in extracting the business cycle component of the IP.

As far as the models are concerned, for each case above we estimate two UCM and a varying number of ARIMA/VAR/VECM models. The UCM models are

- UCM1: local linear trend + seasonal + error, or in formula $\mathbf{y}_t = \boldsymbol{\mu}_t + \boldsymbol{\gamma}_t + \boldsymbol{\varepsilon}_t$, where no constraint on the component variances and covariances is imposed;
- UCM2: integrated random walk + cycle + seasonal + error, or in formula $\mathbf{y}_t = \boldsymbol{\mu}_t + \boldsymbol{\psi}_t + \boldsymbol{\gamma}_t + \boldsymbol{\varepsilon}_t$, where the constraint $\boldsymbol{\Sigma}_\eta = \mathbf{0}$ is imposed.

Since ARIMA/VAR/VECM models must be identified on the basis of the time series, they may change for every series or pair of series. In Table 3 we summarize the models we actually use in out analysis.

Table 3: ARIMA, VAR nad VECM models estimated on data

Model's nickname	*New BS contracts*	*New IT contracts*
Univariate		
ARIMA1	ARIMA(1,0,1)(1,1,1)	ARIMA(2,0,0)(0,1,1)
ARIMA2	ARIMA(0,1,1)(1,1,1) no const	ARIMA(0,1,1)(0,1,1) no const
With contracts expirations		
VAR1	VAR(2) on seasonal diff.	VAR(2) on seasonal diff.
VAR2	VAR(1) no const on simple and seasonal differences	VAR(1) no const on simple and seasonal differences
VECM	VECM(1,12) linear trend and cointegration rank = 1	VECM(1,12) linear trend and cointegration rank = 1
BS and IT new contracts		
VAR1	VAR(2) on seasonal diff.	
VAR2	VAR(1) no const on simple and seasonal differences	
VECM	VECM(1,12) linear trend and cointegration rank = 1	

For ARIMA/VAR/VECM models we used the software package EViews 6 by QMS, while for UCM we employed STAMP 8 by Koopman *et al.* (2007).

All the models are applied to the natural logarithm of the data, as multiplicative patterns are evident in them. Predictions are conditional expectation under the assumption of log-normality. Table 4 reports information on the quality of forecasts for the various models. More precisely, Table 4 presents the ranking of each model for *k*-months-ahead forecast and $k = 1,\ldots,12$, how often each model is the best (# best) or in the best three positions (# best 3) and the RMSE computed on the 144 prediction errors of each model.

For both series the univariate UCM1 model seems to perform the best. The bivariate models with the contract expirations are also not bad: for the BS series the UCM1 performs quite well, while for the IT series the UCM2 could also a reasonable choice.

Table 4: Rankings based on the RMSE of 1 through 12 months ahead forecasts. The first panel concerns the Business Services, while the second the Information Technologies.

BS	**Univariate**				**With expired BS contracts**					**With new IT contracts**					**With IP**	
Steps	UCM1	UCM2	ARIMA1	ARIMA2	UCM1	UCM2	VAR1	VAR2	VECM	UCM1	UCM2	VAR1	VAR2	VECM	UCM1	UCM2
1	8	2	15	16	4	10	12	3	9	7	13	11	5	14	6	1
2	2	1	15	14	8	9	16	3	11	5	10	12	6	13	7	4
3	3	2	15	13	1	6	16	9	12	5	7	14	10	11	8	4
4	2	4	16	10	1	6	15	8	12	3	14	11	9	13	5	7
5	2	3	16	12	1	5	15	10	13	4	14	7	9	11	6	8
6	2	5	16	13	1	8	6	9	15	3	14	4	10	11	7	12
7	2	1	16	14	3	8	6	12	15	4	13	5	11	9	7	10
8	3	6	16	13	1	12	4	9	14	5	15	2	10	7	11	8
9	1	6	16	13	5	9	3	12	14	4	15	2	11	7	8	10
10	3	6	16	13	1	9	4	12	14	5	15	2	11	7	8	10
11	1	6	16	8	5	10	3	11	14	4	15	2	9	7	12	13
12	2	14	16	7	5	13	3	8	10	4	15	1	9	6	11	12
# best	2	2	0	0	6	0	0	0	0	0	0	1	0	0	0	1
# best 3	11	5	0	0	7	0	3	2	0	2	0	5	0	0	0	1
Tot.RMSE	563	847	1639	1071	594	994	806	1010	1169	672	1447	707	1009	933	974	1007
IT	**Univariate**				**With expired IT contracts**					**With new BS contracts**					**With IP**	
Steps	UCM1	UCM2	ARIMA1	ARIMA2	UCM1	UCM2	VAR1	VAR2	VECM	UCM1	UCM2	VAR1	VAR2	VECM	UCM1	UCM2
1	3	4	6	9	2	1	12	13	14	8	10	15	11	16	5	7
2	1	6	10	9	4	2	12	13	15	5	8	14	11	16	3	7
3	1	7	10	9	4	2	11	12	15	5	6	14	13	16	3	8
4	1	6	12	4	8	3	9	13	15	5	10	14	11	16	2	7
5	2	12	13	7	6	5	3	1	15	9	11	14	4	16	8	10
6	3	1	14	2	10	7	5	6	15	8	12	13	4	16	9	11
7	5	8	15	6	7	4	3	1	11	9	14	13	2	16	10	12
8	7	1	16	6	9	5	3	4	14	8	15	11	2	13	10	12
9	6	13	10	5	8	4	3	2	12	7	11	9	1	15	14	16
10	5	8	11	3	9	6	7	4	14	1	15	13	2	16	10	12
11	5	12	11	3	8	6	7	1	14	4	15	13	2	16	9	10
12	3	10	12	1	8	6	9	5	14	2	16	13	4	15	7	11
# best	3	2	0	1	0	1	0	3	0	1	0	0	1	0	0	0
# best 3	7	2	0	4	1	4	4	4	0	2	0	0	5	0	3	0
Tot.RMSE	83	103	123	85	99	85	95	89	143	87	139	135	87	160	104	120

In order to give a relative measure of performance, Table reports the mean absolute percentage errors (MAPE) for each *k*-steps ahead forecasts. We did not base the ranking of the models on MAPE, since this tends to favour models that better forecasts months in which the actual value is small[8].

Table 5: Mean Absolute Percentage Error (MAPE) for the best model of each time series.

Model / Steps	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
BS Uni UCM1	6.7	5.2	5.8	5.2	5.0	4.6	5.1	6.6	4.3	5.7	4.7	7.0
IT Uni UCM1	6.6	4.4	7.5	7.3	8.2	7.7	9.3	8.1	12.4	11.7	11.8	9.6

It seams that BS forecasts tend to be more precise than IT predictions, and curiously their MAPE do not grow with the range of the forecasts.

3.2.2.2 Forecasts for the three skill groups

For the prediction of the number of new contracts for three skill groups in each sector, we compared only two models. Since the UCM models seemed to perform the best, we applied these models univariately and simultaneously to the three skills, that for notational brevity's sake we named *admin*, *tech* and *sales*.

For the BS sector we used the UCM1 model, which was the best performing in both the univariate and the bivariate case. For the IT sector we used the UCM1 model for the univariate estimation and the UCM2 model for the multivariate model. In the latter case, we excluded the *sales* qualification, being the relative number of new contracts very close to zero for almost every month.

Table 6 reports the loss measures for the *k*-steps ahead predictions. It is not clear whether univariate models perform better than univariate. The IT sector seems to be easier to forecast. As expected, the MAPE of the predictions for a skill group are circa twice as large as those relative to the predictions for the whole sectors.

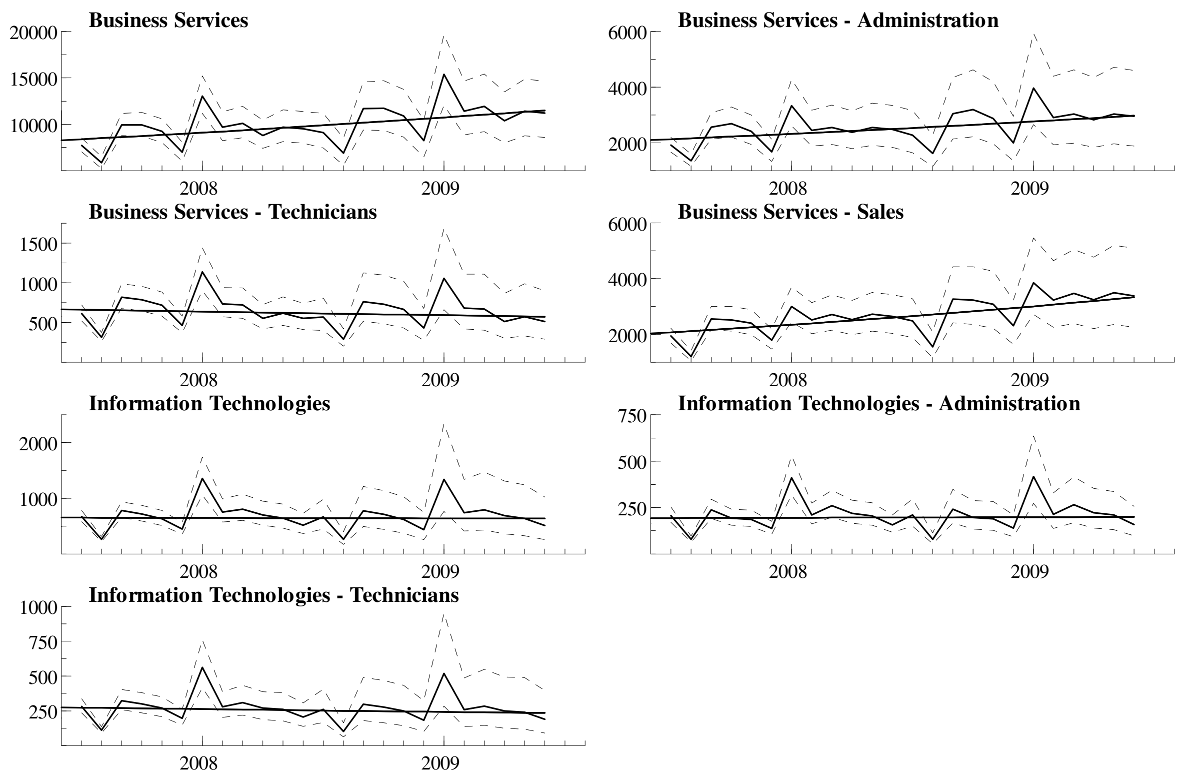
[8] Recall that the MAPE is an average of terms like *absolute forecast error / actual values*, so the smaller is the actual value, the greater is the contribution to the MAPE.

Table 6: Mean absolute percentage errors for sector and qualification.

MAPE	BS admin		BS tech		BS sales		IT admin		IT tech	
Steps	uni	multi	uni	multi	uni	multi	uni	multi	uni	multi
1	11.8	13.1	11.0	11.5	9.2	11.3	14.7	17.5	9.0	10.3
2	11.9	12.7	12.6	13.5	10.3	13.5	12.3	18.2	9.1	8.7
3	14.4	15.9	14.2	15.9	13.6	13.9	13.2	15.9	11.3	9.3
4	16.2	18.5	14.9	13.6	15.8	15.0	12.1	16.4	10.5	8.4
5	14.1	13.2	18.1	15.5	19.0	16.9	10.8	14.0	11.0	10.1
6	14.3	17.8	17.2	16.4	22.5	17.9	13.2	12.6	7.5	9.6
7	11.3	11.8	19.2	16.8	25.2	19.3	12.6	12.5	9.3	11.1
8	11.4	14.9	19.9	16.5	25.3	19.6	12.1	11.5	13.5	10.1
9	8.8	16.3	22.0	17.0	22.0	16.9	16.1	12.6	15.4	11.1
10	10.8	15.8	23.0	17.2	23.6	17.2	17.6	14.8	14.9	12.8
11	12.1	20.5	20.4	17.4	19.8	14.4	20.2	14.9	12.1	11.0
12	14.6	21.0	20.0	17.8	20.8	15.1	17.7	15.4	10.3	11.5
Mean	12.6	15.9	17.7	15.8	18.9	15.9	14.4	14.7	11.1	10.3

Figure 3 reports the forecasts for the period July 2007 – June 2009 based on data until June 2007. The dotted lines represents confidence interval at 68% level. The straight line represents the estimated trend of the time-series.

Figure 3: Forecasts of trend and raw data with 68% level confidence intervalsf or the period July 2007 – June 2009 based on data until June 2007



4 Conclusions and Future Developments

The paper presents the methodology proposed for regional medium-term skill needs forecasting in Lombardy Region. The proposal consists of a two-step approach based on the combination of Martini-Pasinetti's model and time-series forecasting models.

The methodology has been applied to a recent study regarding two sectors of economic activity in the Milan area, i.e. *Business Services* and *Information Technology*.

By means of Martini-Pasinetti's model we have tried to interpret and anticipate the dynamics of regional employment in the macro-sector K (which includes *Information Technology* and *Business Services*).

By means of time-series forecasting models we have made forecasts in the medium-term (up to 24 months) for specific occupations in the two considered sectors. Usually statistical forecasts on the labour market regard a more aggregate level, both from the sector and the territorial point of view, because data come usually from national accounts or LFS. Here we have instead used an administrative source, the PES data-base, which provides a level of detail which is difficult to achieve in other ways.

The statistical models utilized, among the most sophisticated ones in the field of forecasting, require the availability of a fairly large number of time-series data. The series used here are six years and six months long, but in order to perform simulations of estimates for the evaluation of the various models and the choice of the one which provides the best performance, almost two years were cut and the average errors were calculated on fairly short series. Obviously, as the database will increase in the course of time[9], the forecasts will improve significantly.

Despite the relative brevity of the series used, the performance of the models chosen are already good for the *Business Services*, i.e. 7% for the longer step (12 months), while the percentage of error for *Information Technology* is slightly increased, but still remains below 10%. For individual occupations (*technical staff*, *clerical staff* and *sales force*) margins of error are obviously higher, but remain in most cases between 10% and 15%, with peaks around 20%.

Without giving exhaustive economic considerations and conclusions about the presented case-study, it is worth to point out that Figure 3.3, which reports forecasts until 2009, shows that occupations in growth are particularly those relating to *sales force* and *clerical staff* in *Business Services*, while recruitment of *technical staff* appears to be stationary in both sectors. *Technical staff* in *Information Technology* seems even slightly to decrease.

