Forecasting skill supply and demand in Europe to 2020: Replacement demand – methods and results

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Ben Kriechel; Jan Sauermann

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CONTACT DETAILS:

Research Centre for Education and the Labour Market
Maastricht University | ROA
P.O. Box 616, NL-6200 MD Maastricht
www.roa.nl

Alphametrics (AM)

***A*lphametrics Ltd**

Preface and Acknowledgements

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

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

Thanks are also due to the various experts from individual countries who have taken time to review and comment upon the emerging findings as well as from the Cedefop team managing the project. Finally, thanks are due to Peter Millar who undertook much of the technical analysis required to process the European LFS data, and the linking of this with the results from the macroeconomic model.

Rob Wilson (Project team leader)

Abstract

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

Replacement demand is a significant source of labour demand. It is affected by the ageing workforce, which increases replacement demand, and the increasing participation of women, decreasing participation rate.

On the European level it is estimated to reach a level 2.6% annually. The underlying country estimates for all 27 EU countries together with Norway and Switzerland are reported.

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Glossary

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

E3ME	Multi-sectoral macroeconomic model
EDMOD	Model to produce occupational projections
RDMOD	Model to produce projections of replacement demands
QUALMOD	Model to produce qualification projections

1. Introduction and background

In addition to analysing changes in overall occupational employment levels it is important to consider replacement demand arising from retirements, net migration, movement into other occupations and in-service mortality. This is referred to as replacement demand. In general terms, replacement demand can be seen as job openings arising because people leaving the workforce or their occupation. Most work on replacement demand has tended to focus on what might be called “permanent or semi-permanent” withdrawals from the employed workforce. The main reasons for this are retirement, emigration, and especially for women family formation and taking care of children. Next to withdrawals from the labour force, we also include movements of workers from one occupation to another. These movements leave a vacancy for the occupation left; hence demand for a worker to fill that occupation. Given the methodology, the focus will be on net-movement within age cohorts, differentiated by gender.

Related concepts to replacement demand are turnover and churning. Turnover usually defines movements out of a firm, whereas churning is the sum of both in- and outflows. Churning is therefore a measure of gross movements. Replacement demand, as it is defined in this project, measures net flows. Furthermore, replacement demand takes the occupation or the education as the unit of interest, whereas churning and turnover take the plant or firm as the unit of measurement. Replacement demand thus measures the net flows from an occupation or education.

The estimates are an update of the previous estimate of replacement demand (Kriechel & Cörvers, 2007). Relative to the previous estimates, better LFS data have become available that allow for better estimates. We estimate replacement demand for all 29 countries, using the same methodology and underlying data-sources. In order to do this using the cohort-component methodology, we need information on the age structure by gender. This allows us to estimate flows by cohort, and thus identify outflows. The differences in age structure of occupations in a country influence exits. Retirement is positively related to the average age of the workforce, while younger people are more prone to change occupations.

From the LFS, it is possible to analyse the demographic composition of each occupation. This makes it possible to estimate specific rates of retirement for each occupational class. LFS data can also be used for making estimates of rates of outflow. The Replacement Demand model (RDMOD) has been developed based on similar data sources to the occupational model. It is driven in part by the occupational and qualification employment levels projected from Modules 2 and 3, in combination with models and information on the probability of flowing out from employment due to retirements, occupational mobility and migration. The model used builds upon the national model from the Netherlands (Cörvers et al., 2008). Similar models using variants of the methodology are used in several other countries, both within and outside the European Union.

Projections of occupational employment typically 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 net 'gainers' and 'losers', they give a misleading impression of job opportunities and skill requirements. 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, 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 'structural demand' or so called 'expansion demand', resulting from growth in employment in a particular category. It can easily outweigh any negative changes due to projected employment decline.

While the concept of replacement demand is simple enough to grasp, estimating it is a rather different matter. The main problem is that official statistics place much more emphasis on measuring stocks of people in particular states rather than flows from one state to another. Yet it is measurement of such flows, which is essential to estimating replacement demand.

However, use can be made of readily available statistics in order to provide indicative estimates. Ideally, one requires a full set of demographic accounts that trace people's movement from one socio-economic position (e.g. employment in a particular occupation) to another (e.g. retirement). In practice, such a complete set of accounts are rare even at national level. However, the Labour Force Survey (LFS) from several consecutive years now provides a sufficiently large sample to obtain estimates of the main elements at national level. The key components are:

- information on the age and gender structure of occupational employment;
- information on rates of outflows due to:
    - retirement;
    - early retirement;
    - inter-occupational mobility;
    - migration;
    - and other reasons for leaving the workforce.

The information on outflow rates can also be estimated using stocks of age-cohorts within occupations for several years. Using the year-to-year changes the outflow-rates by occupation-age cohort can be estimated. However, these estimates may not allow discrimination between the reasons for the outflow that leads to replacement demand. Given the data availability, we will be using this methodology for the current forecast. The details will be set out in the next section.

Age Structure: Data on age structure are required since many of the flows, especially retirements, mortality and occupational mobility, are age specific. Age structures vary significantly by occupation. For some groups such as corporate managers and administrators, experience is a key requirement and this is associated with age. The proportion in the 45-59 year old category is therefore relatively high. In contrast, in many other occupations the age

structures are much more heavily skewed to younger age groups. In sales occupations, for example, the age structure is much more heavily weighted towards younger age groups. Differences in age structure across occupations influence replacement demand due to occupational mobility and retirement, which are age related. Even inter-occupational mobility is affected differently over occupations.

Retirement Rates: Retirement rates vary by gender and by age and may differ for different occupational groups. But since sample numbers are often too small to allow for meaningful estimates methods to deal with these problems need to be adopted. Estimates can be based on data from the LFS, which show the percentage of those employed one year ago who have retired from employment, either temporarily or permanently. For males, the main outflows are associated with retirement *per se*. For females, in particular, there is significant, quite often temporary, outflow for younger age groups associated with family formation.

Mortality: Another potential outflow is due to mortality. While losses due to death are not great for individual age groups up to the age of 65, they can cumulate to produce significant losses over an extended period. However, the current model does not explicitly incorporate differential mortality risks (not least because no significant or radical changes are expected in them). Rather the focus of the cohort component methodology is to identify overall outflows over cohorts, irrespective of the cause (sickness, death, family obligations).

Migration: *Net* migration can have an important effect on the in- or outflow of the labour market. One of the problems of migration is the lack of suitable data.

Occupational Mobility: Occupational mobility is an important source of replacement demand in some occupations although not for all. The full occupational mobility flow matrix indicates that some occupations such as managers tend to gain employment as people are promoted from other occupations. The cohort component approach does not differentiate the replacement demand due to occupational mobility. It only identifies net mobility.

