Future Skilled-Labour Markets in Germany: from Model-Based Calculations to Scenarios

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Abstract

In this article, we focus on the potential development of the German labour market. For this purpose, we developed a forecasting system that considers both supply and demand by occupational fields and qualifications and that relies on consistent datasets, exogenous assumptions and systematic correlations. We present the key impacts for our forecasting system and highlight the effects of different assumptions (scenarios) exemplified on our demand model. On the supply side, we point out how different behaviours on the individual level influence the structure of development of the supply of skilled labour. Keeping the possibility of those various potential futures in mind, we conclude with an outlook on potential skilled labour shortages in the future.

Keywords	JEL code
Employment, qualification, forecast, scenario building, occupational mobility, demography, labour market	*J11, J21, J32, J40, J62, E27*

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INTRODUCTION

The labour market of the future is very difficult to grasp from today's standpoint except through the lens of model-based analysis. Then again, we have to be aware of the fact that there is not just one exclusive future to be expected. Instead, each point in time, there are many decisions   that could possibly be made that lead to a different outcome. One way to handle this in model-based analysis is through a calculation of scenarios. Scenarios must represent futures that are internally consistent and leastwise possible. Significant conclusions can be drawn from a quantitative approach combined with qualitative knowledge. Instead of hoping that matters will resolve themselves, it emerges that every individuals' choices count: people make the difference. For the benefit of individuals and the community as a whole, it is necessary to analyse education and workforce participation, continuing education and dropout rates with the utmost precision.

Although it is mainly the shortage of skilled workers in the MINT occupations (mathematics, IT, natural sciences and technology) that has penetrated the awareness of the interested public, little is generally said about the equally, if not far more, significant problems in the sphere of initial vocational education and training (IVET). This is precisely where the calculations of the QuBe project on qualifications and occupations (Qualifikation & Beruf, <www.qube-projekt.de>)[5] reveal shortages in the future.

The article is structured as follows. First, we face the fact that there will not only be one specific future that will come true which formulates certain requirements to a model system for the labour market. After explaining the assumptions that drive our model, we first focus on the method and results on the demand side and thereafter present the influencing drivers of the supply side. We finally compare the results on the demand side with the results on the supply side and conclude with implications for practice and an outlook on further model development. The text of this article is mainly based on presentations given during the VDSt (Association of German municipal statisticians) Scenario Workshop at the "Statistische Woche 2012" conference.

1 LIVING WITH DIFFERENT FUTURES

In the sustainability debate, looking into the future means anticipating the usual because only in years to come it will be clear whether our efforts today to save energy, conserve resources and develop technologies were actually successful. For instance, the Stiglitz, Sen, Fitoussi Commission (2008) also correctly infers that projections are necessary, rather than relying on current observations alone, in order to evaluate the actions we take today.

Our view of the future is impeded, however: we do not know the realities of important determinants of our future action and opinions differ about the correct way to model our reactions to them. We must think in terms of the alternative options and leave room for falsification by disclosing the underlying assumptions.

To this end, it is necessary to identify the important exogenous determinants and to combine them consistently in the context of scenarios. Apart from demography, these determinants include the assessment of economic development in other countries and the movements in important commodity prices. A further issue is that of selecting the "correct" model. In the following, the way from the scenario to the model-based calculation is discussed with reference to the QuBe project (Helmrich, Zika, 2010, Helmrich et al., 2012, <www.qube-projekt.de>).

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[5] The QuBe project is a collaboration between the Federal Institute for Vocational Education and Training (*Bundesinstitut für Berufsbildung – BIBB*), the Institute for Employment Research (*Institut für Arbeitsmarkt- und Berufsforschung – IAB*), the Fraunhofer Institute for Applied Information Technology (*Fraunhofer-Institut für Informationstechnik – FIT*) and the Institute of Economic Structures Research (*Gesellschaft für wirtschaftliche Strukturforschung – GWS*).