It can therefore be concluded that the experiment has made satisfactory results and should be continued and deepened. Future developments will regard the research of more suitable data for the application of Martini-Pasinetti's model and the extension of the PES data-base to regional base.

[9] The data-warehouse will be updated every year.

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VIII Evolving Occupations, an Approach at the Heart of the Future for French Regions

Bernard Hillau

In the 1990's the implementation of *Regional Employment and Training Observatories* (RETO) in France's regions accompanied decentralisation with regard to employment and vocational training policies. Concerning employment and managing the job market, the State maintained its prerogatives but devolved its actions by entrusting local and regional authorities with greater responsibilities. In the case of vocational training, the State gradually withdrew its responsibilities by entrusting Regional Councils with the task of planning all initial and continuous vocational training specific to each regional area.

In this context, the observatories are required to take part in debates between the main regional decision-makers, the State for employment and the Regional Council for training. They participate in discussions and planning for which they must provide analyses and indicators based on empirical observation and statistical models.

What role is played by specifically prospective approaches in this both technical and institutional environment?

Firstly, the authorities wanted to place a structure with statistical resources and expertise at the heart of this regional partnership, whilst leaving it free to choose its methods and means of investigation. Hence, the great difference between regions in terms of technical and human means and methodological approaches between the different observatories.

In this context, occupations and their evolution are of central importance. On a regional level, the drafting of a 5 – year training development plan forces regions to anticipate the transformation of occupations to adapt the public training offer. Unlike other European countries and in particular Northern Europe, the French vocational training system was largely developed independently of the business world. Vocational training in high-schools needs to permanently adjust training courses to match evolutions in terms of employment and occupations.

However, the *occupations* are not only important to understand the need for adjustment in training but also to understand the way the labour market works because the relationship between jobs available and demand, and their evolution is based on individual activities. This is true with regard to both the skills required (matching a person's qualities with the job requirements) and also the attractiveness of occupations and the greater or lesser ease with which companies are able to recruit for certain jobs.

Thus, the analysis methods implemented in the regions by observatories must encompass initial training, continuous training and measures for integration into the world of work and employment.

These organisations had to satisfy two types of partly diverging constraints: firstly, acquiring a minimum amount of basic statistical instrumentation (on the regional economy, population, employment, training, etc.) in order to provide original and reliable data for public discussion, and secondly, to answer the concerns of regional players, namely being able to anticipate economic and social developments in the region.

In this paper we will review the implementation of a specific analysis method at the Provence–Alpes–Côte d'Azur Regional Observatory of Professions.

The observatory's method for observing and anticipating is largely based on a series of different *statistical models* (sectors, areas, training schemes) with, at the heart of this system, a statistical model for evolving occupations.

The combined use of these different models enables the observatory to comprehend what *works* in the region's different areas and industries. It is therefore able to characterise their structure and evolutions over a long period of time. The observatory has positioned its interpretation of these results with a view to satisfying the prospective questioning of decision-makers and helping them to take the necessary measures for the region's future. In this paper we give some examples of results thus obtained.

1 The observatory's approach to regional analysis and prospects

1.1 The institutional framework for observing employment and training statistics in France's regions

The central tool for diagnosing the labour market and studying the training – employment relationship in observatories is a regional database containing a large number of statistical data which are summarized, organised and updated.

A certain number of common approaches between observatories from different regions can be seen which can be attached to the main fields of discussion between regional decision-makers. These fields of discussion and negotiation correspond to very different time frames in terms of analysis and anticipation:

Regional measures to support employment and training for the unemployed: this involves observing and analysing the way the labour-market works economically in the short-term. The annual or infra-annual follow-up of job offers and requests leads to measures of employment (aided contracts) by the employment ministry in the region, in addition to the Regional Council's training plan for the unemployed;

The high-school vocational training map: this is managed on an annual basis but must anticipate the evolution of employment in the medium-term. On the other hand, every 5 years a *Regional Training Development Plan* (RTDP) is drawn up covering all training paths and based on a complete regional diagnosis of the labour-market and the training – employment relationship ;

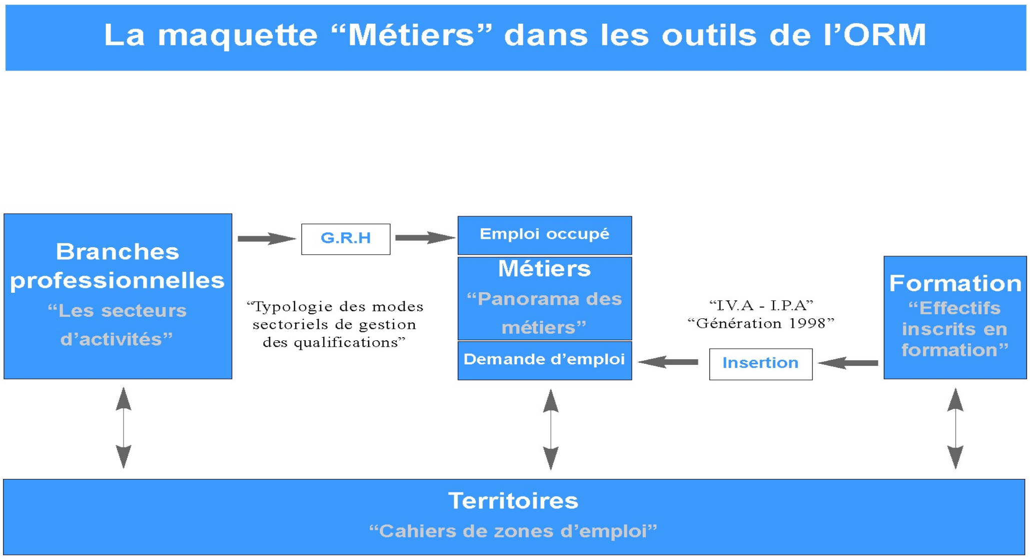
Finally, the follow-up – anticipation of regional evolutions in the long term: this concerns in particular the strategic monitoring of structural *economic transformations* with the state's regional representative.

In terms of strategic anticipation, there are also sector-based negotiations, *Territorial objective contracts,* which are signed between public administrations in the regions and industry representatives for the development of training courses which are useful to industry.

1.2 Database architecture: the observatory's statistical models

The Regional Occupations Observatory has defined a permanent tool for diagnosing and anticipating which works by combining several different *statistical models* to make several heterogeneous statistical series more comparable. The system's general set-up is illustrated in figure 1.

Figure 1: The Occupations model in the Observatory's tools



Note: The occupations model is at the centre of the observatory's statistical system. It includes an important section on the labour market (supply and demand relationship based on the activities of individuals). It creates the link between the *Training* and *Industry* models. Integration indicators give the longitudinal processes for access to occupations following training. Human resource management indicators give the place of occupations and qualifications in sector – based policies. The 5 indicator types, applied on a regional scale for each model, are used on a local scale and compared with a *Territories* model describing the situation of each of the region's 22 employment areas.

Source: ORM (2003), Regional Occupations Observatory Overview of Occupations in Provence – Alpes – Côte d'Azur, Analysis Tool N°4.

1.2.1 The occupations approach – a territorial perspective for qualifications and skills

An *occupations model* is central to the statistical inventory of *occupations* and *social and occupational categories* (SOC) for the working population in employment. The *employment structure* is the distribution of a population of individuals in the job categories held. These categories may be very general (workers, employees, managers, etc.) or extremely precise and varied (up to 455 job titles available in the French National Institute of Economic and Statistical Information's SOC nomenclature).

Since the management of vocational training was entrusted to regional authorities, precise statistical tools have become essential at this level, in particular so that the training offer takes into account the structure and evolution of occupations.

The French statistical system has furthermore developed a correlation table between the occupations of the working population in employment (the INSEE's SOC code) and the declared occupations of the jobless (jobcentre's *Operational Professions Catalogue* code). This correlation table is a central instrument for the occupations model.

Evolution of occupations: the need to measure and objectivise

What is the role of technology in the evolution of occupations? Is its influence as considerable as is said with regard to their transformation? How did the rise in level qualifications achieved develop, that started in the 1980's? Is it as general and uniform as it was predicted? Should we accept at face value the claim according to which only precarious jobs have benefitted from the economic recovery at the end of the 1990's? To answer these questions precise measures of the evolution of the workforce in each occupational category are important in order to identify trends and anticipate future developments.

This method is also an excellent tool to assess actions taken by the authorities in the past and retroactively assessing adjustments to initial and continuous training offers in the effective evolution of employment and work in the region.

The geography of occupations

The PACA region consists of 6 very different sub regions, called ''départements''. They form a relatively heterogeneous unit on a social and economic scale. It is therefore very important to comprehend the geographical distribution of employment in the different ''départements'' and, inside the areas which make them up. Again, it is the "professions approach" which will enable the territory's heterogeneity to be appreciated. Whilst some occupations seem to be very diffuse and are accessible anywhere with local training (trade, crafts industry, services to people), others, on the contrary, are highly concentrated in several of the region's economic areas, and the training offer, must take this into account, even if it does not mechanically follow the location of jobs.

The labour supply

Often, authorities are confronted with a paradox: despite the fact that the PACA region has a high level of unemployment, it is difficult to recruit for certain occupations. The abundance or shortage of labour depends on the occupation in question.

Seasonal work linked to tourism, for example, heavily determines employment and job conditions, salaries, etc., for occupations as varied as that of chef, waiting staff or receptionists. The particularities of different occupations determine the profile of skills required, and also, as we shall see below, their social attractiveness. Thus, an industry, like the building trade, can for some positions seem much more attractive (engineer, technician) than another where it is difficult to recruit (bricklayer).

After having considered occupations based on human resource management policies (left part of the diagram below), we can envisage them in terms of individuals who need to build a career (right part). This may involve young people who need to choose which training path to take or adults who are required to develop, change jobs and even line of work.

Here, the comparison between training and occupation can be directly made based on the content of training (training as a heating engineer refers explicitly to a particular job). However, we also need to take into account the mobility processes of people and the phenomenon of transferring qualifications. Integration and occupational mobility show that a single training course in electricity and electronics, for example, can lead to very varied and diffuse occupations in many fields of activity.

The statistical model for occupations in France's regions

The Regional Occupations Observatory's *occupational* model is divided into 22 fields which are further divided into 84 and 224 families.

Level 22 for example is the field of Building and Civil Engineering occupations and can be further divided with the lower level of aggregation (*level 84)* for occupational families which, for this specific case, allows 8 occupational families to be distinguished:

- non-qualified workers in structural building, civil engineering and extraction work
- qualified civil engineering, concrete and extraction workers
- qualified structural building workers
- non-qualified building workers, light work
- qualified building workers, light work
- building and civil engineering vehicle operators (except traction and lifting)
- building and civil engineering technicians
- building work and civil engineering managers

At the most disaggregate level (224), the *qualified building workers, structural work* family can distinguish between e.g. *bricklayers*, *ironworkers*, *wood carpenters*.

For each of these occupation-families we can distinguish threes type of indicator:

1 – positions filled:

Structure (weight of the occupation-family in the field), rate of evolution between two censuses, distribution of the occupation-family according to business sectors, home work shuttle services, types of work contract and articles of association, proportion of workforce working part-time.

2 – job applications:

Structure according to sex, evolution, duration of unemployment (proportion of unemployed for more than a year, more than 2 years), seasonality indicator, reasons for leaving employment (jobcentre registration).

3 – comparison:

Comparison of positions filled and job applications (tables with two columns comparing percentages of positions filled and percentages of job applications). The individual characteristics: sex, age, level of training, enable the profiles of the unemployed to be characterised with regard to those of the working population. This comparison also takes the geographical factor into account, showing the location (according to employment areas) of the working population and the location of the unemployed.

Source: Regional Occupations Observatory (2003)

Attractiveness of occupations

An occupation is also a space for building a relationship of interest: a person prefers certain types of jobs, or will be able to demand specific benefits and remunerations. The issue of an occupation's attractiveness is all the more significant since it will gradually weigh on the way training paths work when they explicitly refer to an occupation.

Located at the boundary between branch policies and individual projects, an occupation is focal point of regulating the relationship between labour supply and demand, between training and employment. It is a strategic space for action by the authorities, whether they are responsible for vocational training policies, integration policies for those in difficulty, and even the social and economic development policies for areas.

1.2.2 Based on the occupations approach a crossed use of observatory tools

Besides the statistical occupations model, the observatory has since 1997 progressively built four basic statistical models, each corresponding to a field in the training – employment relationship:

1. a statistical model for economic fields of activity (indicators: economic activity and structure of establishments, terms of employment, characteristics of the workforce, characteristics of employment between men and women)
2. a spatial model based on the *territories* which consists of a full series of portraits of 22 employment areas in the region (indicators: population and territories; economic activities; employment, labour market occupations; living conditions and lifestyles of residents; education and training)
3. regional indicators for w*orkers enrolled on vocational training courses* (according to level of training, specialities, initial or continuous training systems, geographical area)
4. a set of systematic works on the integration paths of young people following initial training.

Each of the tools built at the observatory provides for, through its construction principles, the possibility of being compared with other tools so as to *give meaning* to the figures and extricate the employment and training issues.

These generic statistical tools are based on common principles which enable comparisons to be made with a view to drawing operational knowledge:

- the structure of information backed up by figures is both chronological and comparative
- the geographical dimension is systematically taken into account (‘‘départements’’ and employment areas)
- the central role is given to the individual characteristics of the target audience for each model (sex, age, level of training, geographical origin).

The *field*, *occupations*, *training schemes* and *integration path models* thus all include a geographical dispersion analysis (of the sector, the occupation and the training offer) in the region's employment areas. Comparing each of these theme-based models across territories is thus made easier.

Answering the prospective questioning of the region's decision-makers: Inventory of different approaches and methods

National analyses for the qualitative and quantitative transformations of occupations

This involves introducing, in the assessment of occupational evolutions, knowledge of technological and organisational factors for transforming work to extricate new needs in terms of occupational skills and training. Occupational principles are generally considered as trans - territorial. We can add methods for statistical projection to these qualitative approaches. (cf. D'Agostino and Guitton, 2007)

Flow analyses

The labour market and the training-employment relationship can be compared in terms of stock (correspondence between the number of application and the number of offers on a given date) or flows. With regard to the issue of prospects after training, the analysis of integration flows is more robust than simply checking stock. Analysing the mobility flows of young people entering the labour market opportunely enriches the evolving occupational approach as in the work (cf. Onisep, no year).