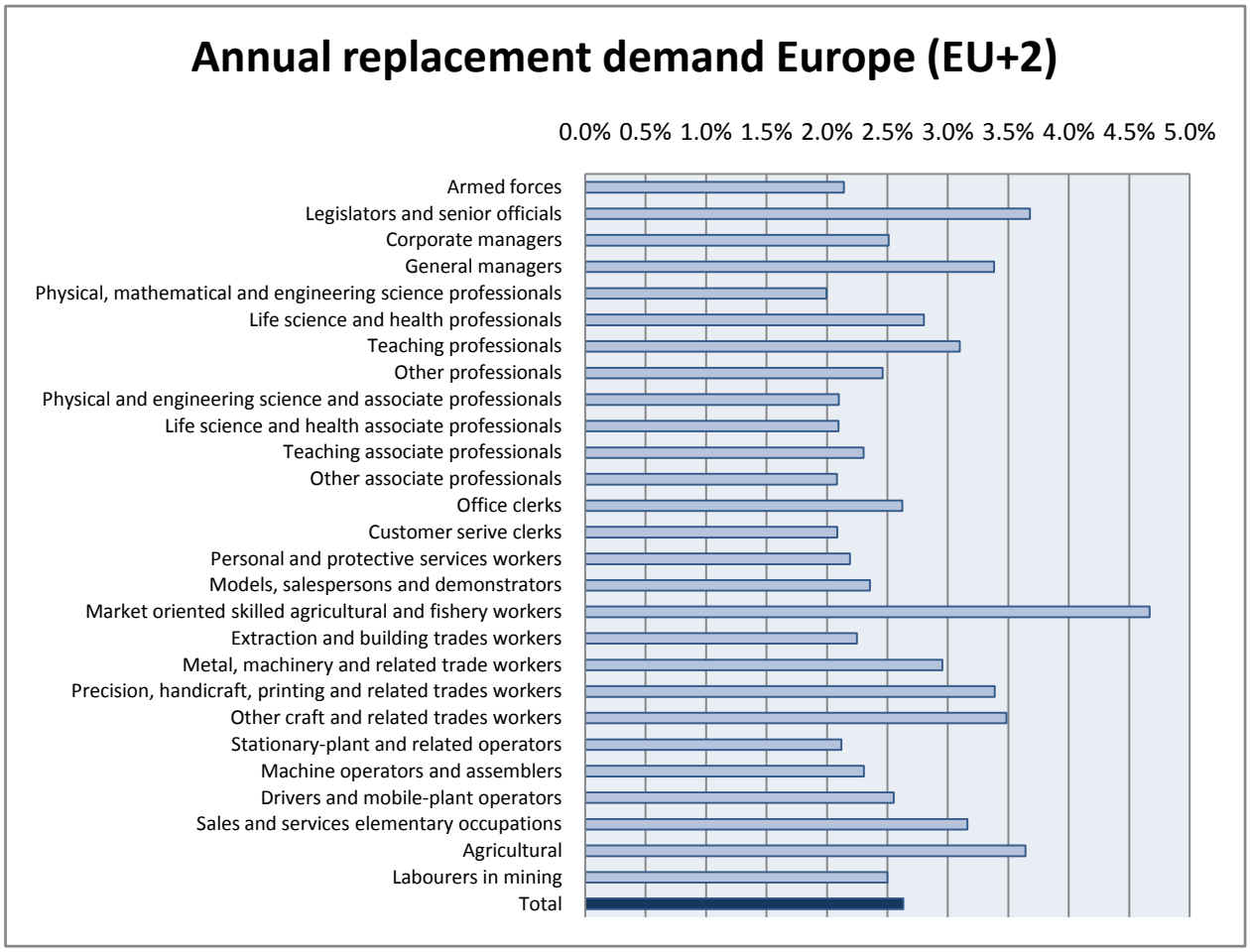
The overall scale of change is obviously dependent upon the length of period considered, as well as the opening stocks and the age structure of the current workforce. Replacement demand is also dependent on the level of occupational aggregation. With lower levels of aggregation, the observed occupational mobility is lower. For most, projections rates of outflow are assumed to be constant over time. The scale of structural or expansion demand (which in some cases may be negative) is usually modest compared with replacement needs, and in most cases the latter offsets any negative change.

In the next section, we will summarize the replacement demand estimates on the European level. Section three discusses the influence of the economic crisis on the results of the forecast. Section four describes the methodology. Section five discusses the data used. Section six describes problems with the data. In section seven, the components of the replacement demand is described, detailed results per country can be found in the workbook as described in that section. Section eight concludes.

2. Summary of Results

Overall, the replacement demand is forecasted to be 2.6% annually. This overall figure varies – of course – over occupational groups. Figure 1 gives the overall replacement demand by occupation for the European Union, Switzerland and Norway. It is an aggregation of the individual countries' replacement demand by occupation to the European level.

Figure 1: Annual replacement demand by occupation



Source: RDMOD, calculated by ROA

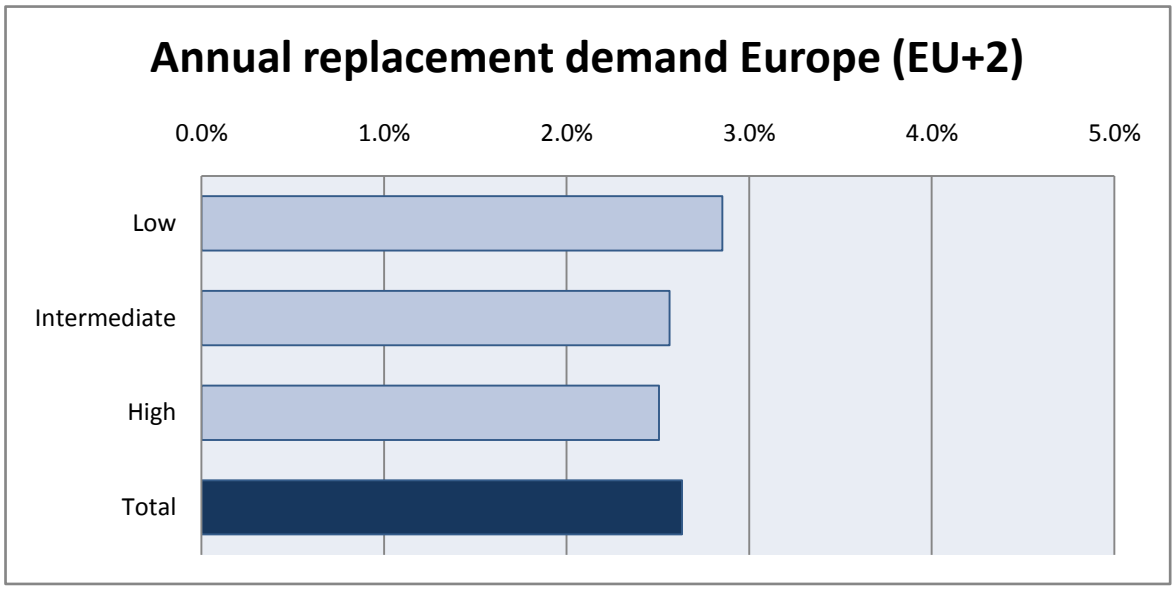
Groups of occupations with high level of replacement demand are occupations with an older workforce because they belong to traditional sectors, e.g. Metal, machinery and related trade workers; Precision, handicraft, printing and related trades workers. Or they are occupations in which generally more experienced workers are found (older workers), such as legislators and senior officials, and general managers.