1.1 Requirements for a model-based analysis of the future

In many cases, today's action on the labour market is regarded with uncertainty as to the effects of that action in the medium- to long-term future. At the same time, today we can already anticipate certain future changes (demography, the global shift in economic significance) which necessitate action now. Above all, questions of sustainability on the social, ecological and economic dimension require us to "look into the future". But to do this, a model has to fulfil certain requirements, namely an integral and simultaneous view as well as consistency, transparency and interdisciplinary.

The work of the QuBe project takes an *integral* (not just the labour market but the economic development as a whole; not just dual system but also university-based IVET) and hence a *simultaneous* approach. Changes in the labour market, for example, affect income generation (wage income) but also consequently the spending of income (the consumption of private households). Households' consumption choices, in turn, have an effect on the labour market.

For reasons of *consistency*, a standard dataset for labour market activity is used. The data are based on the German Microcensus (German Labour Force Survey) and are adapted to the parameters of the German Federal Statistical Office's national accounts. This is the only feasible way to put the development of the labour market into the context of the economy as a whole.

Furthermore, the principles of *transparency* and *interdisciplinarity* are put into practice: the project is based on the expertise of occupational researchers, social scientists and economists, who evaluate the results extensively in an open dialogue and cooperate fully in reporting the findings. This is especially important when specific occupations and sectors are analysed (see e.g. in the Building sector Weiss, Rehbold, 2012, Maier, Thobe, 2012).

1.2 How does the future look? Components of the QuBe reference scenario

To aid an understanding of the route from our research aspirations to the completion of the results, the components of the QuBe reference scenario are described below: these consist of (1) *datasets*, (2) *exogenous assumptions* and (3) *systematic correlations* in the form of definition and behavioural equations. These three elements will now be examined.

Two important components of the *dataset* are the German national accounts and the population projections and estimates of the Federal Statistical Office. With historical data in general, we find ourselves to be on safe ground. After all, the past is completed and hence known. The reality, however, is somewhat different. On occasions, gross domestic product (GDP) undergoes notable corrections. For instance, the growth rate for 2010 was corrected in September 2012 from 3.7 to 4.2 per cent. Currently 0.5 per cent corresponds to more than €10 billion, quite a windfall. Population development in the past is likewise a matter of considerable uncertainty: today it has been 25 years since Germany's last census; since then population figures are extrapolated. Since the results of the extrapolation are used in population projections, even the 12th Coordinated Population Projection of the Federal Statistical Office is burdened with more than the usual uncertainties. Only the results of the 2011 census and the subsequently produced 13th Coordinated Population Projection will shed light on the necessary correction. Particularly for cities and municipalities, these projections are of decisive importance for political action.

The list could be continued: what is certain is that even the past can be a puzzle for us. It is therefore of critical importance to be certain of our data and to document clearly how it was compiled when looking at the future.

The *exogenous* assumptions of the QuBe project are specified up to the time horizon of 2030. Because of Germany's high share of exports and great dependency on raw materials, important parameters for the dynamics of the German economy relate to development on global markets. In order to be able to set parameters for the petroleum price, reference is generally made to the annual World Energy Outlook of the International Energy Agency (IEA), which provides oil-price projections up to (most recently) 2035.

A look at the history of oil price projections shows that assessments of the 2030 oil price have changed considerably between 2004 and today. Whereas not quite 10 years ago it was still assumed that oil prices would be approximately $50/barrel in 2030, today's assumption for the same year is around $210/barrel. So we have to bear in mind that assumptions for exogenous impacts are also burdened with considerable uncertainties.

It is worth stating as an *interim conclusion* that in the setting of a fluctuating past, any assumptions we work with when constructing a model are very volatile. This insight is not peculiar to QuBe: no model-based calculation or other type of *statement* about the future – whether quantitative or qualitative – is *unaffected* by the stated considerations.

How can they be dealt with? Researchers are left with no choice but to make a selection with regard to data and assumptions and to document this clearly. By means of scenario calculations, consequences of modified assumptions can then be determined and the corridors of developments mapped out. Sensitivity calculations make it possible to gauge the influence exerted by assumptions, particularly on the object of the research. A description of the system and transparency are absolutely essential. As part of the QuBe project, scenario calculations have already been produced on behalf of the Federal Ministry of Education and Research (*Bundesministerium für Bildung und Forschung* – BMBF). Furthermore, the impacts of globalisation on the German labour market have been studied (Mönnig et al., 2013) and the costs of energy-efficiency refurbishment and construction in accordance with European Union targets have been calculated (Weiss, Rehbold, 2012, <www.bauinitiative.de>).