Structure analyses, by a reasoned crossing of indicators

Combining indicators for analysing mechanisms and tendencies: this means giving a meaning to the data. Several different methods are combined like in the statistical description of employment areas combining evolving approaches, statistical correlations between indicators, etc. (cf. ORM, 2004).

Demographics projections

The use of demographic projection methods is now common educational environments to foresee future needs in terms of capacity. This involves *sliding* groups of pupils at the age of 6 for example, and anticipating numbers of secondary or high-school pupils in several years time by introducing coefficients for estimating the number of migrant families, etc. (high-school investment forecasts).

Projections according to age structures are also possible to forecast the flow of retiring employees and compare needs for the future renewal of employment by sector. We can also see statistical projections in use for populations according to occupation (cf. Chardon and Estrade, 2007).

Sliding forecasts

This involves repeated observations which enable the solidity of hypotheses made to be checked and developed. The continuity of regional observatories enables them to reedit such observations like at the observatory, for example, sector-based portraits or even territorial diagnoses.

Confronting the figures and needs expressed by those involved.

This involves integrating into the interpretation of statistical data the expression of needs by those involved, based on their operational expertise. For example, the expression of needs by a branch, by its nationally or regionally appointed representatives, is to be taken into account, and compared on the one hand with the figures themselves and on the other hand with other expressions by those involved.

1.3 The prospective interpretation of regional developments

The approach proposed by the observatory is based on several principles relating to the construction of knowledge and anticipation. An organisation to help with decision-making, like a regional occupations observatory, is responsible for finding the best possible balance between statistical knowledge the demand of the users, on behalf of decision-makers, using information tools which will enable them to optimally plan their future actions. In terms of training, decisions taken today will have consequences for the future.

The approach for providing information implemented by the observatory aims to propose a reasoned framework of answers to prospective questioning, a representation built on the evolution of the training-employment relationship.

Three complementary approaches are used at the observatory:

1. analyses of structures and tendencies
2. demographic projections and sliding forecasts
3. discussion of objective data and confrontation of projects and opinions of those involved.

1.3.1 Structure and tendency analyses

This means *making the data speak*. Several methods are used. Firstly, by using descriptive statistics (eg. portraits of employment areas). All indicators are chronological (so as to define evolving tendencies) and comparative (so as to identify structural particularities). This point was widely dealt with through the description of statistical models which give rise to reasoned indicator comparisons. More generally, all the *generic statistical models* (comparing branches, territories, systems, etc.) must be based on a prior comparison grid of indicators, based on reasoned technical construction and operational usage.

Multidimensional statistical methods can also be used. Thus, apart from the use of occupational branch indicators in a descriptive statistical model, these were used in multifactorial analysis work on 82 business sectors. These analyses led to the identification of five major human resource management systems by regional companies.

1.3.2 Demographic projections and sliding forecasts

Major statistics operators like the French National Institute of Economic and Statistical Information (INSEE) or the Ministry of Education's DEPP have developed statistic projection models. The INSEE's OMPHALE model proposes evolution curves for the population of territories. The Work Ministry's FLIP-FAP model proposes projection curves of numbers according to occupational families. Finally the Department of

Education, based on the number of new pupils in primary education, is able to assess future development of pupil numbers in secondary schools.

We can, more generally, list statistical projections in the following fields:

Demographic projections according to age groups and school projections (forecast general needs in terms of capacity for new generations)

Parameterise regional mobility and migration (e.g. new educational needs linked to urban decentralisation and peri-urban development)

Analyse factors of occupational transformation according to families of occupation for the opening and closing of vocational training courses with regard to new job prospects (prepare youths and adults to work and encourage life long career development, and therefore anticipate the evolution of occupations and the labour-market, etc.)

- Evolution of the social demand for training and education, so as to ensure that the content of new courses match the true demand by occupation families.
- Economic approach with regard to territories *subject to restructuring* so as to anticipate reversals in the situation and fluctuations of local labour markets.
- Systemic regional socio-economic approach on the level of territories enabling the above demographic, social, technological and economic factors to be presented for the same area.

The observatory, for example, used the age structure for industry. By identifying sectors where labour was older, it tried to foresee recruitment and the risk of differentiated tensions on the labour market. However, the projection of an age pyramid cannot be applied mechanically because labour is not renewed in equivalent conditions. The evolution of work productivity (the number of people required for a given production capacity may decrease according to the rate of mechanisation and work/capital substitution), and even the evolution of qualification criteria and the characteristics of labour available have to be taken into account.

1.3.3 Discussing objective data

Government as well as economic and social partners are committed by medium term decisions relating to the institution, company or systems for which they are responsible. These reorientations according to sector-based interests will interact in the territory's systemic evolution. For example, *expressing the needs* of an industry, by its nationally or regionally appointed representatives, is to be taken into consideration and compared with other expressions by those involved. The debate between hotel industry employees who are part of the industry's needs in terms of basic qualifications, and academic officials who are part of the demand with regard to the continuation of studies by young people towards intermediate qualifications, is a true debate where all the participants have a legitimate role.

In such a context, contributing to the debate with objective data (structure of qualifications in the industry and its evolution) will encourage dialogue and help those involved to move away from their operational logic.

2 Examples of results obtained

2.1 A regional medium-term scenario: diversified needs in qualifications at all levels

Between the last two population censuses in France (1990 – 1999), intermediate and upper occupational categories have increased as has the number of employees in the tertiary sector, whilst the number of workers has decreased. But compared with the national average, the PACA region stands out by a higher increase of intermediate professions (technicians, secretaries, etc.: +20% compared to + 8% nationally) and a more moderate increase for managers (+13% compared to +19% nationally). Occupations whose progression is greater in the region are social and health workers (child minders, social workers, nursing auxiliaries, etc). Families of occupations which are rapidly increasing are therefore not only limited to higher professions and certain jobs have progressed spectacularly.

Finally, with regard to certain occupations there is a much higher level of training and qualifications. In mechanics and electricity/electronics, there has been an upsurge in the number of level V vocational training certificates (vocational training certificate and technical school certificate), whilst in administrative positions, secretarial work and accounting, the number of baccalaureate level certificates has increased particularly.

In the PACA region several factors favour the anticipation of needs in terms of very diverse qualifications both with regard to specialisation and the level of qualification.

In certain tertiary sectors linked to the region's tourist activity, such as trade and the hotel – catering industry, the need for basic qualifications is maintained by the seasonal nature of the activity and the drain of a large number of qualified employees towards other sectors. In sectors with a protected status in the civil service (namely teachers), as well as technicians and managers in industry, the stability of long-term employment leads to an ageing population and the in the age pyramid a large proportion of the working population is approaching the age of retirement. In addition, there is an increasing need for care and personal help staff. Faced with the need for qualifications in very diverse occupations and covering the entire spectrum of qualifications and diplomas, it is not certain that the labour market is renewed over a long period of time in the same way. The demand for education and training of young people (particularly young girls) is less diversified and basically concerns general training courses in secondary education and literary studies in further education. The orientation of young people who leave technological and scientific courses poses a true problem with regard to the future need for qualifications.

2.2 The issue of transforming the labour market differs greatly from one area to another: the case of non-qualified youth unemployment in the Arles employment area

Based on the territorial diagnosis model applied to the Arles employment area we can see significant correlations between statistical indicators in different registers (demographics, economy, employment, training, living standards). In terms of economic values, the area has a large proportion of agricultural work, and employment in intermediate goods industries (paper, card industries, food industries) in addition to activities linked to transport and handling (wholesale). Overall the population in these types of activity is not highly qualified (43 % of the active population is not qualified compared to a regional average of 36%) and the level of income is rather modest: the relative proportion of people on minimum welfare payment is 3.5% of the area's population compared to 2.6% in the region as a whole. Unemployment figures for this area show a high rate of youth unemployment for the under 25's (35% for the area compared to 30.5% for the region), as well as a large proportion of non-qualified workers (27% for the area compared to 22% for the region). These figures can be explained not by the current economic situation, but rather by the effect of long-term *social reproduction*. Income and the modest occupational level of the area's families can be seen by a low level of school demand by families in terms of education and training (proportion of 16 – 18 year olds educated 94 .8% compared to 95.8 for the region and above all the share of 19 – 24 year olds is only 45 % for the area compared to 56% for the region). The number of non-qualified early school leavers entering the labour market increases the youth unemployment numbers and the proportion of non qualified workers. The small basic vocational training offer (apprenticeships and vocational high-schools) alone seems to be detrimental with regard to this type of population.

2.3 Prospective diagnosis: confronting the figures with needs expressed in projects by those involved

Developing prospective diagnoses in the regions requires relevant statistical models, although that is not enough. The experience of regional observatories is interesting in so far as they are responsible for acting as interfaces in regional discussions, namely between public players and industry representatives. Their contribution is essential when a detailed diagnosis is discussed in negotiations. Supplying objective figures has the advantage of encouraging exchanges and the building of a common culture for the area (territory portrait) or the industry (sector-based portrait). However, the attitude of those involved is also essential: the expression of their needs by industry representatives. Planning issues carried by those involved in a territory can significantly enrich the diagnosis and help those involved to appropriate it.

In the case of the hotel and catering industry, with a large workforce in the PACA region, a preparatory meeting to draft the *regional training plan* was held during which employers from the hotel industry expressed the industry's needs in terms of basic qualifications. Educational authorities on the contrary stated their wish to raise the level of studies by encouraging young technical certificate holders to continue studying for the vocational baccalaureate. Figures provided by the observatory highlight the drain of young qualified workers to other industries, which explains the industry's demand, but also brings them back to their own practices in terms of pay and working conditions.

The ministry of education noted a real need to continue studying after high-school courses, but these courses are generally located in Marseille whilst the main catchment area for employment is around Nice. In this type of debate each player defends its own role and interests. The observatory's analysis can contribute by helping each side to put its position into perspective and listen to that of its partners.

3 Use of prospective approaches in the technical and institutional running

The use of prospective approaches by regional employment and training observatories is part of their permanent role to study and help regional authorities to make decisions.

Firstly, setting up a statistical database is central to the observatory's role in so far as it is an essential tool for objectivising the region's social and economic realities. Secondly, the data observed must be discussed in the regional partnership. Based on the data architecture established in the PACA region, we have tried to show that a core of extremely wide-ranging statistical data, based on long and retrospective statistical series, is necessary. This core will then provide answers to regional players with regard to training and employment policies to be enforced. According to the subjects to be dealt with, (drafting the picture of an infra-regional territory, helping partners to discuss based on an industry diagnosis, extricating issues for the future of a particular training scheme such as apprenticeships), the basic architecture is designed so that the data are subject to relevant comparisons for the issue in question. The database's organisation according to different *generic statistical models* is the solution chosen by the regional observatory for use as a base with *flexible standardisation*: being able to extract *ad hoc* data from a standard tool.

How do prospective anticipation approaches lie within such a technical and institutional landscape? It can be said that with certain means of comparison and data uses, prospective anticipation is a common task of the observatory: retracing long evolution curves on indicators, establishing reasoned comparisons and statistical correlations likely to define what *structurally* differentiates areas, industries, training schemes. In this, flow data (mobility on the labour market) is preferred over stock data. It basically involves creating social and economic expertise based on tangible data with a dynamic approach of the social and economic fabric. The evolution of professions and occupations is at the heart of the region's social and economic intelligence with a view to managing the labour market and enforcing vocational training policies.

Based on this general instrumentation, there are methods more directly dedicated to develop future scenarios like demographic projections applied to certain populations: pupils and young people, forecasts according to the retirement age of the active population, demographic forecasts applied to local areas integrating the effects of migration, etc.

We have illustrated with several examples that high-performance models can be used for precise needs: in the PACA region this is the case with demographic studies prior to setting up new schools, for example (projected catchment area, foreseeable effects of competition on neighbouring establishments, etc).

But beyond these particular needs, *dedicated* prospective methods are essential to the evolution of observatories because they show the way forward in order to increase their know-how with regard to their main task of providing the most relevant and *dynamic* possible answers to the prospective questions of those involved.

When all is said and done, the boundary between analysis and diagnosis methods based on observing existing solutions and prospective anticipation methods is not always as clear as we may often think. Understanding a territory using objectivised statistical data means apprehending this territory with regard to its evolution dynamics, giving priority to tendencies, movements and flows, all of which are perfectly observable. Statistical projection models and methods for means fall within the scope of this general objective of intelligibility, and also open up new perspectives for work and investigation.

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IX AMS-Skills Barometer – Austria's Target Group oriented Labour Market Information System

Stefan Humpl, Maria Kargl

The "AMS-Skills Barometer" was developed to provide a broad group of users with valid, comprehensible and well structured information on current and short term qualification needs as an internet information platform. Information that was already available is exploited and merged in a synoptical way. Information on regional labour market trends is not the main focus of the AMS-Skills Barometer. But since studies used contain regional forecasts and the compilation of information on occupational fields also uses regional labour market data, a regional focus of information on basis of the nine Austrian regions ("Bundesländer") can be found in the AMS-Skills Barometer. Although there is an attempt to attract more notice to skills and competencies, it is still occupational and vocational information which guides the structure and composition of the information system. Regional information sometimes merges into the AMS-Skills Barometer through the regional distribution of different occupations, and therefore regional labour market trend information is sometimes also part of the edited occupational information (like in specific occupational fields such as service tourism, automotive industries, or the creative industries).

1 Background Information

1.1 History of the AMS-Skills Barometer

The interaction between economic trends (globalisation, service orientation), technological trends (diffusion of information and communication technologies) and labour organisational trends (growing need for flexibility, restructuring of labour processes) brings about rapid changes in the occupational environment and especially in the field of qualifications[1] needed for economic success. The growing need for information in this respect – especially on labour market trends at national and regional level – lead to considerations about the necessity of a new information system for continuous monitoring of changes in qualification demand at micro-level.

In the late 1990s the Austrian Labour Market Service (Arbeitsmarktservice, "AMS") started to reshape their labour market information system, which was originally designed especially for young people needing to gain information about job descriptions (job profiles, educational background for each job), and job opportunities. At that time job guidance and counselling was hindered by highly differing information sources, on the one hand, and a restricted focus on only very specific occupations on the other. At the same time the concept of occupations as a stable bundle of requirements (education, tasks to be carried out, experiences, attitutes, skills and competences) was already breaking up, and job seekers were forced to be more flexible than ever before. It was felt that focussing more on competencies, rather than on segregated vocations, would be a far better approach in vocational guidance and counselling.