Low replacement demand can be found in occupations that have had recent cohorts of inflow, are in newer sectors of the economy, or are simply occupations that employ younger worker without much experience. On the European level physical and engineering science and

associate professionals; life science and health associate professionals; other associate professionals; customer service clerks; and the other craft and related trades workers are currently all exhibiting lower replacement demand.

The annual replacement demand by education has been directly derived from the replacement demand by occupation and is thus on average the same as the average over all occupations. It is based on the replacement demand by occupation and the distribution of education levels across the occupations. Figure 2 gives the annual replacement demand for Europe, all EU countries together with Switzerland and Norway, by three broad education levels: low (ISCED 1 and 2), intermediate (ISCED 3 and 4) and high (ISCED 5 and 6).

Figure 2: Annual replacement demand by education

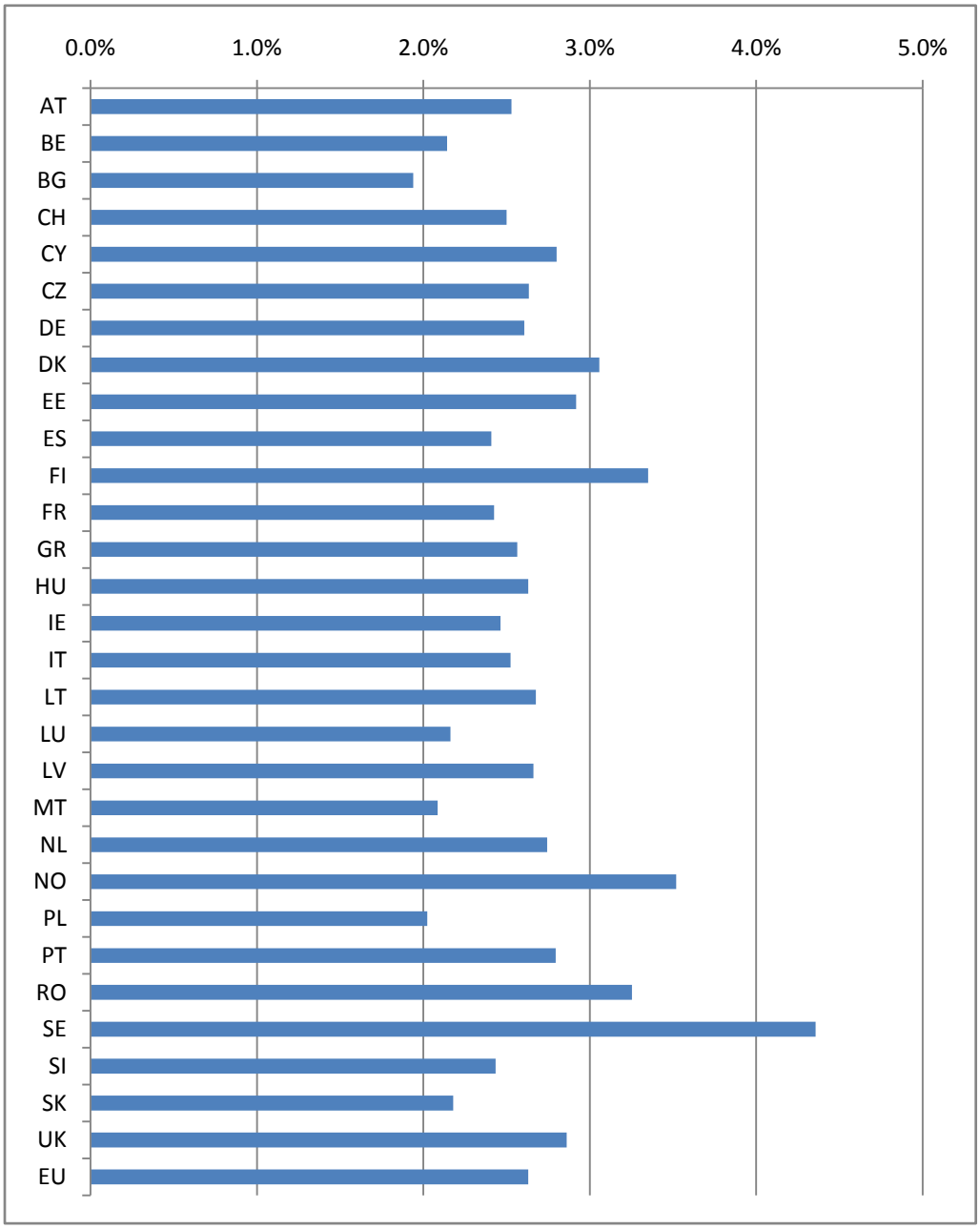


Source: RDMOD, calculated by ROA

Figure 3 depicts the annual replacement percentage by country. This is the total over all occupations in a country. The replacement demand varies from a low replacement demand in Bulgaria of 1.9% to a high replacement demand in Sweden of 4.4%. The EU wide replacement rate, as reported above, is 2.6% annually.

Sweden is at the higher end of the annual replacement demand. There are some institutional factors that support a higher level of replacement demand in Sweden: it has low statuary retirement ages for both male and female workers. This does not only lead to higher levels of retirement, it also feeds through in outflows out of the labour market before retirement (mainly for early retirement). Furthermore, the already high level of participation of women does not – as in other countries – allow for a compensation of the greying of the workforce with higher levels of participation by women.

Figure 3: Annual replacement demand by country



Source: RDMOD, calculated by ROA

3. Influence of the crisis on replacement demand and forecast

Replacement demand is driven by the proportion of employees in an occupation that is likely leave within the forecasting period. A higher share of those workers in the base period of a forecast will lead to higher predicted replacement demand. Business cycles are prone to shift outflows somewhat in time. With respect to the timing of (early) retirement, in economic good times, people are likely to stay on a little longer, hence the outflow rate will be somewhat lower and in economically bad times, people that are likely to leave soon, will get incentives to move out earlier.

The economic crisis will have an impact on the timing of the outflow. The crisis started in the financial sector in the second half of 2008 and continued in 2009 and will probably lead to some short-term shifts in replacement demand. Such a crisis, in which real demand for goods and services is reduced, manifests itself with lower employment.

Companies try to accommodate the lower demand for workers by reducing flexible work, but also by bringing forward outflows that are likely to occur in the near future. In other words, early retirement schemes – official or not – are being used to reduce the workforce if possible. This implies that the outflow among the cohort of older workers, close to retirement is temporarily higher, while the amount of outflow will be lower for some time after the crisis. The lowering is the simple result of the reduction in the population of workers that reach retirement age.

On the other end of the age distribution, the outflow of younger workers is also likely to be increased somewhat as they are more likely to have temporary contracts or, through the institutional setting, may be the workers that are the easiest to lay-off. There can be several interrelated reasons for this, including common “last-in first-out” rules which apply in many countries or sectors and legal rules which often stipulate compensation based on tenure and age which encourages employers to focus on younger workers. Other economic arguments of accumulated human capital can also lead to this result.