Finally, the results are substantially influenced by the correlations in the model, definition and behavioural equations. Against the background of the labour market being examined here, the question is which contents need to be modelled.

Figure 1 Which correlations must be modelled? Varying time-frames and intensities
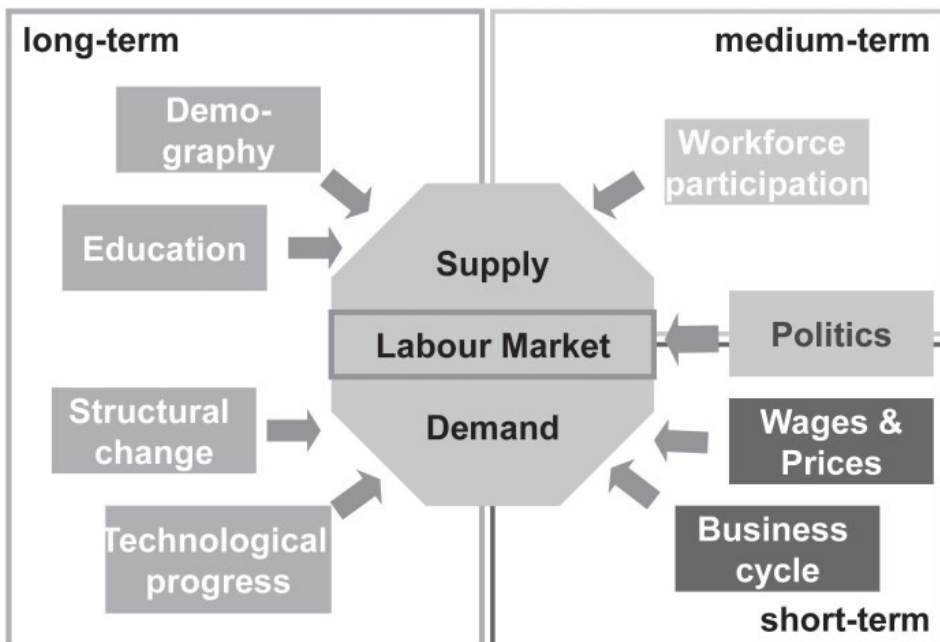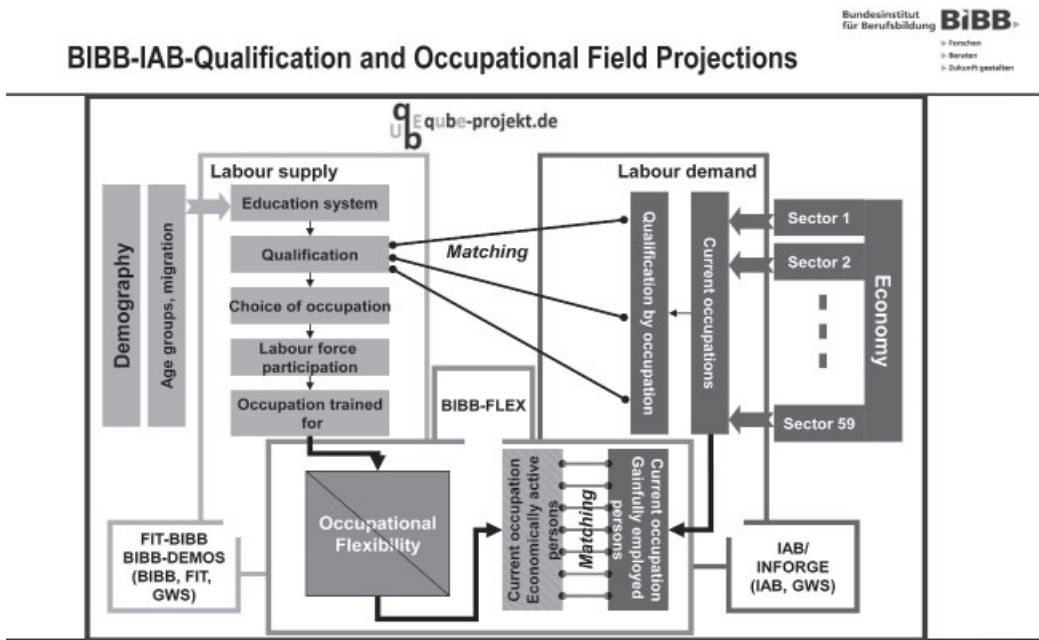