[1] In analogy to the German "Qualifikation" we use the English term "qualification" in the sense of "vocational competence" or "skills and competencies" within the whole context of the AMS-Skills Barometer, thus including knowledge and physical abiltities as well as social skills, language competencies or even certain personal features related to vocational specifications. In this article we use "competence" and "skill" alternatively, but meaning the same.

For these reasons the "AMS" – as the main provider of job information at that time – decided to develop an online information tool for job and career guidance and counselling, including meta-information from different sources about the whole job-market: The "AMS-Skills Barometer" ("AMS-Qualifikations-Barometer" in the German language original), which was designed and developed by 3s Unternehmensberatung (3s) and the Institute für Bildungsforschung der Wirtschaft (ibw), two main players in the field of labour market and qualification forecasting.[2]

1.2 Objectives and Target Groups

Main objective of the AMS-Skills Barometer is to provide a broad group of users with valid, comprehensible and well structured information on current and short term qualification needs. Right from the beginning it was evident that information that was already available should be exploited and merged in a synoptical way. Additionally, methods like expert interviews and processing of statistical data should be allowed. The AMS-Skills Barometer therefore is first and foremost an instrument for representation and only secondary one for data analysis.

Not only young people looking for information on current occupational job profiles and qualification needs are meant to benefit from this information tool. Further target groups of the AMS-Skills Barometer can be described as follows:

- Decision makers and public services staff at different political levels
- Education and career development guides and labour market counsellors in different institutions and organisations
- Journalists
- Decision makers and their staff in educational and research institutions
- Decision makers in enterprises
- Employees, job-seekers and people interested in further education and qualification
- Staff members of the "AMS" at all levels and in all organisational units.

1.3 Usability Problems – Heterogenous User Groups

The AMS-Skills Barometer was realized as a web-based information tool accessible to a broad range of users. Most of these are not expected to have any previous experience with socioeconomic research or taxonomies. The attempt to provide this group with technical information that is at the same time comprehensive, concise and easy to understand, turned out to be a real challenge at all levels of representation: wording, phrasing and text length; user guidance; technical usability of the website (the range of search and select functions etc.). On the other hand, the AMS-Skills Barometer also wants to adress experts. Compromises needed to be made to meet the needs of such a broad range of users.

In an evaluation undertaken in 2004 about 200 decision-makers in the field of labour market, education and qualifications (such as representatives from social partner organisations, ministries, vocational counsellors and researchers) were asked to use the

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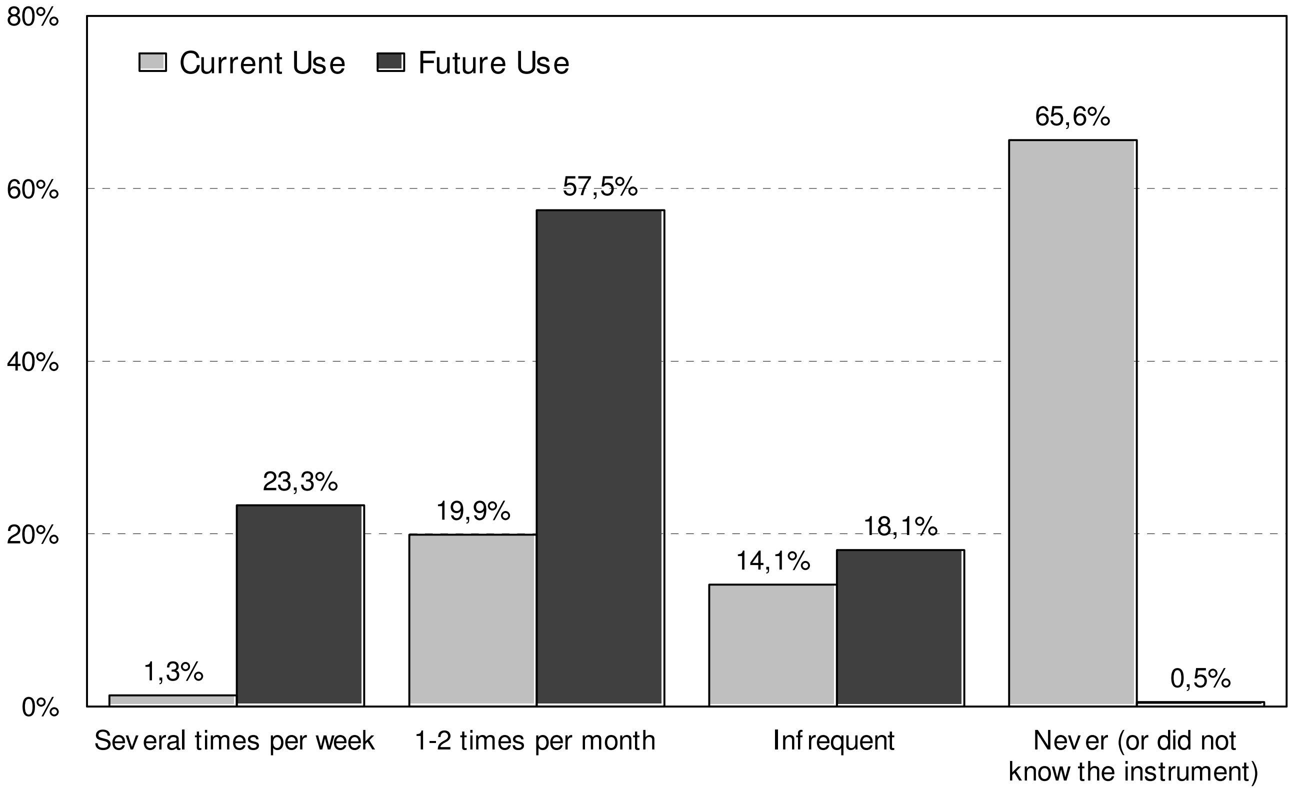
2 www.ams.at/qualifikationen

AMS-Skills Barometer and report about their experience in telephone interviews. More than half of these people had never used the instrument before. Those having done so, used it once or twice per month at the most.

When asked if they would use the AMS-Skills Barometer in the future, their answers were encouraging: more than half planned to use the instrument once or twice per month, and almost none could imagine not using it at all in the future. When asked 'will you further recommend the AMS-Skills Barometer (e.g. to colleagues, clients, etc.)', 98% declared that they would recommend the instrument to others.

Figure 1: Evaluation of the AMS-Skills Barometer 2004: Expected future use



Source: 3s

As a reaction to the results of the evaluation, the site was relaunched. Graphic design, menue navigation and search functions were re-engineered to provide even better usability in the future.

2 Methodology and Basic Structure

2.1 Methodological Background

The methodological approach applied in the process of establishing and updating the AMS-Skills Barometer principally was and still is one of editing already existing information. This is done by a process of searching sources, collecting and evaluating information critically, joining these together and finally editing them along the given structures of the AMS-Skills Barometer. The result, both textual and graphic, can be looked upon as a synopsis of compiled information.

Editing is done by a team of experienced authors. They follow a common framework of “working rules” that guarantee that all texts within the AMS-Skills Barometer are homogenous with regard to content and style. Additional quantitative data is extracted from different sources like articles on labour market needs and qualification trends, analysis of job advertisements and job openings recorded at the AMS. The editing process is based on the critical use of all these different sources. To summarize, the main sources of information are:

- Quantitative data (labour market statistics from data providers like Statistik Austria, Hauptverband der Sozialversicherungsträger, etc.)
- Research, analyses and forecasts on skill demand for the Austrian labour market (at regional and national level)
- Specific analyses on job advertisements, commissioned by the “AMS”
- Relevant texts from a broad range of sources ranging from general publications (even articles from mass media) to specific branch journals
- Relevant PhD- and Master-Theses
- Explorative interviews with labour market experts in specific occupational fields (HR management members in leading enterprises, directors of educational institutions, representatives of professional bodies, etc.)

Closeness to relevant practical occupational environments is provided especially by the interviewed experts, who can call attention to trends, which otherwise would only be detected in relevant statistical analyses much later.

The editing work is based on constant desktop and literature research and source analysis throughout the year. A general update of the online tool AMS-Skills Barometer takes place every March and October.

As mentioned before, the AMS-Skills Barometer was designed as a representation tool for labour market trends, based on a critical evaluation of already existing information. This implies that the sources used have not been compiled to be exploited by the AMS-Skills Barometer, and therefore cannot be expected to apply comparable structures, like classifications of skills and occupations. Furthermore, the quality of representation can only be as good as the information sources used – therefore a critical evaluation of these sources is one of the most prominent tasks of the editing process. With respect to the sources it is based upon, the compilation of the AMS-Skills Barometer faces the following conditions and problems:

Level of differentiation: One of AMS-Skill Barometer’s main goals is to provide highly detailed information on trends down to the detailed level of individual occupations, e.g. “tour guide”. Unfortunately, most trend forecasts refer to a much more general level, such as to “trends in tourism” (which sometimes might even include economic information, instead of being restricted to labour market trends alone). In the majority of cases also research analysing and/or forecasting skill needs dooes so only in a very global way, such as assessing a growing need for “key qualifications”, “soft skills”, or “technical qualification”. In the AMS-Skills Barometer, however, specific knowledge, abilities and competencies are named and evaluated at a highly differentiated level, like “basic IT skills” or “knowledge of accounting software”.

Restriction of research scales: Many skill forecasts restrict their result statements to specific random chosen occupations, economic branches or regions, whereas the AMS-

Skills Barometer always applies a comprehensive approach, with respect both to regions and occupational sectors. Primarily the focus is on the national level; then specific statements for regional differentiations are made (if available). Surveys restricting themselves to a certain region or industrial sector therefore can only be of limited significance for the AMS-Skills Barometer.

Differing reference frames: As mentioned above, almost no research is commissioned specifically for integration into the AMS-Skills Barometer. Diverging classifications and occupational structures have to be “integrated” by an editing process. Because of this trend statements from very detailed analyses – if available at all - often cannot be used in the AMS-Skills Barometer directly. Editing in this sense includes e.g. identifying occupations from a certain occupational sector which can be easily transferred to the classification used in the AMS-Skills Barometer, reducing statistical labour market data by those occupations, which cannot be transferred to the same sector, but can maybe be subsumed under a different sector, and so on. In some case the differences between the classifications applied are so large, that the prognosis can either not be used at all, or only serve as background information, at a very general level.

Different time periods: All trend forecasts of the AMS-Skills Barometer have a time horizon of four years. It is self-evident that all information on skill trends that is found in the sources must be adjusted to this time scale. The quality of the forecasts is improved by exploiting several analyses for the same occupational field, and supplementing them by additional sources like expert interviews and articles both from branch specific journals and mass media.

2.2 Methodological Developments

Skill forecasts designed and accomplished specifically for the AMS-Skills Barometer would significantly alleviate the editing process. But unfortunately up to now this is only done in two cases: Every year an analysis of job advertisements is carried out that has the objective to extract information on jobs, occupational fields and skills from Austrian print media. Only this study - together with statistical data on job vacancies reported to the “AMS” - is 100% compatible to the classifications used in the AMS-Skills Barometer.

But even this kind of survey shows specific limitations:

The demand for jobs (and skills) in job advertisements does not reflect the “real” demand of the labour market, because:

- Many job vacancies are filled without publishing a job advertisement, e.g. via direct job application (which is of growing importance in tight labour markets), via personal contacts between future employee and employer, and via direct recruiting after graduating from certain vocational schooling (“hidden labour market”, e.g. in nursing occupations).
- In occupational fields with a high fluctuation of employees the quantity of job advertisements is higher than in others. Taking this into account, the analysis shows a “higher demand” in such occupational fields, but the chances for long term job occupations are low. The demand appears to be higher than it actually is, if you compare the number of vacancies and the number of actual job openings. This is the case e.g. in the tourism sector, where the same job might be advertised twice a year (for the summer and the winter season).

Furthermore, an analysis of job advertisements can only give a quantitative picture of the past. The editing work, in contrast, is focused on recent and future developments. This is why the presentation of quantitative data and textual information in the same occupational field sometimes seems contradictory.

Whether the need for further surveys specifically designed to serve the AMS-Skills Barometer can be met, remains to be seen. However, some other steps have been taken to broaden the information basis of this web tool:

Gender specific information

has been implemented for each occupational area. It is summarized on one web page per occupational area and accessible through a button ("Mehr Informationen" – "more information"). It contains basic information on gender segregation (employment figures according to gender), differences in educational level, income and others for the respective branch or sector.

The "gender" pages are clearly marked by the use of a different colour (orange), as the information, due to the lack of sources using comparable classifications, could not be implemented into the pages of the relevant occupational areas. Thus, a clear separation from the main information was preferred.

Enterprise survey as a new source: A broad survey on occupational developments in enterprises with more than 20 employees is carried out every two years by the "AMS". The original focus was on contacting Human Resource Managers to gain information about labour force demand, and thereby also enhancing the contact between the regional offices of the "AMS" and their customers. Recently the focus changed: Now, more attention is given to collecting information on occupational and skill trends. The survey's questionnaire has been adapted accordingly, e.g. it now includes more detailed questions, such as:

'Name three occupations that your company highly demanded in the last two years'; 'Please specify the demand trend for these occupations within the next 12 months'; or: 'Which skills and competencies will be needed specifically for these occupations?'

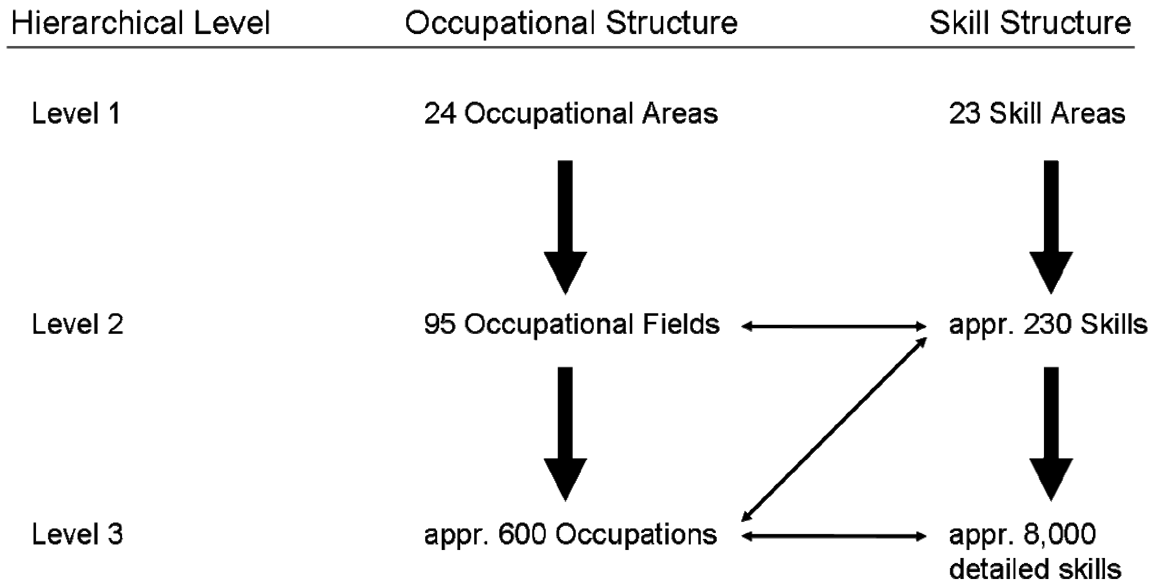
As a result, specific trend information on "occupations most demanded", "skills most demanded", and "most dynamic occupations" (increase or decrease of occupational demand) can be displayed via "charts" for occupations and skills. The results can also be edited according to the nine Austrian "Bundesländer" (regions), which will give us a quantitative database for regional occupation and skill trends.