While the outflow increases temporarily – this in the methodology of replacement demand means that the replacement demand increases as well –, it is not likely in those economic circumstances that replacement demand will be filled immediately. Rather, some catch-up will take place after the economic recovery. The annual replacement rate is taken as an average over the entire forecasting period, which is not affected by such cyclical behaviour on the labour market. However, it is important to be aware of the implications of the crisis for in- and outflows of workers that might lead to a temporary deviation from the overall replacement rate.

The forecast does not use data from the time of the crisis. These data were not available at the time that the forecast was made. As described in the data section the forecast uses data from the LFS up to the year 2007, which is well before the crisis hit the European economies.

4. Modelling and predicting replacement demand

The methodology follows the approach used by ROA in its national forecasts (Cörvers et al., 2008), adapted for the data availability of the European countries. It is a model based on the cohort-component model that uses the Eurostat LFS for all countries, while disaggregating education into several ISCED categories (for replacement demand by education), and occupation (several ISCO categories, allowing estimates of replacement demand by occupation).

There are three components to the model:

1. A forecast of demographic development within a country
2. A forecast of (changes in) participation, preferably by gender and age groups
3. An estimate of the outflow by occupation (education) category, gender and age group

Components (1) and (2) are usually considered external to the replacement demand model. We will rely on the baseline model of the *Europop2008* forecast, which is the most recent demographic forecast by Eurostat. Changes in participation will be using the same participation rate by country, age and gender as generated within the *E3ME* model of Cambridge Econometrics (Gardiner, 2007; Pollitt, 2007). This insures consistency across the entire set of forecasts.

Estimated and projected flows

In the following, we will be discussing the basic steps using occupation, subindex *o*, as the relevant subcategory. One can however, read the methodology analogously if education is used instead. For the course of the project, given the high level of aggregation on the education variable, education is not estimated separately. Rather, the replacement demand by education is deduced from the occupational replacement demand. By using the occupational replacement demand and imposing the most recent distribution of education by occupation, we are able to present the most likely replacement demand using the current demand for education levels within an occupational class.

Table 1 gives a schematic input-output table of the labour force/ population in a country (see also Willems and de Grip, 1993). The first rectangle gives the movements within the labour market. The second, bigger rectangle encompasses movements out of the labour market, while the third rectangle also considers changes in the population. Adding rows (for time *t)* or columns (for time *t-n*) of these flows gives the total population within an occupation.

Table 1: Schematic of replacement demand

t / *t-n*	Occupation 1	Occupation *l*	Unemployed	Outside the labour force	Outflow Population	Total
Occupation 1	A	B	C	D		$W_{1,t-n}$
Occupation *l*	E					$W_{l,t-n}$
Unemployed	F					
Outside the labour force	G					
Inflow population						
Total	$W_{1,t}$	$W_{l,t}$				

Source: Willems and de Grip (1993)

Several flows are indicated in the table with capital letters. A denotes the workers that work in occupation 1 at time *t-n* and continue to do so in period *t.* B denote the workers that move from occupation 1 to occupation *l* in the observed time. While E denotes the opposite movement from *l* to 1. Thus, B and E denote the job-to-job mobility. C and D denote movement out of the labour market from holders of occupation 1. Corresponding inflows into occupation 1 are F and G in the schema.

Replacement demand depends on the expansion demand forecast, as replacement demand is derived from the relative size of the categories in terms of total employment levels. If there is positive expansion demand, i.e. growing occupations, replacement demand is equal to the number of workers leaving that occupation over the relevant time. Vacancies have to be filled before a rise in employment within the occupation can be achieved. Table 1 would consider the sum of B, C, D as the relevant replacement demand.

If the occupation is declining, only the (remaining) inflow into the occupation will constitute the replacement demand. In terms of table 2 this implies the sum of flows E, F, G.

The first step in modelling future replacement demand per occupational class is a description of the inflow and outflow patterns by occupational class in a historical period. Because there is no appropriate data for mobility flows on the labour market, stock data are used. With the so-called cohort components method, *cohort-change rates* based on the number of persons of the same birth cohort who were employed at two different times can be calculated (see Shryock and Siegel, 1980). These cohort-change rates can be rewritten as average annual net inflow or outflow percentages (flow rates for males and females are differentiated):

$$\dot{F}_{o,a}^{t-1} = \frac{{}_kW_{o,a+1}^{t} - {}_kW_{o,a}^{t-1}}{{}_kW_{o,a}^{t-1}} \qquad (1)$$

Where $\dot{F}_{o,a}^{t-1}$ is the annual net inflow or outflow ratio of workers in occupational class *o* of age group *a* (with class width *k*) at time *t-1* during the period (*t-1,t*);

$W_{o,a}^{t}$ is the number of people working in occupational class *o* of age group *a* (with class width *k*) at time *t*.

If $F_{o,a}^{t-1} > 0$, there is a net inflow for a certain age group from an occupational class, and if $F_{o,a}^{t-1} < 0$ there is a net outflow.

The second step in modelling is to translate these inflow- and outflow-percentages into the replacement demand by occupational class. As stated above, for occupational classes with an increase in employment in the period (*t-1,t*), replacement demand is equal to total net outflow in this period. However, for occupational classes, which faced a decrease in employment, not all vacancies due to the outflow of workers will have been filled. Therefore, replacement demand for these occupational classes equals the number of vacancies that is likely to be actually refilled, that is, the total inflow of workers into the occupational class. In this way, the more or less 'structural' replacement demand is derived. This methodology measures only the net flow to or from an occupational class. This means that replacement demand satisfied by re-entering workers of the same age cohort is not measured. So replacement demand is actually measured for newcomers on the labour market.

A fixed effect model is then estimated in which the net inflow or outflow ratios are explained on the basis of the average inflow or outflow from the total working population on the one hand and the occupation-specific deviations per age-gender group on the other. This approach guarantees that the sum of the net flows among the occupations corresponds to the total inflow or outflow.

Written mathematically:

$$\dot{F}_{o} = \dot{F} + \sum_{x} \beta_{ox} D_{x} \qquad (2)$$

Where:

$\dot{F}_{o}$ is the vector of net inflow of outflow ratios for occupation *o*, with observations for gender, age group and year;

$\dot{F}$ = is the vector of net inflow of outflow ratios for the total working population;

D_x = matrix with dummy variables; elements are equal to 1 for cohort *x* and 0 elsewhere;

β_{ox} = random parameters.

The third step is to project the historically measured net replacement demand rates per age-gender group for a particular occupational class onto the age-gender structure of the workers at the beginning of the forecasting period. The outflow coefficient is then combined with changes in

the participation rates and applied to the population of workers within an age cohort. An increase of participation rates implies less replacement demand. Higher participation rates of workers manifest themselves in this model by lower outflow rates. Given that we estimate on historic outflow rates, the estimated coefficient of outflow will be too high for the future. The expected increase in the participation rate is included by correcting the outflow coefficient for these changes in participation rate.