Source: QuBe-Projekt

The correlations vary particularly in their time-frames and in the magnitude of their effects (see Figure 1). Demography and education modify the labour market supply in the long term. Economic structural change and technological progress do the same on the demand side. In terms of magnitude of their effect, these four variables are very different. In the medium term, a change in workforce participation can affect the supply side considerably. The current developments of salaries as well as economic cycles have an influence on the demand side in the short-term. Politics is usually geared towards the short and medium term. An important example from the recent past is the expansion in temporary employment as a state of affairs during the economic and financial crisis.

What is certain is the consequences for economic growth cannot be determined by "acute thinking". Based on these considerations, we formed the view that qualitative models alone are not sufficient and therefore opted for a quantitative approach. Quantification of a model requires underpinning it with some empirical foundations, however, to avoid producing a mere "thought experiment". Moreover, this highlights important characteristics that the quantitative model must fulfil.

(1) It must model precise dates because it is critical for the evaluation of undesirable developments on the labour market to know not only "whether" but also "when".
(2) It must be calculated in absolute figures in order for supply and demand to be comparable.
(3) It must model different forms of structural change: Transitions (population – education – workforce participation) are to be captured in detail and changes at sector level taken into account, since scarcity is not revealed in the aggregate but in the segments of the labour market.
(4) It must be able to represent options for political action (e.g. social contributions, state expenditures, pension age of 67).
(5) It requires empirical foundations.

Figure 2 QuBe project – an overview

Source: Helmrich et al. (2012)

An introductory look at the QuBe project is given by the highly simplified diagram in Figure 2. The labour market is determined substantially by two concurrent processes: demography (green) and economic structural change (blue). While the supply of people available to the labour market, starting in the population and progressing through the education and training system to workforce participation is counted in terms of "occupation trained for", companies in the various sectors are exposed to shifting competitive opportunities or technological change and therefore state their demand in terms of "occupations held". These two sides would stand in juxtaposition without any prospect of reconciliation if occupational flexibility (orange), which stems from the willingness of both sides of the labour market to adapt, were not taken into account. In the following, we will describe the construction and the results of the demand model; thereafter we present the influencing drivers of the supply side and finally oppose the results on the demand side with the supply side.

2 CHANGING NEEDS: WHAT KIND OF WORKERS WILL BE IN DEMAND IN THE FUTURE?

The updated BIBB-IAB Qualification and Occupational Field Projections extrapolate observable developments in the German education system and labour market. Nevertheless, it is not only possible but also likely that future developments will deviate from past patterns. It is therefore sensible to point out various alternative development paths. One basis for alternative calculations might be, for example, political objectives along with the assumption that the labour market might respond with anticipatory adaptations.

In order to give an impression of the underlying complexity, we briefly look at a more detailed representation of the economy. It is represented within the QuBe project by the INFORGE model of the Institute of Economic Structures Research (GWS); the labour market of the model is adapted to the necessities of this project in close cooperation with the Institute for Employment Research (IAB). INFORGE (*Interindustrie Forecasting Germany*) is an econometric model operated since the beginning of the 1990s which models the development of the German economy based on the official system of national accounts of the Federal Statistical Office. The established model (e.g. EUROSTAT, 2008, pp. 527ff) is fully documented (Distelkamp et al., 2003, Ahlert et al., 2009) and is used in many projects for different clients (including e.g. the German Savings Banks Association or the Federal Ministry of Economics and Technology).