In the survey, more than 7,000 enterprises provided detailed information. The response is representative for the Austrian enterprise structure with more than 20 employees.

2.3 Basic Structure of the AMS-Skills Barometer – Occupational Information

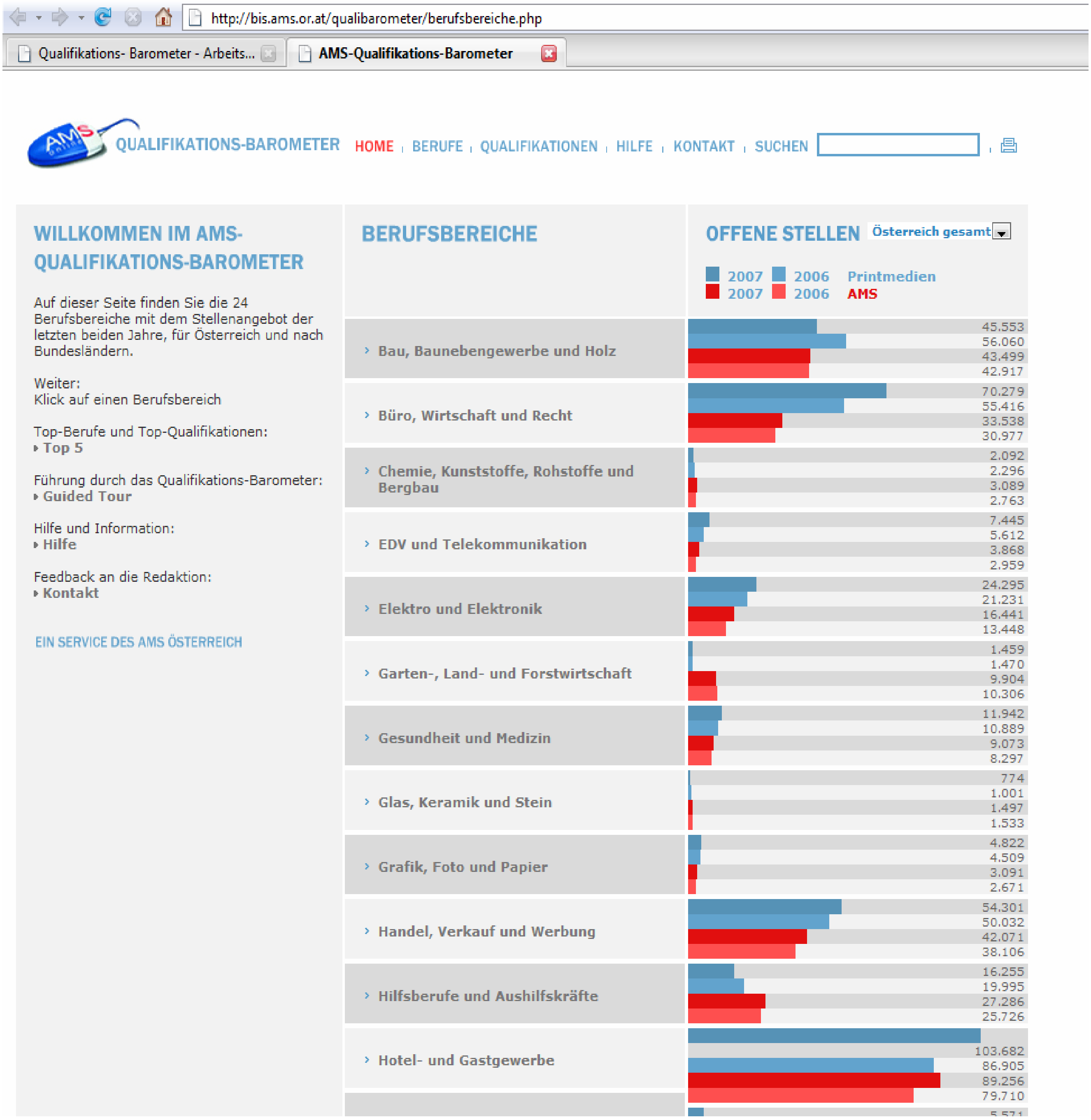
All information given by the AMS-Skills Barometer follows a hierarchical structure, outlined along a concept of the labour market, which distinguishes what we call (bigger) "occupational areas" ("Berufsbereiche") and (smaller) "occupational fields" ("Berufsfelder"): Thus, the whole labour market is divided into 24 main occupational areas (which can be overseen on the first page view of the AMS-Skills Barometer, compare figure 3), further broken down into smaller occupational fields (total: 95 occupational fields, compare figure 4). Each occupational field contains several job titles. These are linked to another online information system of the "AMS", the Vocational Information System ("AMS-Berufsinformationssystem, see http://www.ams.at/bis/, containing appr. 600 occupational profiles).

Figure 2: Basic information structure on occupations and skills in the AMS-Skills Barometer



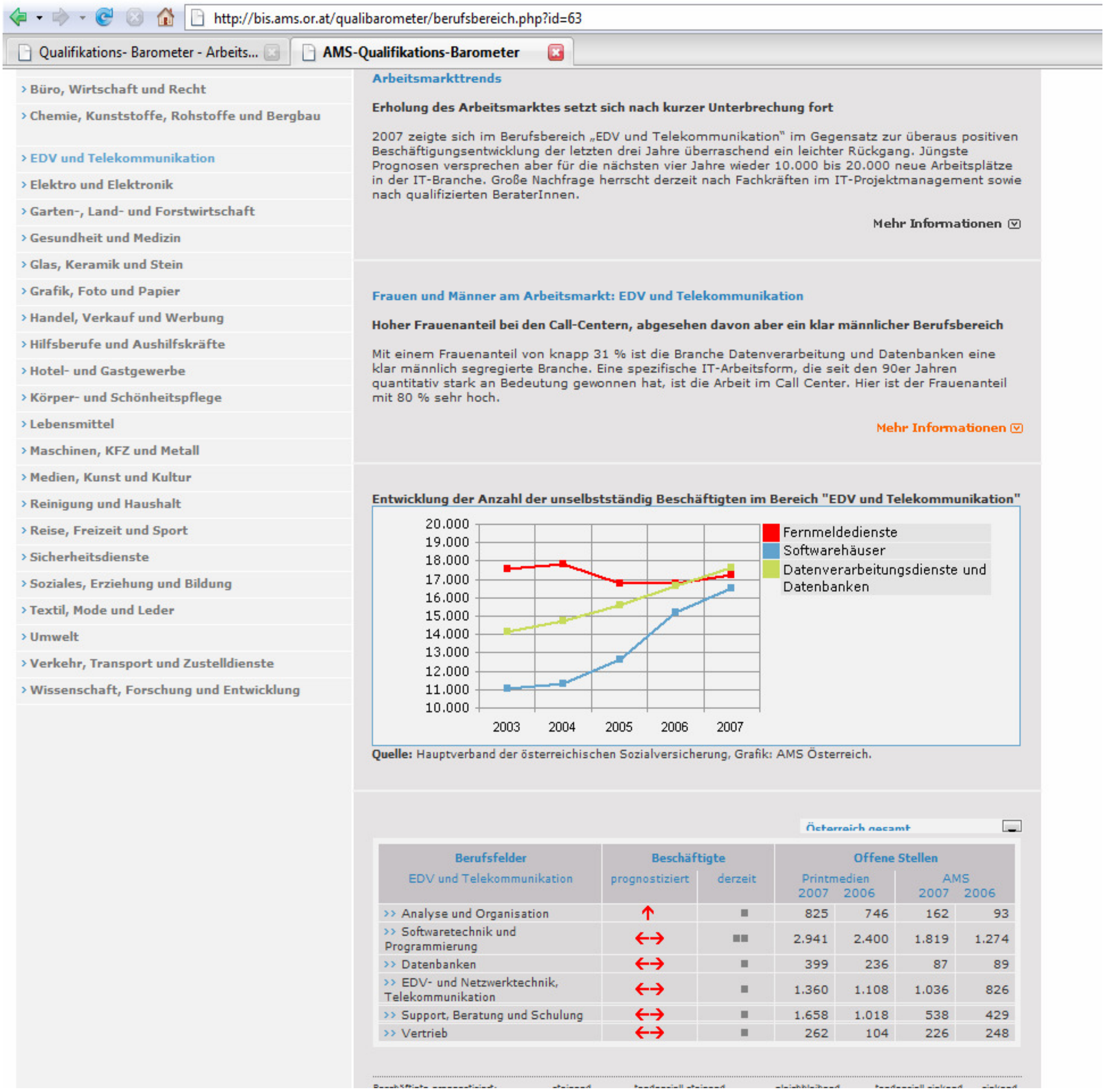
Source: 3s

Figure 3: First page view of the AMS-Skills Barometer:



Source: www.ams.at/qualifikationen

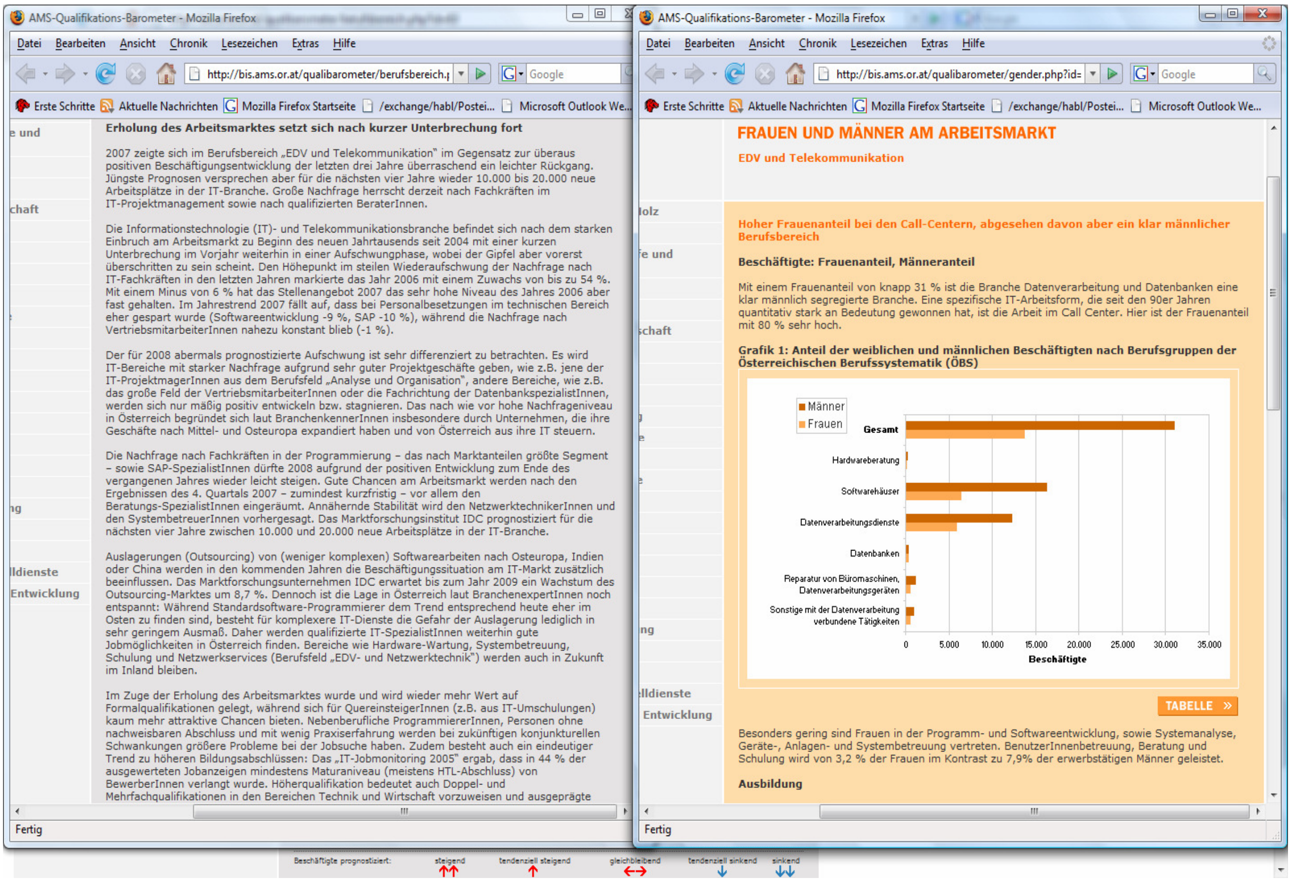
Figure 4: Occupational area "IT and Telecommunication" in the AMS-Skills Barometer



Source: www.ams.at/qualifikationen

The link "Mehr Informationen" (blue) at the end of the first text section expands the short introduction to a more comprehensive text (see left half of the following figure). Another link "Mehr Informationen" (orange) at the end of the second text section provides more information on gender specifics for the respective occupational area (see right half of the following figure).