Finally, a projection is made based on the estimated coefficient combined with participation rate changes applied to the age-gender structure of the occupation as predicted by demographic and participation forecasts. To model the demographic composition of an occupation and its dynamic changes, we project uniform changes of one age cohort in the next cohort over the total projected time-horizon.

5. Data

The forecast of replacement demand in Europe is based on the European Labour Force Survey (LFS) by EUROSTAT. The data have been processed and prepared by Alphametrics (see: Steher and Ward. 2010).

The LFS is a representative survey of the active and the inactive labour force, i.e. it comprises people employed in the formal economy, as well as people who are inactive or unemployed. The LFS covers the active population from age 15 through 70 covering all European Union Member States (EU27), plus Norway and Switzerland. The forecast for replacement demand uses yearly LFS-information on the active population from 1995 until 2007, although data are not available for all years for all countries (see Table 2).

For estimating replacement demand, information on occupational level and education is required. The occupational information is classified according to ISCO 2 and comprises 28 occupational categories. Regarding the educational structure of the active labour force, the data contain information on the number of low-, medium-, and high-educated people among the active labour force according to ISCED. In order to estimate the year to year in- and outflows, the cohort-component method uses 5-year age cohorts by gender (see previous section).

Table 2: Available LFS data by country

country	description	period
AT	Austria	1995-2007
BE	Belgium	1995-2007
BG	Bulgaria	2000-2007
CH	Switzerland	1996-2007
CY	Cyprus	1999-2007
CZ	Czech Republic	1998-2007
DE	Germany	1995-2007
DK	Denmark	1995-2007
EE	Estonia	1997-2007
ES	Spain	1995-2007
FI	Finland	1997-2007
FR	France	1995-2007
GR	Greece	1995-2007
HU	Hungary	1997-2007
IE	Ireland	1995-2007
IT	Italy	1995-2007
LT	Lithuania	1998-2007
LU	Luxembourg	1995-2007
LV	Latvia	1998-2007
MT	Malta	2000-2007
NL	Netherlands	1996-2007
NO	Norway	1996-2007
PL	Poland	1997-2007
PT	Portugal	1995-2007
RO	Romania	1997-2007
SE	Sweden	1997-2007
SI	Slovenia	1996-2007
SK	Slovak Republic	1998-2007
UK	United Kingdom	1995-2007

Age distributions and cohorts

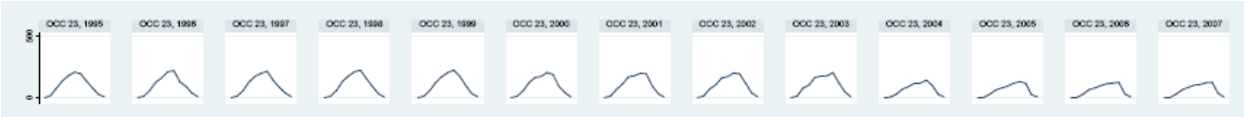
The figures in Part 2 of the electronic Appendix show age distributions across occupational classes and years, and employment of age cohorts over the years. The figures are organised as follows: the first 5 pages show the age distribution by occupation (pages 1-4 of each country) and by education (page 5) over the years available. Pages 6-10 show the employment dynamics of the cohorts over the years available. Employment dynamics are shown by occupation and by educational level.

The first four pages for each country show the age distribution for each year and each occupational class for which LFS-data are available. Each figure is based on employment (in thousands of workers) in 5-year age groups, starting from 15-19, 20-24 … 60-64 (see Figure 4). The distribution shows how the stock of workers in one occupation is distributed across age groups. The increase at the lower end of the distribution is most likely to be due to individuals entering an occupational class, after completing education, whereas the upper end of the distribution shows individuals leaving an occupational class to non-employment, such as retirement.

The distributions may thus have cut-offs on the left or on the right of the distribution, either due to average length of education in an occupation (left), or due to retirement schemes (right). In the centre of the distribution, the curve should be rather smooth,. Sharp cut-offs in the middle of the distributions are most likely to be due to changes in definitions of occupations.

These age distributions allow us to have a closer look at whether the age structure has shifted in certain occupations, either towards younger, or towards older workers. Since the cohort-component method uses shifts in age-groups to assess replacement demand by occupation, the figures presented can be used to assess the underlying data generating the replacement demand estimate.

Figure 4: Age distribution in Italy occupation 23 (ISCO)



Source: European LFS, Eurostat; prepared by Alphametrics; calculations ROA

To illustrate this, occupation class 23 for Italy (page 152 of the Appendix) shows an even distribution of workers in 1995. When following this occupation over the years as in figure 4, one can see that from 2001, the age distribution shifted towards older workers, whereas younger workers were less likely to be employed in this occupation, compared to the figures for earlier years. This shift becomes stronger in more recent years. The cut-off after the age group 55-59 is probably most likely due to early retirement schemes.

The following figures (pages 6-9 for each country) show how employment of each age cohort develops over time. Age cohorts are defined as age groups in the first year of observation. In the case of Italy, our observations start with 1995. In this case, cohort 1 consists of all workers aged 15-19 employed in one occupation in 1995, cohort 2 consists of all workers aged 20-24 employed in one occupation in 1995, etc. Each figure then shows the development of one particular age cohort over the years.

A figure in the far left column thus shows employment of workers aged 15-19 in 1995, 16-20 in 1996, etc The second figure from the left shows the same development of workers aged 20-24 in 1995, 21-25 in 1996, etc. For younger cohorts, the curves should thus be increasing since school leavers enter the labour market. For older cohorts in 1995, the curve should be flat if there are no changes in the age distribution.

Figure 5: Age cohort development 1995-2007, Italy, occupation 72 (ISCO)

Source: European LFS, Eurostat; prepared by Alphametrics; calculations ROA

Figure 5 – the case of Italy, occupation 72 – roughly shows this development: the first cohort (aged 15-19 in 1995) is increasing over the years, most likely due to workers with higher education entering the labour market. Cohort 2 (20-24 in 1995) to cohort 4 (30-34 in 1995) show a rather stable employment over the years 1995-2007, while the older cohorts show a decrease in employment.

Both types of figures, age distributions and cohorts, are generated for educational classes as well (pages 5 and 10 for each country. Since these numbers are aggregated at a higher level, all curves should be much smoother than in the case of occupational classes.

6. Challenges

Data constraints and problems

A main problem when using highly disaggregated data for estimation of replacement demand occurs due to differences in sampling/survey concepts or when occupations are redefined. Both can either happen in single countries, but also on the European level.

For the purpose of detecting these inconsistencies, it is worth looking at the development of groups of workers over time. For this purpose the electronic supplement or Appendix provides data on age distribution for each occupation and year, separately for each country (see the section on “Age distributions and cohorts” for details of the calculation).

The age distributions, however, do not have to be stable over all years in the data. Peaks and changes may also be the result of economic processes: skill-biased technological change leads to differences in demand for certain tasks. If a new technology is age-biased, i.e. it can be applied more efficiently by younger or more recently educated workers, the age distribution should have more weight on the lower end of the age distribution. These “natural” changes of age distribution in occupations over time are the result of supply and demand and are modelled when forecasting replacement demand.