2.1 Modelling the demand side

Starting from exogenous parameters and taking account of important stock variables, the developments of economic branches are modelled. At the core, the branches are interlinked through their supplies of inputs to each other. Production and value creation, determined for every branch, exert an influence on the labour market and on price formation via unit cost calculation. The aggregates are entered in the national accounts system. Consistency remains assured only by virtue of double bookkeeping.

On the basis of the projection of sectoral structural change by the IAB-INFORGE model and the extrapolation of long-term trends in the development of demand within the sectors by qualification and occupation, a projection of labour demand by qualifications and occupations in Germany up to 2030 can be derived (Hummel et al., 2010, Zika, 2012).

The entire project, of which this is only a superficial description, provides the tool for generating the QuBe reference scenario. This can be described as a continuation of the correlations and changes identified in the past whilst maintaining consistency. That is to say, revenues and expenditures are identical with reference to the economy as a whole, and every individual as a part of the population is captured. The rising trend in workforce participation rates of women and older people continues, as does the progressive advancement in qualification levels of women. Moreover, previously agreed political interventions whose effects will continue into the future, like the pension age of 67, are implemented.

Figure 3 IAB/INFORGE
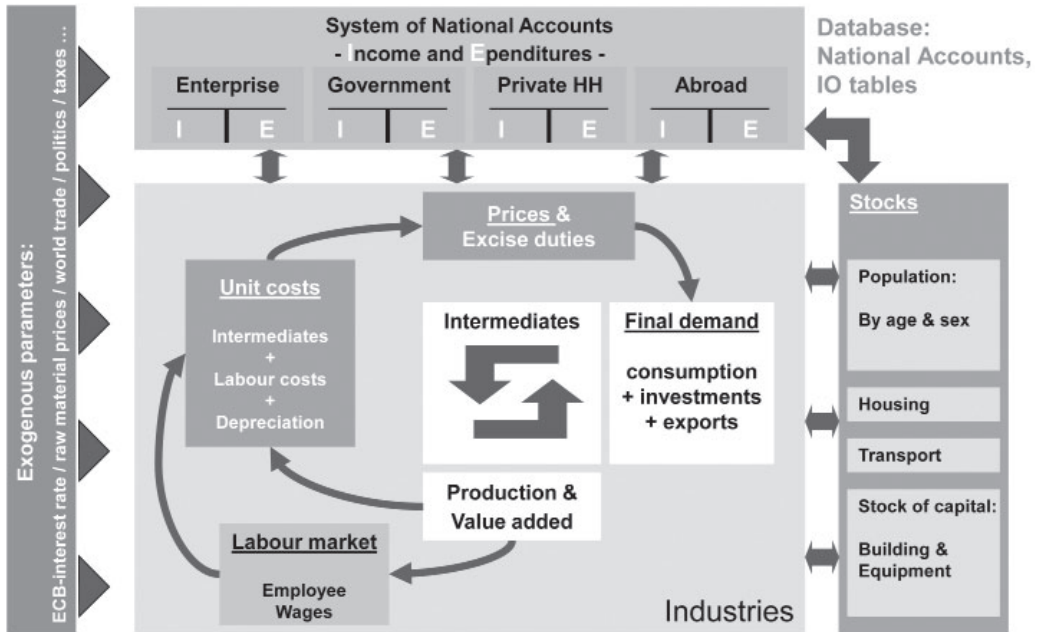
Source: QuBe-Projekt

The reference scenario serves as a starting point for sensitivity and scenario calculations. Whereas a sensitivity calculation only gives information about an isolated intervention in the model (e.g. increase in world trade, see Maier et al., 2012), scenarios represent several interrelated interventions (e.g. accelerated energy efficiency refurbishment with part private financing, see Weiss, Rehbold, 2012). Sensitivity calculations thus give information about the properties of the model and the impacts of individual parameters. A scenario, on the other hand, describes a different but equally consistent and equally possible future.

The reference scenario described here relates to the period up to 2030. The assumption was made that the potential economically active population would fall by around 3.7 million people compared to the year 2010, corresponding to a sizeable 8 per cent decline. An important control variable for the labour market is the development of annual working time. In the QuBe projection, a rise in annual working times was presupposed. Furthermore, moderate pay growth and a rise in exports and imports were assumed in the course of the recovery and advancing globalisation of the world economy.