Figure 5: Particular text information on labour market trends (left) and gender related labour market situation (right) in the occupational area of "IT and Telecommunication"



Source: www.ams.at/qualifikationen

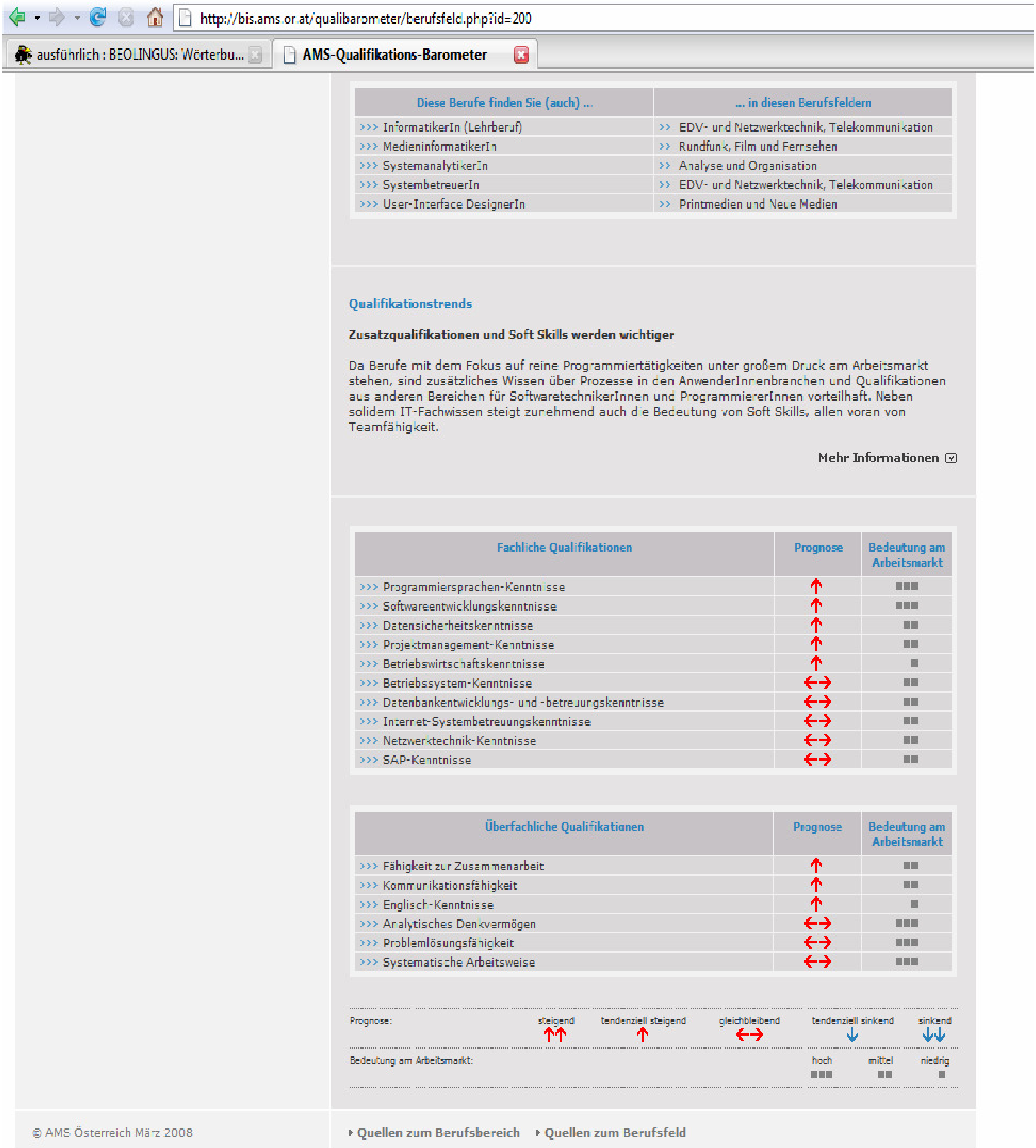
Trend information captured in tables for vocations and vocational fields is visualised by arrows and dots. The assessment is based on the evaluation of the editors and rely on the trend information provided by quantitative and qualitative analyses as well as on expert interviews.

2.4 Basic Structure of the Skills Barometer – Qualification Information

Following recent trends in vocational research the AMS-Skills Barometer also undertakes the attempt to pay more detailed attention to skills and competencies than usual in more traditional labour market information systems. Thus, a second ontology, a comprehensive classification of skills and competencies (summarized as "Qualifikationen/qualifications"; compare figure 2) has been designed and implemented:

Tables for every occupational field display relevant qualifications taken from this ontology and rate their present ("Bedeutung am Arbeitsplatz"/importance at the workplace) and future significance ("Prognose"/prognosis) This trend rating is also represented by means of graphic symbols (compare figure 6).

Figure 6: Qualification information in the occupational field of "Software Technology and Programming"



http://bis.ams.or.at/qualibarometer/berufsfeld.php?id=200

ausführlich : BEOLINGUS: Wörterbu... | AMS-Qualifikations-Barometer

Diese Berufe finden Sie (auch) ...	... in diesen Berufsfeldern
>>> InformatikerIn (Lehrberuf)	>> EDV- und Netzwerktechnik, Telekommunikation
>>> MedieninformatikerIn	>> Rundfunk, Film und Fernsehen
>>> SystemanalytikerIn	>> Analyse und Organisation
>>> SystembetreuerIn	>> EDV- und Netzwerktechnik, Telekommunikation
>>> User-Interface DesignerIn	>> Printmedien und Neue Medien

Qualifikationstrends

Zusatzqualifikationen und Soft Skills werden wichtiger

Da Berufe mit dem Fokus auf reine Programmiertätigkeiten unter großem Druck am Arbeitsmarkt stehen, sind zusätzliches Wissen über Prozesse in den AnwenderInnenbranchen und Qualifikationen aus anderen Bereichen für SoftwaretechnikerInnen und ProgrammiererInnen vorteilhaft. Neben solidem IT-Fachwissen steigt zunehmend auch die Bedeutung von Soft Skills, allen voran von Teamfähigkeit.

Mehr Informationen

Fachliche Qualifikationen	Prognose	Bedeutung am Arbeitsmarkt
>>> Programmiersprachen-Kenntnisse	↑	■■■
>>> Softwareentwicklungskenntnisse	↑	■■■
>>> Datensicherheitskenntnisse	↑	■■
>>> Projektmanagement-Kenntnisse	↑	■■
>>> Betriebswirtschaftskenntnisse	↑	■
>>> Betriebssystem-Kenntnisse	↔	■■
>>> Datenbankentwicklungs- und -betreuungskenntnisse	↔	■■
>>> Internet-Systembetreuungskenntnisse	↔	■■
>>> Netzwerktechnik-Kenntnisse	↔	■■
>>> SAP-Kenntnisse	↔	■■

Überfachliche Qualifikationen	Prognose	Bedeutung am Arbeitsmarkt
>>> Fähigkeit zur Zusammenarbeit	↑	■■
>>> Kommunikationsfähigkeit	↑	■■
>>> Englisch-Kenntnisse	↑	■
>>> Analytisches Denkvermögen	↔	■■■
>>> Problemlösungsfähigkeit	↔	■■■
>>> Systematische Arbeitsweise	↔	■■■

Prognose: steigend ↑↑ · tendenziell steigend ↑ · gleichbleibend ↔ · tendenziell sinkend ↓ · sinkend ↓↓

Bedeutung am Arbeitsmarkt: hoch ■■■ · mittel ■■ · niedrig ■

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Quellen zum Berufsbereich · Quellen zum Berufsfeld

Source: www.ams.at/qualifikationen

"Qualifications" are, as mentioned before, seen in a comprehensive way and represent knowledge, skills and abilities. The AMS-Skills Barometer does not only inform about domain specific skills for every occupational field, but also about personal skills, the need for particular professional experiences, or additional skills in demand (like specific IT-skills as a chance for quicker job integration).

3 Regional Forecasts in the AMS-Skills Barometer

3.1 The AMS-Skills Barometer and Regional Forecasting

Information on regional labour market trends is not the main focus of the AMS-Skills Barometer. But since also studies containing regional forecasts are evaluated when compiling the information on occupational fields, regional disparities in skill trends are being referred to in the texts, if needed. Furthermore, the quantitative data displayed in the AMS-Skills Barometer – data on job vacancies – is represented with a regional focus: job vacancies for the last year (and the year before) can be looked upon either at national level, or at the level of one of the nine Austrian federal states ("Bundesländer", like Upper Austria, Burgenland, Vienna, the Tyrol …).

A few words have to be said about Austria's regional structure: Austria is a country with little more than 8 million inhabitants, divided into 9 different federal states. The Austrian Labour Market service is responsible for the whole country, no specific difference being made in the service within the different regions.

On the other hand, regional differences do exist and constantly influence the development of the labour market. Usually these regional labour market differences do not strictly follow the borders of the nine federal states, but align themselves to other regional demarcations, such as rural / urban environments, tourism regions, industrial service areas, etc. Basic statistical data is usually represented according to the 9 federal states, and therefore provides only insufficient trend information at the level of the many different regions.

At the same time, one could argue that Austria's labour market information is relating to a small regional basis anyway, due to the small scaled division of the country. After all, some German regions have more inhabitants than Austria as a whole.

3.2 Examples for regional forecasts within the AMS-Skills Barometer

As we said before, providing information at a regional level is only seen as one of the tasks of the AMS-Skills Barometer. Despite the attempt to attract more notice to skills and competencies, it is still occupations and vocational information which guides the structure and composition of the information system. Regional information has always been – and still is – one of the aspects that have constantly been kept in mind, right from the beginning.

Apart from data on job vacancies, which can be displayed at the level of Austria's nine federal states, information on regional specifics is provided in the texts on occupational fields, sometimes even in occupational areas, throughout the AMS-Skills Barometer. Due to the limits of the evaluated sources (see above, 2.1), this cannot be done as systematically as with the data on job vacancies. A few examples might deliver a deeper insight.

Service tourism: In Eastern border regions of Austria a specific phenomenon has occurred for several years that is usually referred to as "personal service tourism". Quite a few Austrians living close to the border prefer to travel to the Czech Republic, to Hungary, or Slovakia, to get dental services, to have their hair done, and such. This applies to (parts of) the federal states Upper and Lower Austria, Styria and Burgenland. The effects on the labour market are described in the texts of the respective vocational fieldswith phrases like: "growing cross-border competition", "declining prices for services", and "decreasing chances for job seekers in Austria".

Regional differences in tourism: According to geographic conditions, different characteristics of tourism are concentrated in different regions. Thus, winter sport tourism plays an important role in Western Austria (within the federal states of Tyrol, Vorarlberg, Salzburg), in the South (within the federal state of Carinthia), and is less important (but partially still important) as a job market in federal states like Upper Austria or Styria. On the other hand, tourism has become more important in parts of Eastern Austria over the last years, following the "wellness boom" and the development of spas and hot springs. Information like this can be found in texts on the occupational area of tourism.

Similar descriptions are presented for topics like *automotive industries,* which are concentrated in specific industrial areas in the federal states of Upper Austria and Styria. Creative industries, media development, printing industry and professions in art and culture will find better conditions in the central region of Vienna (a federal state itself) and its surroundings (the surrounding regions of the federal state of Lower Austria), where the related sectors are concentrated.

With respect to the need for *medical doctors* and *teachers,* there are differences in demand between rural areas and bigger cities, or in other words cities with universities and cities without: In rural areas, *medical doctors* and *teachers* might still find good employment opportunities, whereas in bigger cities chances have decreased.

There exists yet another type of forecast with a regional reference, but with a different angle: In certain fields and occupational sectors, a shift from regional structures towards international, European, or global markets can be observed. This is especially the case e.g. for the printing and paper industry, where companies more and more face an international competition.

In a different way internationalization plays an increasing role on national labour markets: E.g. Austrian banks and insurance companies were expanding to the CEE-countries for several years. This also had an impact on skill demand and job chances: for instance more and more future employees are expected to accept placements for a certain period of time; on the other hand, people from neighbouring countries improved their chances on the Austrian labour market, as they bring along native speaker competencies for languages in demand, thus intensifying competition between national and international job seekers.

All of this kind of information is integrated following the main basic structure of the AMS-Skills Barometer, which does not have its main focus on regional information, but offers it, whenever regional differences are reshaping the development of occupational fields.

The AMS-Skills Barometer could, of course, also follow Austria's federal structure to provide information on labour market needs focussing strongly on regional differences, and delivering information on trends and development in sectors which shape the respective region. But this is not done so far.

Leaving the AMS-Skills Barometer as an online tool behind, we would like to point out a printed information tool, which we consider as the most important example for regional information in this context.

The *regional "Qualification Structure Reports"*[3] *("AMS-Qualifikationsstrukturberichte")* are a set of reports, which consist of textual trend descriptions at national level, and in addition, of detailed data on job vacancies for each federal state (Bundesland). So each regional

[3] Arbeitsmarktservice Österreich, ABI / Abteilung Arbeitsmarktforschung und Berufsinformation: Qualifikationsstrukturbericht des AMS Österreich für das Jahr 2007. Wien, Juni 2008.

report has the same texts for all of the occupational areas and fields, but differs in the figures and tables provided. The quantitative data shown in these figures and tables are based on the analysis of job advertisements in print media and the job vacancies announced at the “AMS”, and are displayed for the respective federal states, such as vacancies for the Tyrol.

The regional “Qualification Structure Reports” are intensely used by the regional offices of the “AMS” for further analysis of regional labour markets, supporting them in such decisions as financing vocational training in selected occupational fields.

4 Further Developments concerning the AMS-Skills Barometer

Structured feedback from users (within evaluation projects, but also from an expected online user’s survey which will take place in 2008), discussions with relevant user groups, and the discussion with information providers (like experts of labour market analysis, statistical institutions, etc.) influence the ongoing work on the AMS-Skills Barometer insofar as they serve as an impulse for further development leading to new challenges for the AMS-Skills Barometer.

For instance, the overall design as a “basic information instrument”, serving all different user groups at once, is in question. Maybe more detailed information for experts, and basic information for a first insight, should be separated, in one way or the other. Also, the presentation of “(seemingly) contradictory results” from labour market forecasts for expert use is discussed, needing complementing references to different sources, different structures and different methods in use for forecasting and further comparison. Supplementary information of this kind might not be made accessible for a broad public, in order to avoid misunderstandings and misleading information.

These and more ideas and considerations are still in discussion; which of them will ultimately be implemented, depends not only on the expected effects, but also on the available resources.

Following the overall trend that the “concept of occupations” decreases in importance, while the “concept of job related tasks” becomes more prominent, AMS-Skills Barometer’s focus on information will shift: Sooner or later the structure and description of workplace related skills will replace constructions that use occupations.

The AMS-Skills Barometer allows for this trend by reserving more and more space to the information system’s own skills ontology. Through a nationwide survey done by the “AMS” (see 2.2), quantitative data on skill demand will be integrated into the AMS-Skills Barometer. This kind of quantification of skills demand (not comparable to “qualifications” as levels of education) is a new concept for broad labour market information services in Austria. On the basis of the respective survey, quantified skill demand will be visualised at regional level for the first time.