There are, however, some indications when changes or peaks are not due to economic processes, but due to changes in concepts or definitions. For this purpose, the first five pages for each country in Part 2 of the electronic Appendix show age distributions for each occupational level and the three educational levels used for forecasting replacement demand. Each figure shows the number of workers in one occupation distributed over age for just one year. For some occupations in some countries, the age distributions show a sharp movement from one year to the next, often accompanied by adverse movements in other occupational groups.[1] In these cases, it is most likely that these changes are due to changes in occupational definitions/classifications or simply “noise” in the data and are not the result of economic processes.

While some of these sharp changes seem obvious to adjust, e.g. when one occupation show a sudden increase in employment while a second occupation shows the opposite, it is not straightforward hardly possible to adjust the data. Even if all reclassifications were known, it is not clear which share of a change in employment is due to “natural” shifts and which is due to reclassification or “noise”. Adjusting the data thus imposes new assumptions and thereby potentially introduces new errors into the data.

This problem is most evident when looking at more highly disaggregated numbers, such as ISCO 2 digit level data. When distinguishing between low-, medium, and high-educated workers, changes in classifications or definitions do not matter to that extent.

[1] There are a number of examples of these patterns in the data. In Italy (see pages 151-154 of the Appendix), two occupational groups (10 and 13) had hardly any observations until 2003. While they had a much larger number of observations from 2004 on, the occupational group 52 had a large decrease in numbers of observations.

A second problem occurs if occupations have low levels of employment. Since the LFS is based on a sample of the whole population, small absolute changes in the numbers of observed individuals may arise due to sample variability ("noise"). This problem arises especially (1) for occupations with a low number of workers relative to the overall labour force, and (2) for any occupational group in very small countries. This variation in year-to-year numbers, which is not due to changes in "real" employment can potentially weaken the precision of the estimates of replacement demand.

This problem can especially be seen in occupations such as 1 ("Armed Forces"). Also in some other occupations where employed numbers are either mostly zero, or zero for all years. This highlights the problems in distinguishing between real changes in definitions and random variations in the data.

Adjusting the data

The higher the degree of disaggregation, the more severe re-definitions over time or changes in measurement can become for estimation. The question remains how these artificial changes can be adjusted. Though it is in many cases obvious in which year the change took place and which occupational groups were affected, it is difficult simply to recalculate the "true" numbers without knowledge about the actual changes in the classification. The only adjustments that have taken place – over and above those that Alphametrics have done in preparing the data – are redistributing aggregate categories of ISCO over the underlying disaggregate occupational groups. This has been done taking the average share of the disaggregate groups into account. All other data problems will feed into the estimation process and might disturb the estimation somewhat.

There were two rounds of estimates. First, an estimate by country was done, and second, a joint estimate of all countries pooled. For countries in which the separate country level estimate seemed unstable, the results of the pooled estimate or a weighted combination of both estimates have been taken. Table 2 summarizes these estimation decisions.

Table 3: Estimation Method

	Country	Combined	Joint
AT	X		
BE	X		
BG			X
CH			X
CY	X		
CZ	X		
DE		X	
DK			X
EE			X
ES	X		
FI	X		
FR		X	
GR		X	
HU	X		
IE		X	
IT		X	
LT		X	
LU	X		
LV			X
MT		X	
NL	X		
NO	X		
PL	X		
PT			X
RO	X		
SE		X	
SI			X
SK	X		
UK			X

Notes: Three possible estimation techniques were possible. Country means that a country specific estimation was used. Pooled is an estimation based on data pooled over all countries. Combined is a weighted combination of these two alternative results.

7. Components of replacement demand

In the presentation of the results, we distinguish between replacement demand by retirement and other forms of replacement demand. The data do not allow us to identify the reason for an outflow. Therefore, we can only infer reasons for differences between the same cohorts over subsequent years. We define those workers that reach the official retirement age within the forecast period to be retired. The official retirement age differs by country, see Table 3. It is still possible in many countries to enter early retirement before the official retirement age. These cases will also lead to replacement demand, and are captured in our estimation. They are, however, not counted under the heading “pension” or “retirement”, but included with other replacement demand.

Table 4: Retirement age by country

	Man	Women
AT	**65**	**60**
BE	**65**	**65**
BG	**63**	**60**
CH	**65**	**64**
CY	**65**	**65**
CZ	**62**	**60**
DE	**66**	**66**
DK	**65**	**65**
EE	**65**	**65**
ES	**65**	**65**
FI	**65**	**65**
FR	**65**	**60**
GR	**65**	**65**
HU	**62**	**62**
IE	**66**	**66**
IT	**65**	**60**
LT	**63**	**60**
LU	**65**	**65**
LV	**62**	**62**
MT	**63**	**63**
NL	**65**	**65**
NO	**67**	**67**
PL	**65**	**60**
PT	**65**	**65**
RO	**65**	**60**
SE	**61**	**61**
SI	**65**	**65**
SK	**62**	**62**
UK	**65**	**65**

Source: EuroSoc

Components of replacement demand

Replacement demand total are calculated through the estimation technique described in Section 4. This gives an estimate of total replacement demand by either occupation or education. It can be informative to examine the main components of replacement demand. We divide replacement demand two components: Replacement demand due to retirement and replacement demand for other reasons. The first: replacement demand due to retirement is calculated through on the size of the age group that will enter the official retirement age (see Table 4) within the period of the forecast. Thus, this result is driven by the age structure, or the size of the older age cohorts relative to the total working population.

Replacement demand due to other reasons is the remainder of the estimated replacement demand net of the retirement group. It comprises the occupational mobility, migration, early retirement, and movements out of the labour force for other reasons. This result is therefore driven by all elements of replacement demand, population, participation, and the gender-age specific outflow coefficient.

Figures 6 and 7 distinguish between the two components of replacement demand: retirement and other reasons. While the first figure gives the components by country totals, the second calculates the European totals by occupation group. It can be seen that retirement accounts for less than half of the replacement demand. This does however, not imply that retirement is not one of the important reasons for replacement demand, as it can also be reflected in some countries as early retirement schemes, or other permanent outflows from the labour force (e.g. unemployment of older workers), which diminishes the population of active older workers before they reach the official retirement age.

An important aspect that influences replacement demand is the participation rate of cohorts by gender. For example, an increase of participation of woman around the time that their children reach school age (usually in the cohorts of 30-34 and 35-39) will offset other elements of replacement demand. This is a change that has happened or is happening in many countries of the European Union. Female labour participation is increasing, especially around the age groups that were formerly retreating from the labour market. Figure 8 present data on the mean change over the forecasting period across all cohorts, and in addition the maximum change within one cohort.