That is the kind of scenario that emerges from the assumptions and from the empirically estimated behavioural parameters contained in the model. Accordingly, German GDP grows in the projection period by an annual 1.0 per cent if price-adjusted, and per-capita GDP by an annual 1.3 per cent in real terms. The model assumes that private consumption and state consumption will grow at below average rates (because of the 'debt cap'), resulting in continuing high levels of saving and investment. Under these – from the viewpoint of the labour market – cautiously optimistic assumptions, there would be a slightly declining demand for labour from companies. Under the model's assumptions, the number of people in employment would fall only moderately to 39 million by 2030. Underemployment would nevertheless continue to decline perceptibly because the supply of labour in the same period would fall markedly from 43.4 million to 40.0 millionpeople.

In the short term, workforce demand is strongly determined by the economic cycle, although the economic trend can certainly have varying effects on demand for individual qualifications and occupations. In the long term, the demand for labour depends on sectoral structural change and, within the sectors, on the changing demand for qualifications and occupations.

2.2 Demand by economic sectors

For the sectoral development of labour demand in hours, the projection confirms the fundamental tendencies of a persistent tertiarisation as already found previously. The significance of the service sector overall continues to grow (Hummel et al., 2010, cf. Figure 4).

However, it is unlikely that all branches of the services sector will increase to the same extent. Quite the opposite: high-productivity branches of the service industry such as "Trade, maintenance and repair of motor vehicles and consumer goods" require fewer and fewer employees. Likewise the sector of "Public administration, defence, social insurance" will need far less labour in future. In contrast, there is strong growth in the number of people employed in business services. This is partially due to practices, such as employee leasing, being expected to become even more significant in future. Additionally, the persisting process of outsourcing company units and business functions is likely to play a continuing role although this trend is declining. A very good employment outlook is also recorded in "Health and social services". The main reason for this, alongside the growing importance of childcare, is the ageing of society. As a result, on the one hand the demand for health services will rise enormously, and on the other hand employment will expand in institutions for the elderly and in outpatient care services (see also Maier, Afentakis, 2013).

**Figure 4** Number of people in employment by sectors, 2000–2030, in millions
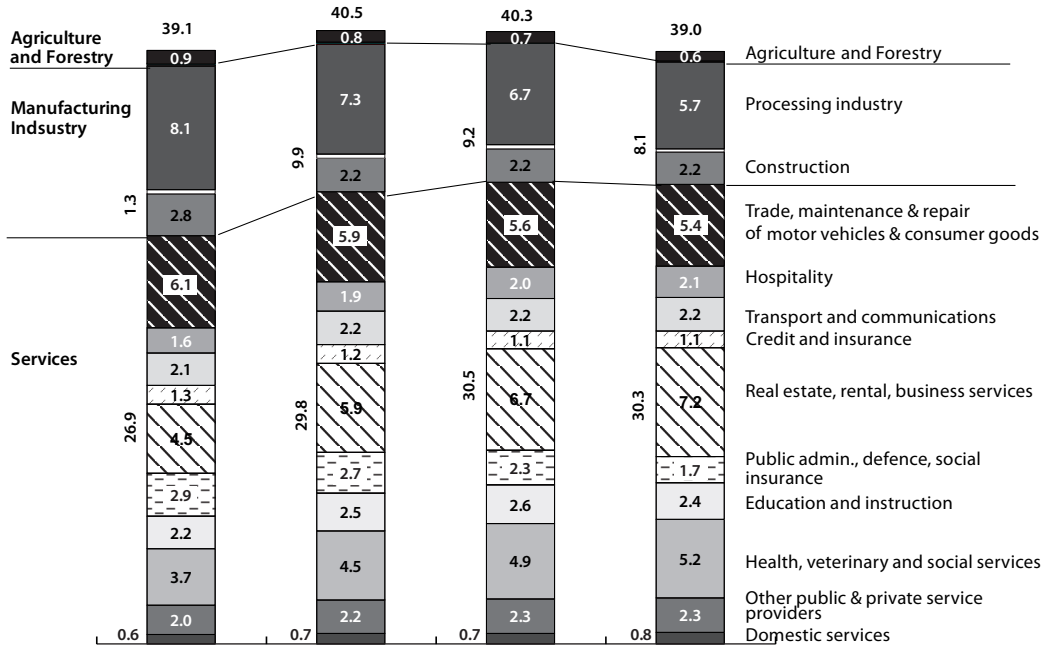
Source: Microcensus of the Federal Statistical Office; QuBe-Projekt