On the other hand, the skills ontology used in the AMS-Skills Barometer already cut across Austrian borders to form the basis of a European skills ontology developed within the budget of a recent Leonardo da Vinci project (“DISCO – Dictionary on Skills and Competencies”), funded by the European Commission (more information can be found at http://www.disco-tools.eu). Also the development of the European Qualification Framework (EQF) and the National Qualification Frameworks (NQF’s) could be seen as a sign for the growing importance of comparable competence structures, based on comparable descriptions of competences and skills. The skills ontology used in the AMS-Skills Barometer is one basic tool in action for providing occupation and skills trend information.

X The Systems for the Early Identification of Skills Needs in Ireland

John McGrath

1 Introduction

This paper contains a summary of the key players, systems and processes involved in the early identification of skill needs in Ireland. It focuses, in particular, on three aspects of the system; the institutional framework; the methodologies used to gather and analyse data on skill shortages and the ways in which the data is used as an aide to policy formulation.

The Skills Needs Identification model described in this paper is usually used by policy analysts to identify imbalances between the demand and supply of skills at a national level. This is because the Ireland is a relatively small country and to date, labour mobility as not been identified as a major problem in reconciling skills demand and supply.

However, many of the indications of skills shortages used in the model, can be applied at a regional level. Specifically, the model can and, in certain cases has information on skill shortages at regional level to policy-makers.. The data on employment, vacancies and immigration can all be analysed at the level of the region.

2 The Institutional Framework.

There are four key players in the national skills identification system. These are the Expert Group on Future Skills Needs (EGFSN); Forfas – the National Policy and Advisory Board for Enterprise, Trade, Science and Innovation; FAS, the National Training and Employment Authority of Ireland and, in particular, its Skills and Labour Market Unit; and the Economic and Social Research Institute. Their functions are summarised briefly below.

The Expert Group on Future Skills Needs EGFSN) was set up by Government in 1997 – initially in response to what was perceived at the time as a chronic shortage of computer professionals. However, its remit has expanded and it now monitors all sectors of the Irish economy – albeit with an emphasis on the enterprise sector – with a view to identifying any current or future skill shortages and making recommendations to Government on how they can be resolved.

The Expert Group is a tripartite committee – that is it contains representatives of the social partners and Government. It meets at least every quarter and the Group is chaired by an independent chair-person appointed by the Government.

The Expert Group has a secretariat within Forfas and the secretariat is responsible for providing the administrative and clerical support required by the Expert Group.

The Secretariat also provides a research resource to the EGFSN. Since its inception, the Expert Group, through the Secretariat, have commissioned external researchers to monitor the skills profile of different sectors of the economy. However, in 2001 the Expert Group decided to create its own research arm – the Skills and Labour Market Research Unit (SLMRU) – to provide it with on-going analysis of skill needs in different sectors. The Expert Group continue to commission research from external research agencies for substantive pieces of work – the rationale for setting up the SLMRU was to have an in-house facility capable of providing a skills monitoring role tracking trends in skills demand and supply across the economy rather than any in-depth investigation into a particular sector.

The SLMRU is part of FAS. FAS was chosen for the location of the SLMRU because it already had a strong reputation in the area of skills research and indeed it was already collecting a considerable amount of data on the labour market such as data on vacancies, job-seekers and apprentices.

The Economic and Social Research Institute (ESRI) is also a key player in the system of skills research. It is the major ‘private’ research organisation in Ireland and it is involved in a very wide range of research on both economic and social issues. From the point of view of skills research however, the critical role played by the ESRI is that it provides medium term forecasts of growth in the economy using a macro-economic model. These forecasts are very well regarded and the Government regularly utilise such forecasts in formulating and justifying policy interventions in many areas.

Since the early 1990’s, the ESRI have engaged in a joint venture with FAS on the basis of which the ESRI ‘translate’ their output forecasts into forecasts of employment by 43 occupational sub-groups for 5 year periods.. The ESRI use a methodology known as the shift – share analysis in translating their sectoral output forecasts into employment projections by broad occupational group.

The ESRI play a critical role in the Irish system of skills identification by providing that ‘bridge’ between the forecast output from each sector of the economy and the skills needed to produce that level of output.

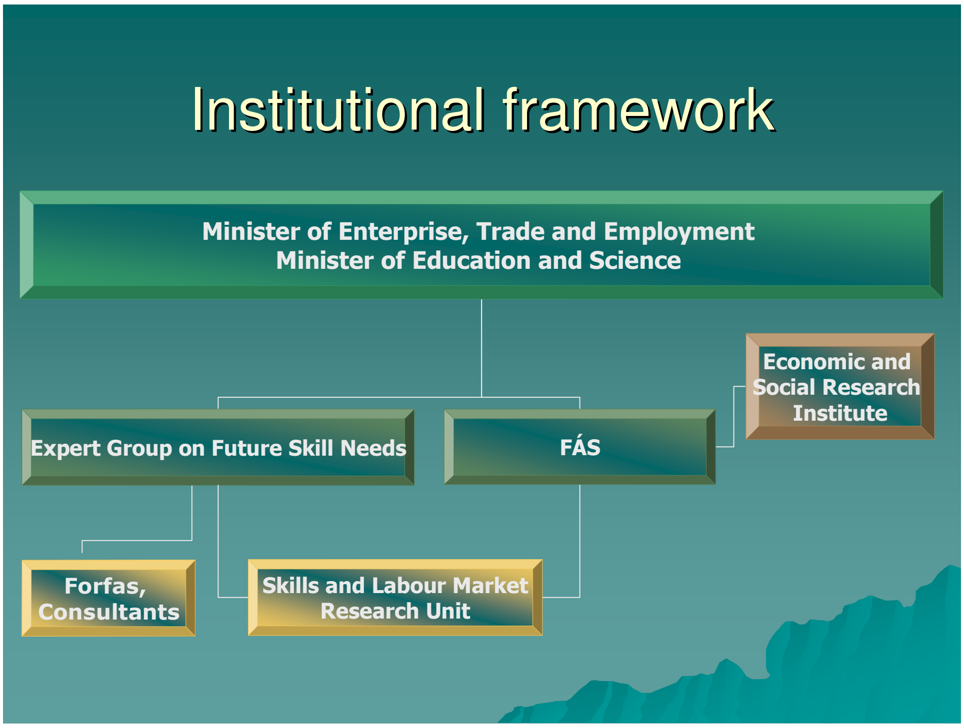
Both the ESRI and the SLMRU provide forecasts of skills demand. However, the forecasts provided by the SLMRU differ from those provided by the ESRI in that they are forecasts of individual occupations rather than forecast of occupational groups. Of course, this means that the potential for significant error is much greater in the context of the SLMRU forecast. However, the Expert Group is interested in the demand and supply of skills as such. For example, they would wish to know if the supply of architects or civil engineers is sufficient to meet the requirements of the construction industry over the next decade and this type of questions can only be answered by attempting to forecast at the level of the individual occupation. The SLMRU attempt to reduce the margin of error by conducting regular reviews of their forecasts and by ensuring that, in cases where the forecast is identifying shortages, that conclusion is consistent with a range of labour market indicators such as immigration, vacancies, earnings trends and so on.

From 2009, the SLMRU will be more involved in the initial forecasting exercise. The ESRI will continue to provide the sectoral output forecasts from their macro-economic model but the SLMRU will apply the shift-share analysis to translate the growth forecasts into forecasts of occupations.

The structure of the skills identification model in Ireland is outlined below. The EGFSN’s reports to both the Minister for Enterprise, Trade and Employment and the Minister for Education and Science. The rationale behind the inclusion of both Ministers is to ensure that both those who are responsible for the formulation of public policy in respect of the supply of skills and qualifications, and those who are responsible for policy in respect of the demand for skills are embedded in the structure.

The Expert Group is obliged to issue an annual report of its activities, including the results of the research it has undertaken in the previous twelve months and the actions which have been implemented to achieve the recommendations. One of the reasons for the inclusion of such a report in the structure is to ensure that the recommendations of research reports are regularly reviewed and that the recommendations are implemented.

Figure 1: The Structure of the Early Skills Needs identification Model



3 Methodologies for collecting and analysing data.

The data which the SLMRU use to produce their skills monitoring reports comes from a National Skills Database, which has been developed by the SLMRU at the request of the Expert Group.

The National Skills Database has been developed in order to collate all available data about the Irish labour market which is relevant to the issue of the demand and supply of skills. The staff of the SLMRU have the status of 'statistical officers of the State'. All of the Public Authorities who gather relevant data supply that data to the SLMRU in a format which allows for its inclusion in the database. Such data includes data on the salient characteristics of the employed population, the student population, immigrants and jobseekers. The SLMRU also collect data on vacancies from the Public Employment Services (PES). However, the PES only represents about 40% of the total vacancy market in Ireland and vacancies for traditional industrial jobs are over-represented in the dataset. Consequently, the SLMR augment the public vacancy data-base with two data-bases from the private sector. The first database is from the Irish Times newspaper, where most vacancies in professional occupations are advertised. The second database is from www.Irishjobs.ie which is the largest source of internet-based vacancies in Ireland.

Inevitably, there is some double-counting of vacancies between the publicly notified vacancies and the vacancies notified to the internet site or the newspapers. However, the SLMRU use the vacancy trend rather than the absolute figures as an indication of demand trends in a particular occupation.

The SLMRU conduct two surveys to augment the data in the database. The first is a monthly survey which it conducts jointly with the Economic and Social Research Institute. This survey covers a representative sample of companies in the construction, manufacturing, retail and services sectors.

The purpose of this survey is to gather data on skills which are considered to be in short supply by industry and to obtain from employers information on their recruitment plans in the short-term.

The survey asks employers, who are experiencing difficulties in filling vacancies, to list, in their own words, the job titles of the five vacancies which are, in their experience, the most difficult to fill. The answers to this question are one of the indicators of shortages which the SLMRU use to identify skills which are in short supply.

In addition, the SLMRU also undertakes a survey of recruitment agencies. This survey is conducted on-line and is carried out twice a year. The objective of this survey is to obtain information from recruitment agencies on the job titles of the vacancies which are moist difficult to fill. Unlike the previous survey, this survey attempts to elicit information on the causes of the shortage in order to distinguish between those shortages which arise from an insufficient supply of persons with either the relevant experience or qualifications or both, and other reasons.

4 The Outputs from the System

The main outputs from the database include two annual reports which track both the demand for, and the supply of skills in the Irish economy. These reports are based primarily on the data contained in the National Skills Database.

a. The national Skills Bulletin: The report monitoring trends on the demand side of the labour market is called the ‘National Skills Bulletin’. The main focus of the Bulletin is the analysis of employment at occupational level over the previous five years. Each occupation is examined in terms of data in the NSD. These include its employment profile and five year trends; the number of employment permits issued to non-EU nationals by the Department of Enterprise, Trade and Employment; an indication of difficulty in filling positions from the monthly FÁS/ESRI Vacancy Survey; movements in the number of vacancies advertised through FÁS, the Irish Times and www.Irishjobs.ie; an estimation of the supply emerging from the Irish education and training system as provided by the Higher Education Authority, Higher Education and Training Awarding Council (HETAC), Further Education and Training Awarding Council (FETAC), Department of Education and Science, State Examinations Commission and various private providers; any other relevant findings from the EGFSN’s sector studies and the SLMRU sector studies.

By synthesizing all of the above information in the Bulletin, it is possible to arrive at a reasonably reliable estimation of the balance between the demand and supply for each occupation. Identified shortages are defined in terms of their characteristics, i.e. skill shortage or labour shortage, expected duration and significance.

This information is summarised in respect of over 300 occupations in a table in the Bulletin. A page from the table is shown below for illustrative purposes. For illustrative purposes, a page from the bulletin indicating how shortages are identified in shown below in Table 1.

b. Monitoring Ireland's Skills Supply; Trends in Education/Training Output:

The report monitoring the supply of skills in called 'Monitoring Ireland's Skills Supply; Trends in Education/Training Outputs'. The objective of this report is to provide an indication of the current and future supply of skills to the Irish Labour Market from the formal education and training system. It examines these outflows across 7 levels of the 10-level National Qualifications System (i.e. levels 3-10). At each level, the supply of skills is examined under the following indicators;

Graduate output: It is used as an indicator of future supply.

Student inflows: this is used as an indicator of the potential future supply of skills

Gender: this is used as an indicator of gender balance**.**

Discipline: This is used as an indicator of the supply of skills by broad range**.**

First destination: this is used as an indication of the student's destination following graduation.

International comparison: This is an indicator of how Ireland performs internationally in terms of education flows.

5 Other Outputs from the National Skills Database

The SLMRU through the NSD provides many different types of analysis of the labour market for a wide range of clients. For the EGFSN, the Unit provides the annual monitoring reports on skills demand and supply, the quantitative analysis for all sector studies and the demographic forecasts for the national skills strategy document Tomorrows Skills; Towards a National Skills Strategy'.

The Unit is also responsible for tracking the extent to which the targets in the national skills strategy are being met. It does this through a detailed analysis of the qualifications of the workforce on an annual basis.