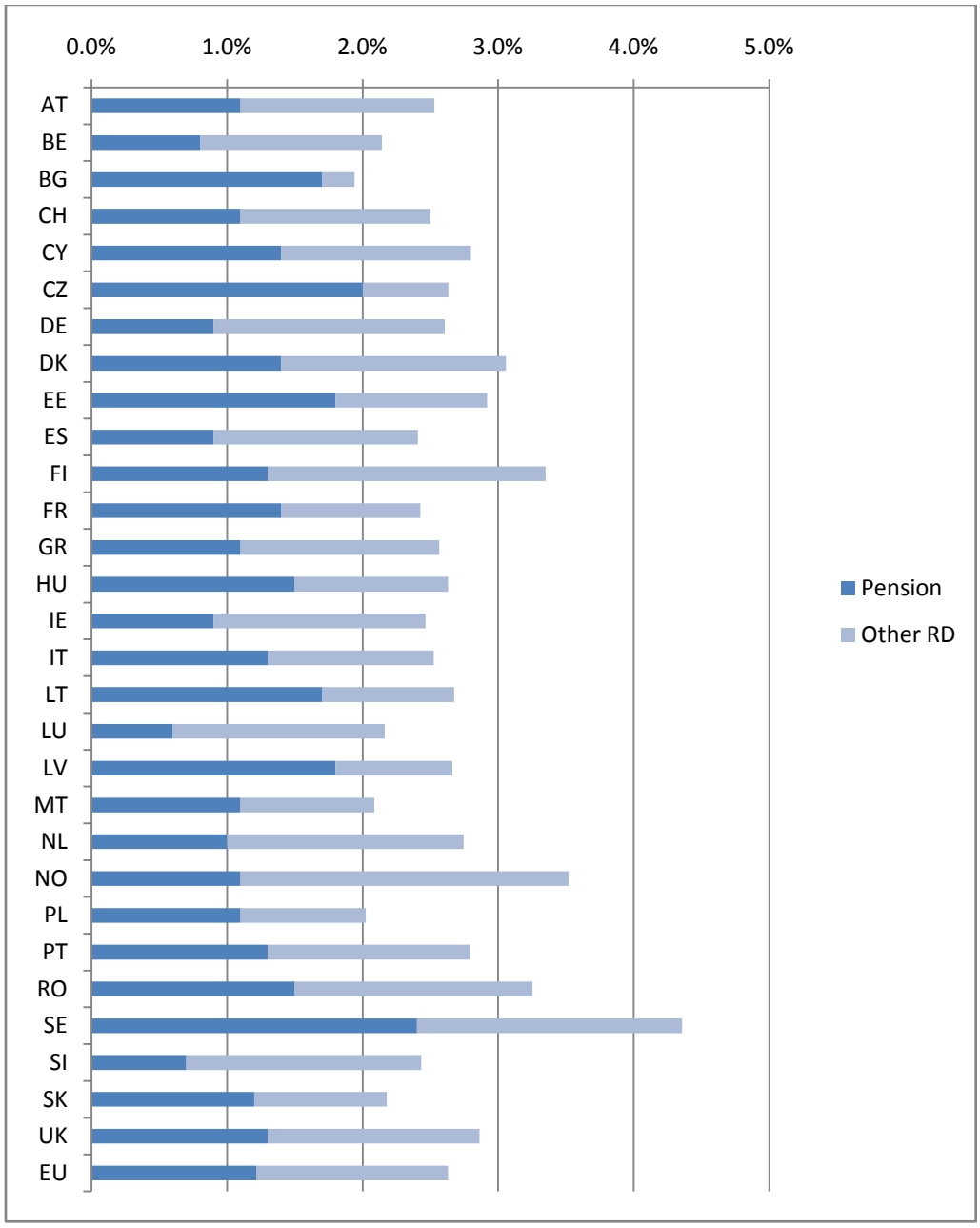
Some Nordic countries, but also the Netherlands, with high replacement demand forecasts have already achieved a high level of participation of women across all age cohorts. They cannot gain as much from increasing participation as countries that are starting from a low level of participation for cohorts of middle aged women.

Country workbooks

The country workbooks give the detailed results by occupation (for ISCO 2 digit categories). Furthermore, the replacement demand estimates by education levels (ISCED), low, intermediate, and high are given for each country.

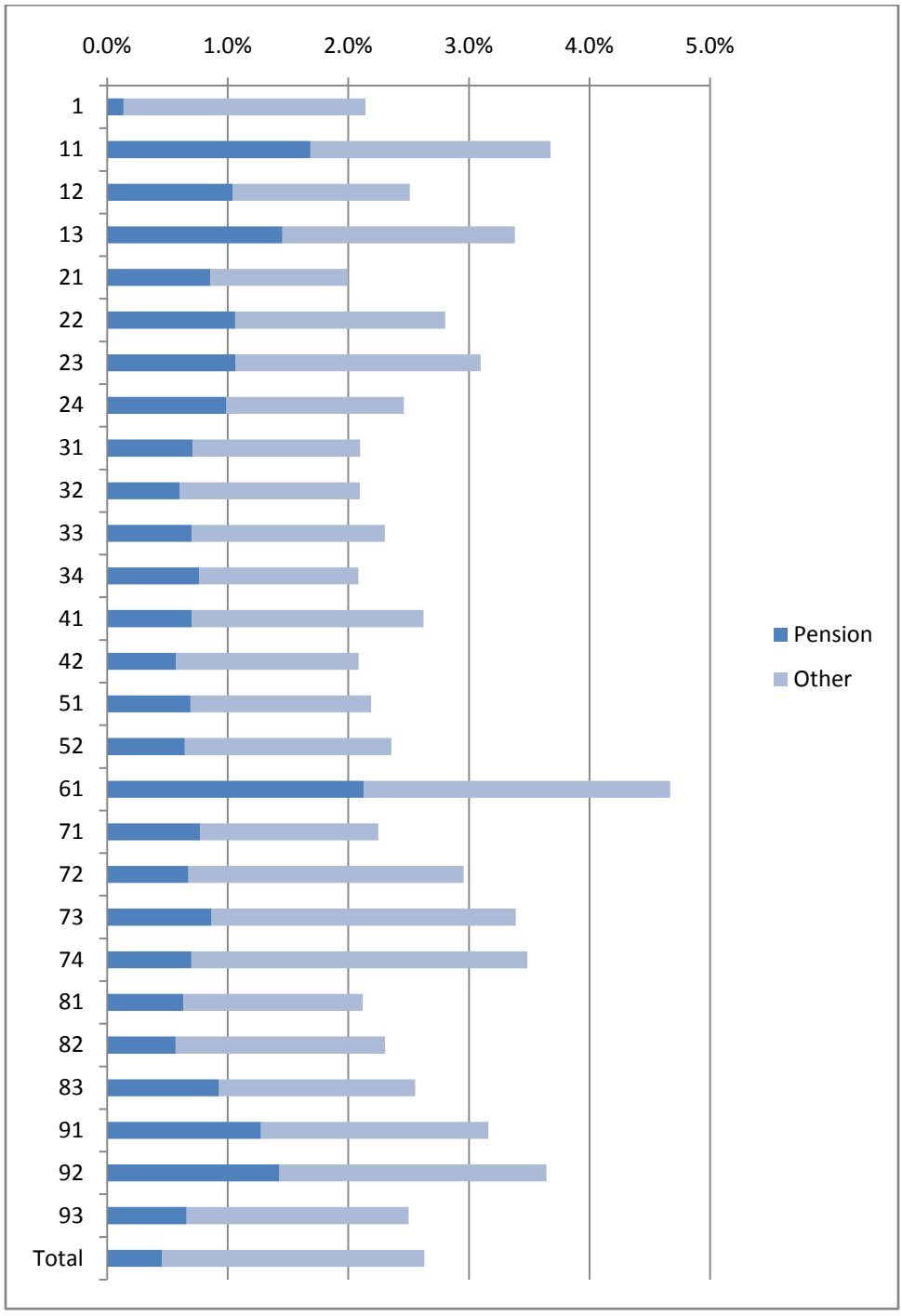
The decomposition between retirement and other factors is not at present reported in the workbooks.