2.3 Demand by major occupational fields

The projection of workforce demand by major occupational fields, which reflect both occupations and core tasks (Tiemann et al., 2008), supplies an extrapolation of the developments that have been observable for a long time (cf. Figure 5). It can be assumed that the demand for production-related occupations will decline markedly. Likewise, the demand in the primary service occupations, namely in "Occupations involving the sale and marketing of goods", "Transport, storage and security occupations" and for "Office and commercial services occupations", will decrease. The only branch in which a constant rise is expected is in "Gastronomy and cleaning occupations". Within the secondary service occupations, the main area of growth is in the "Health and social care" occupations.

Figure 5 Number of people in employment by major occupational fields, 2000–2030, in millions
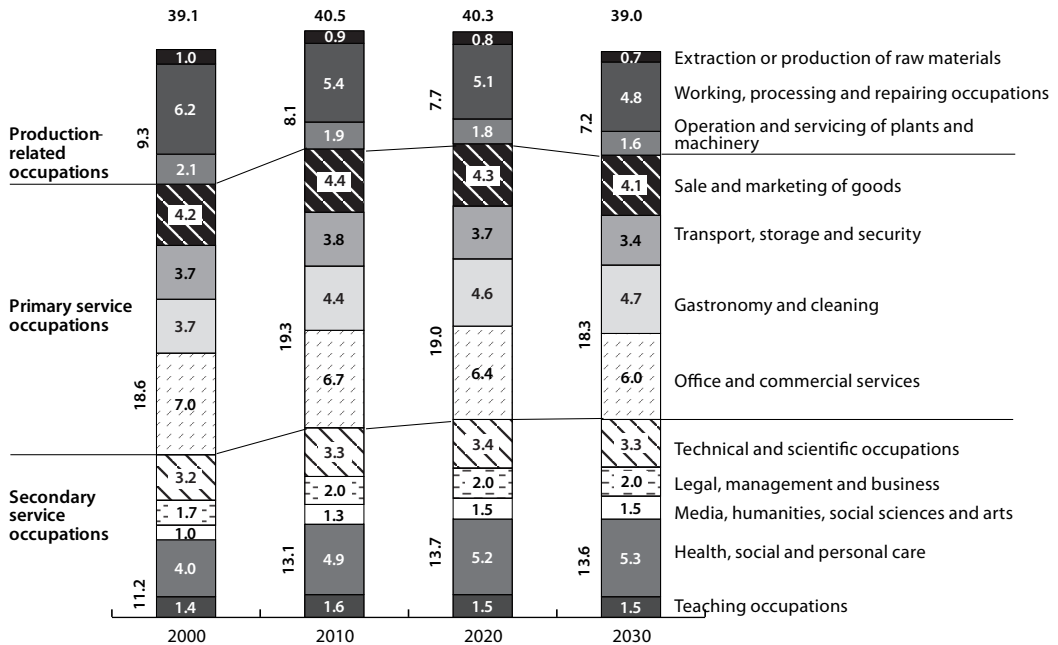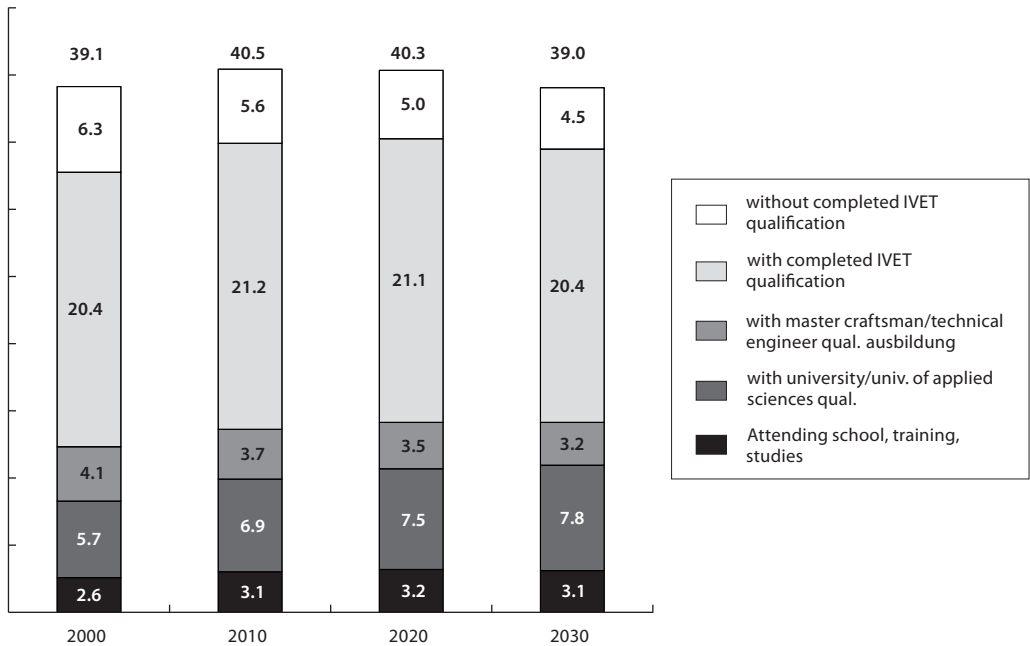