The Unit also provides regular analysis to the Economic Development Agencies – particularly IDA Ireland – and to the career guidance department in FAS

Table 1: Example of Demand and Shortage Indicators for Selected Occupations

Occupations	Numbers employed	% female	Part-time	Unemployment	% >55	% Non-Irish National	Annual average growth rate 2001-2006	Work permits 2006	Work Visas/ Authorisations 2006	Difficult to fill vacancies	Replacement rate	Shortage indicator	Comment
Natural scientists	9,700	59.7%	7.1%	Below Average	5.6%	7.3%	7.1%	39		17	2.8%	No shortage	
Chemists	2,400	17.9%	2.0%		5.4%	5.5%	6.7%	3		7	2.8%	Skill shortage	F
Biological scientists	4,400	61.1%	10.0%		10.0%	5.0%	10.0%	13	2	8	2.8%	Skill shortage	F
Physicists & other natural scientists	2,900	52.7%	7.4%		0.0%	11.7%	3.7%	23	1	2	2.8%	Skill shortage	F
Engineers and technologists	45,200	12.1%	2.7%	Below Average	7.4%	11.3%	6.0%	281		142	2.8%	Skill shortage	
Civil/mining engineers	11,500	7.6%	0.8%		9.1%	10.5%	9.3%	6	105	28	2.8%	Skill shortage	S,C,F
Mechanical engineers	5,200	4.9%	1.3%		8.3%	11.2%	7.5%	0		6	2.8%	Skill shortage	F
Electrical engineers	4,000	4.2%	1.5%		6.9%	7.9%	5.8%	3		6	2.8%	Skill shortage	C,F
Electronic engineers	3,500	11.5%	4.3%		5.3%	10.0%	-0.1%	23		0	2.8%	Skill shortage	C,F
Software engineers	10,200	20.9%	5.8%		2.3%	11.5%	4.9%	174	313	7	2.8%	Skill shortage	S,C,F
Chemical engineers	1,600	5.9%	2.3%		3.1%	13.2%	9.1%	0		3	2.8%	Skill shortage	C,F
Design & development engineers	1,900	25.2%	3.6%		7.8%	17.7%	7.8%	19		7	2.8%	Skill shortage	C
Planning & quality control engineers	1,800	27.9%	0.0%		12.9%	11.3%	-0.6%	5		22	2.8%	Skill shortage	C
Other engineers & technologists n.e.c.	5,700	12.0%	2.7%		12.1%	13.0%	6.1%	51		63	2.8%	No shortage	
Health professionals	17,200	43.5%	13.1%	Below Average	15.7%	14.7%	5.6%	719		0	2.8%	Skill shortage	

Medical practitioners	10,400	39.1%	12.7%		16.2%	19.1%	7.2%	620	33	0	2.8%	Skill shortage	S,C,F
Pharmacists/pharmacologists etc	2,800	70.2%	16.2%		17.9%	9.9%	3.8%	94		0	2.8%	Skill shortage	C
Dental practitioners	1,500	68.2%	20.7%		9.5%	0.0%	2.9%	2	1	0	2.8%	Skill shortage	S,C,F
Veterinarians	1,900	82.0%	7.2%		14.7%	6.1%	5.8%	3		0	2.8%	No shortage	
Teaching professionals	84,200	70.9%	14.9%	Below Average	14.5%	4.6%	3.9%	97		0	2.8%	No shortage	
University and IoT lecturers	11,800	45.6%	13.0%		17.4%	13.6%	5.6%	53		0	2.8%	No shortage	
Secondary and vocational education teachers	32,100	68.2%	13.2%		16.2%	3.9%	4.0%	2		0	2.8%	No shortage	
Primary & nursery education teachers	32,000	82.0%	8.1%		11.4%	2.1%	4.4%	9		0	2.8%	No shortage	
Legal professionals	10,700	46.1%	5.5%	Below Average	11.0%	2.8%	5.8%	15		11	2.8%	No shortage	

The type of information which is generally requested by the Development Agencies involves regional skill profiles. Such profiles are very useful for companies who are considering locating a plant in a particular area.

The Unit also provides quantitative profiles of occupations for the FAS career guidance service and for the national prison service. The research staff of the Unit regularly give presentations to schools on future skill trends.

6 The Role of Sectoral Studies in the System

The Forfas secretariat conduct studies of sectors at the request of the EGFSN. In some cases, these studies are commissioned to external consultants; in other cases, the secretariat will request the SLMRU to carry out the study.

In general, the SLMRU conduct sector studies for the EGFSN in cases where the Unit is considered to have expert knowledge of the sector. Thus the Unit is carrying out two sector studies in 2008 for the EGFSN; one on the skill needs of the construction sector and on the skill needs of the healthcare sector.

However, even in those cases where the EGFSN commission a sector study to external consultants, *all of the quantitative analysis for the study* - including the statistical profiles of the sector and the employment forecasts - are provided by the SLMRU. Thus, in the case of the recently completed study on Financial Services, the SLMRU provided all of the quantitative research and the external consultants focused on gathering the qualitative data in respect of the type of skills required by those companies who are operating at the higher value-added level in the international Financial Services sector.

Under this arrangement, the consultants are contracted to provide the specialist knowledge associated with the sector and to conduct the qualitative interviews with the employers and the sector experts.

Thus, the level of knowledge of the sector is one of the key criteria in appointing the consultants. The focus of the commissioned research is on producing ‘added value’ rather than simply regurgitating existing statistics.

The rationale underpinning the decision of the EGFSN to do a study of a particular sector is a perception that the sector must or will change its current ‘modus operandi’ in some fundamental respect. The study is required to identify in quantitative and qualitative terms the human resources required to facilitate and support that change.

Thus, in the case of the recently completed study on the Financial Services Sector, it is Government Policy to encourage the sector to move up the value chain from activities which are primarily related to fund administration to more sophisticated fund management activities and the study was designed to identify the human resource strategy required to facilitate this transition.

Similarly, both the Irish construction industry and the healthcare sector are undergoing a process of profound structural change, which will have serious implications in terms of the future skills profile of each sector.

While the methodological approach may vary from sector to sector, there are certain fundamental features which are common to every sector study. A sector study is first and foremost a systematic exploration of what is required in terms of human resource strategies to promote and sustain best practice performance within a particular sector. As such, the methodology will generally include an analysis of international companies which are considered to exhibit best practice. Invariably this task will entail an international study visit.

In the case of the recently completed study of the Financial Services Sector, this involved the consultants conducting detailed structured interviews with a large number of 'state of the art' financial services companies in New York and London and visits to universities whose finance programmes and departments have an international reputation.

The type information which the consultants gathered during these study visits include information on the skills and technology of best practice companies; the type of educational curricula which is favoured by the industry and the nature of the interface between the education system and the sector.

The profile which emerges is then compared to the corresponding situation in Ireland and this exercise invariably produces a number of skills gaps and human resource strategic deficiencies. Addressing these gaps and deficiencies become the basis for the recommendations of the study.

7 Conclusions

The skill needs identification system in Ireland consists of five key players. Forfas – the organisation responsible for economic development - contains the secretariat, which provides the administrative and research support to the EGFSN. FAS – the National Training and Employment Authority – contain the Skills Unit which provides the quantitative data and some research studies required by the EGFSN and other Government Departments and Agencies. Finally, the Economic and Social Research Institute provides the macro-economic forecast on which the more detailed individual occupation forecasts from the SLMRU are based.

There are both strengths and weaknesses in the Irish skills needs identification model and these are summarised below.

Perhaps its greatest strength is that there is an appreciation in Government that a national system of skills needs identification is critical to the future success of the Irish economy. Consequently, both the EGFSN and the SLMRU work within a supportive environment which encourages the public authorities to provide data to the SLMRU and which also facilitates the implementation of the recommendations of studies commissioned by the EGFSN.

Through the EGFSN, there is a high level of formal co-ordination between those who are responsible for economic development and those who are responsible for the provision of training and education. Thus the demand-side and the supply side of the labour market are brought together in a centralised structure. This co-ordination is exemplified in the fact that the EGFSN reports to both the Minister of Enterprise, Trade and Employment (i.e. those who influence the demand side of the labour market) and the Minister of Education and Science (i.e. those who influence the supply-side of the labour market).

The National Skills Database is also a major strength of the system because it means that any analysis of the demand or supply of skills required by policy-makers can be made available – based on the most up-to-date data – within a few days at most. It also means that consultants can focus exclusively on bringing 'added-value' to sector studies rather than being concerned with collating secondary data to provide statistical profiles and forecasts.

The creation of a skills research unit within the Skills Needs Identification System means that the expertise developed through conducting sector studies and forecasting exercises and other analysis of the labour market is retained and developed within the system.

There are a number of features of the Irish system which could be considered weaknesses in the context of any consideration regarding the adoption of this system *tout court* in another country.

Firstly, unlike the skill needs identification systems in many European countries, notably France[1] Norway, Austria and Lithuania, the Irish system does not use the public employment services data on registered job-seekers or notified vacancies as a means for generating 'barometers' of skill shortages. The SLMRU are discussing the possibility of creating such barometers with FAS, but it is concerned that the data on 'vacancies filled' may not be sufficiently robust to generate reliable indicators.

Secondly, the SLMRU does not carry out an economy-wide enterprise survey for the purpose of acquiring information on skill shortages, nor does it involve employers in focus groups or panels. The views of employers are sought only in the context of studies of specific sectors.

The SLMRU does not use the information collected by the tax authorities unlike for example the systems in Germany and the Netherlands. This information is useful for identifying skill shortages because it provides data on salary levels and it is difficult to find reliable data on salaries. It is also useful for forecasting because it provides information on inter-sector mobility and turnover rates which may be used in the estimation of replacement demand. It is the intention of the SLMRU to seek to persuade the relevant authorities to provide this data.

The official occupation nomenclature used by the SLMRU has only 3 digits. It is also out-of-date. Consequently, there is a danger that the Irish skills needs identification system will not 'capture' emerging skills which are in short supply. The SLMRU is attempting to address this issue through its surveys by collecting data on 'job descriptions' which are difficult to fill and by including additional columns in the occupational nomenclature.

The Irish Skills Needs system does not as yet have a strong regional basis although this could be developed. This is not a particular weakness from Ireland's point of view because the country is relatively small in geographic terms. Indeed, in European, the Irish National Skills Identification model, is essentially a regional skills forecasting model.

[1] For example, AnPE, the French Public Employment Services use the job-seeker and vacancy data to produce 'tension indicators' at the level of broad occupational groups. NAV.

XI Outlook

The different approaches of forecasting regional skill needs and in some cases labour supply show a broad variety of methodology as described in the introduction. Some models are forecasting short term (Italy, Germany Wapler et al.) and some medium term (UK; Netherlands, Germany Bade, Rhine-Main, Ireland, Austria and France). The data used varies from detailed national occupational and educational data, additional regional data, sector and skill data to specific regional data. This information is gained by official statistics or by expert interviews and questionnaires. The seize of the regions analyzed differs between the presented countries. Some are on NUTS 2 but others are on NUTS 3 level. And the methods of the approaches are different. Beside time series estimation expert interviews, shift-share-analysis and macroeconomic models are used.

Although there are so many different approaches which are used in Europe the aim of the forecasting models is to provide information about the labour market for workers and firms as for labour market actors like labour offices or chambers of commerce on a regional level. Information about the future development of demand and supply on the labour market can be used to overcome imbalances on the labour market quickly, or insure that the future imbalance will not manifest itself. In order to be an attractive region both for workers and firms, there should be a balance of labour demand and supply, on each skill level, but preferably also on the occupational level. It is by no means necessary to plan the education of workers and the match to firm's demand in detail, skill forecasting attempts to make future imbalance visible. So this information is also used for developing adequate vocational training inside and outside of enterprises.

Regional data especially is important because there are large differences across regions within a country. Examples are economic sectors, occupational groups etc. which importance for the region can differ from region to region. For most regions past and present information on regional labour markets is available. But the plain availability of information is not sufficient. Having timely information on future developments will be an important factor in regions that provide forecast for the regional employment developments and the qualification demands derived from that.

In our opinion, in the long run, a viable European method of regional employment forecasting and an adequate data basis should be developed. It is well known that forecasting employment developments for a small region is more difficult than doing the same at a national level. From a practical point of view we should focus on a concept of regional forecasting that is not complicated and practically convenient, one that produces reliable results and can be used to forecast several aspects of the regional employment developments. The methodology should be applicable for several regions in Europe. This implies that not only the concept of forecasting should be flexible but also that the data basis for regional forecasting in several regions has to be taken in account.

Such a European concept of medium term forecasting of regional employment developments should combine several concepts of regional forecasting. A possibility would be to combine a bottom-up with a top-down approach, as well as to connect quantitative with qualitative data and methods. Short-term forecasts can go alongside with medium-term forecasts with their respective approaches.

Statistical approaches make projections from past developments into the future. This method assumes structural conditions in the past will not change in the future. But projecting past developments into the future cannot account for new developments. Those developments with no historic precedence in the data can be as simple as the development of new industries, new occupations or educational degrees; or the shift of importance away from some economic activities. Furthermore, structural change can develop gradually or suddenly. This can even differ by regions as some are leading and other are lagging in structural change. Such structural changes have strong influences on employment developments in the regions. As quantitative forecasting methods fall short of new developments or sudden shocks such concepts can be covered by including qualitative methods. This has two aspects. The first one concerns the evaluation of the results of statistical forecasting. The second one concerns new developments of skills, occupations, etc. One method for obtaining information about these new developments would be an expert panel. With a panel of regional experts the results of quantitative statistical methods can be evaluated. Experts can also give information concerning future developments of new qualifications, new occupations, etc. The results of the combined forecasting – i.e. those obtained by quantitative statistical methods together with qualitative projections of structural changes – will offer additional information about future employment developments on a low regional level for regional actors.

The adequate usage of the regional labour market monitoring system with its forecasts should also be considered. Decision makers on the regional labour markets, i.e. firms, workers, policy makers to name only a few, have to learn *interpreting* and *using* the information adequately. Interpreting results correctly usually involves observing the development of the forecasts over time while comparing the forecasts with actual outcomes. This allows the actors to gauge the reaction of all participants to the information available. In essence actors also have to learn how to use the information once they understand how they can be used. Which reaction to forecasted shortages is necessary? What actions are needed, given this information? These are typical questions that an actor has to learn to answer optimally for his or her situation in order to reap the full benefit from the information provided. In essence, actors have to derive the correct interpretation from the forecasts given to generate *knowledge* that allows them to use the information by making well-informed decisions.

This learning process in the use of labour market information system by all actors implies that forecasts should not be a one-shot exercise, rather the introduction of new forecasting system, ideally embedded in a labour market information or monitoring system, should encompass several cycles of forecasting and usage before the impact and usability can be evaluated. In order to improve the efficiency of regional labour markets and to increase the effectiveness of regional labour market policies, it is crucial to communicate information extracted from the forecasting of future developments to actors in order to produce new knowledge. These two elements – information and communication – are necessary for a complete functioning regional forecasting system on labour markets.

XII About the Authors

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XIII Abstract

Claudia Knobel / Ben Kriechel / Alfons Schmid (Eds.) (2008):
Regional Forecasting on Labour Markets. Rainer Hampp Verlag. München and Meringen. Germany.

Regional Forecasting on labour markets is a regional approach to generate data about future developments that cover adequately the information needs of labour market actors. Approaches from different European regions are presented in this book. Furthermore, the central elements of these approaches are discussed with respect to their problems in data and / or methodology. Some solutions are discussed within the different models presented.

This book was developed by several members of the European Network of Regional Labour Market Monitoring.

Key Words: Regional Labour Market – Regional Forecasting - Regional Information

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