Figure 6: Retirement and other replacement demand by country (annual %)



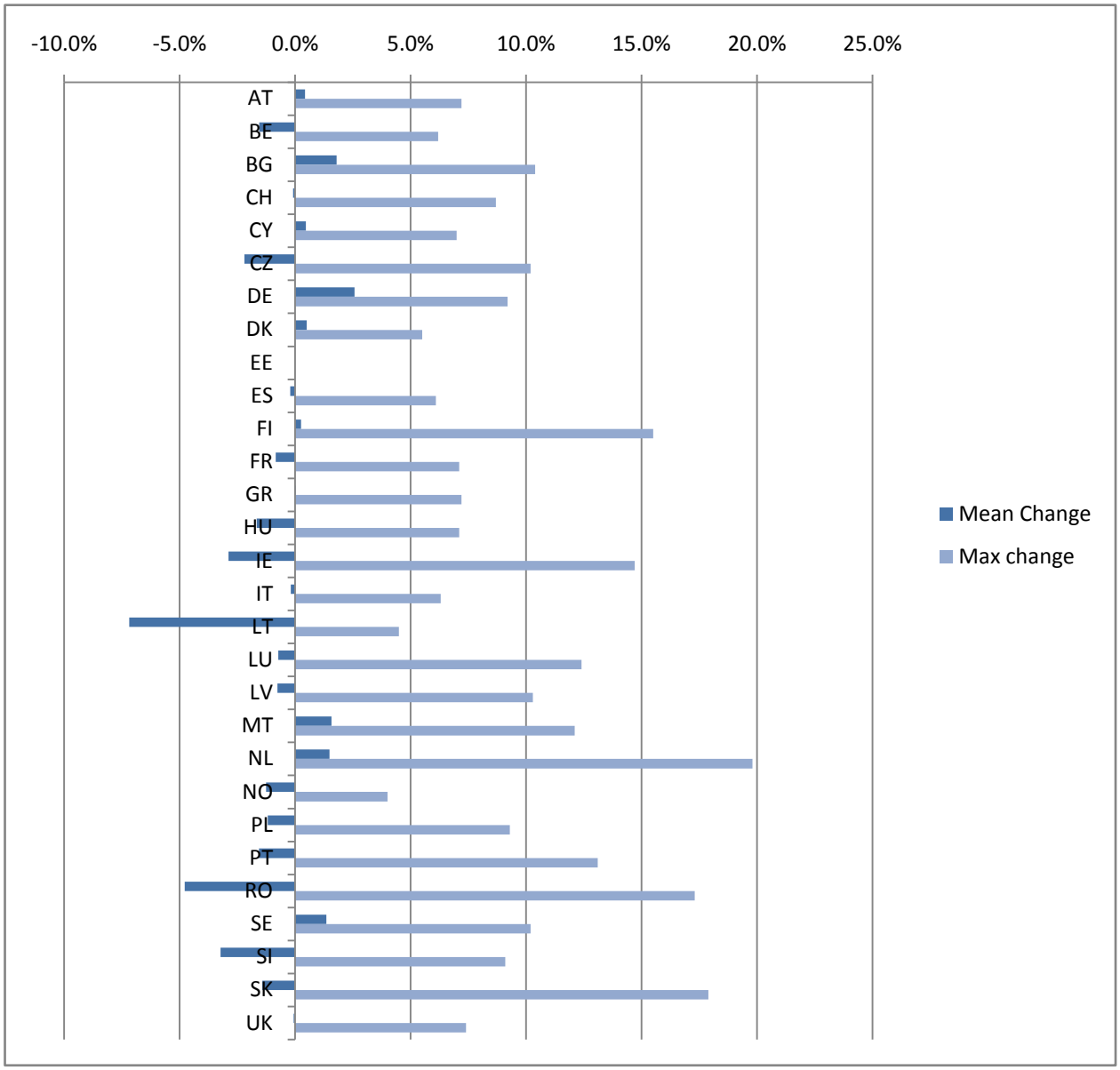
Source: RDMOD, calculated by ROA

Figure 7: Retirement and other replacement demand by occupation (annual %, all EU countries)



Source: RDMOD, calculated by ROA

Figure 8: Participation Change: Change in participation over forecasting period



Source: E3ME, Cambridge Econometrics

8. Conclusion

Replacement demand is an important component of the overall demand for workers. Especially in sectors that are not growing, or in times of decline, replacement demands are an important avenue through which school-leavers find their way onto the labour market.

The updated estimates presented here make full use of the improved data. The cohort-component method is used, taking year-to-year changes, in order to estimate net-flows. All 27 EU countries are now included, with the addition of Norway and Switzerland. Overall, replacement demand is estimated to be at a rate of 2.6% annually for Europe as a whole.

There is significant variation across the countries. This can be the result of differences in the structure of the population in terms of age, gender and their behaviour. However, it is also possible that – at least for some countries – unresolved data issues bias the results.

The estimated replacement demand is on average higher than the previous forecast from the pilot phase. Next to the further greying of the population, which causes an increase in replacement demand, the improved data and methodology are the cause of the differing results.

It is nevertheless important to stress the need for care in using the results. While the estimates reflect best practice given our current understanding and the available data, it should be noted that for some countries the historical data range is *shorter* than the forecasted period. The limitations on data alone should thus warrant a caveat in the use of the results.

The crisis will necessarily influence the economy, and also the mechanics of replacement demand. As discussed above, it is quite likely that there may be lag between the outflow of workers, as employers try to cut costs, before eventually replacing them once the economy picks up. Once the economy recovers, there will however be a catch-up to fill those positions that were temporarily left vacant.

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Electronic Supplement

The detailed replacement demand results are available in an electronic supplement available through *SkillsNet*, in which the age distribution over time and the cohort development by country and occupation are set out. Given the size of the supplement, and that for most part only country experts might be interested in this underlying data, we have decided to publish these data only electronically. The electronic supplement contains the following parts:

1. Overview tables;
2. Short overview of countries and years;
3. Occupations;
4. Age distribution and cohort development by country and occupation.

The overall estimates of replacement demands and total requirements are also available in the main set of *country workbooks.*