Source: Microcensus of the Federal Statistical Office; QuBe-Projekt

But, in this consideration of future developments, it is essential to bear in mind that these are highly aggregated "major occupational fields" (MOFs). The occupations grouped within them can exhibit divergent trends. For example, the major occupational field of "Technical and scientific occupations" comprises a total of 247 occupations (Tiemann et al., 2008).

2.4 Demand by qualification levels

The hypothesis of a trend towards higher qualification, which has received widespread publicity, is supported by the projection of workforce demand by highest vocational qualification (cf. Figure 6). Thus, it can be assumed that the number of working people in the services sector will continue to rise. This growth is based on sectoral development, on the trend towards more demanding occupations within the branches of the economy, and also on the fact that the formal qualification level (taken as indicator for the requirement level of tasks) within the occupational fields is steadily increasing.

Figure 6 Number of people in employment by qualification levels, 2000–2030, in millions

Source: Microcensus of the Federal Statistical Office; QuBe-Projekt

The demand for work performed by people with a qualification from a company-based apprenticeship or a full-time vocational school remains more or less constant up to 2020 and declining somewhat thereafter. This means that the dual system IVET or the corresponding school-based alternatives remain the dominant form of IVET in Germany.

Ever-diminishing demand is likely for workers who have not completed an initial vocational qualification. Wider-ranging analyses show that the decline in low-skilled work is almost entirely attributable to the tendency towards more demanding tasks within the occupational fields. This means that the driving force behind the falling demand for low-skilled work is not economic structural change, but rather technological and organisational change. Once again this underscores the significance of the share of unskilled workers for the labour market of the future.

Nevertheless, one glimmer of hope for the low-qualified still remains: the model-based calculations show persisting demand for work that is typically carried out by schoolchildren and students alongside their schooling or studies. Since the number of people in the education system is falling due to the demographic trend, in future it will not be possible to meet this demand fully. In this area, employment opportunities for low-skilled workers might potentially open up.

3 PEOPLE MAKE THE DIFFERENCE: ASSESSING FUTURE EDUCATIONAL AND EMPLOYMENT CHOICES

As mentioned in section 1.2, our reference scenario is based on past developments. Apart from the development of demand, the other main factor is the development in the supply of workers. Along with the demographic variables, the focus here is on the educational and employment choices made by individuals. In the following we will answer to the question: what are the consequences of economically active people's choices and courses of action for the supply of labour in the year 2030?

3.1 Germany up to the year 2030

Based on what is currently know n, the population of Germany is not only shrinking in the coming years, but also ageing (cf. 12. koordinierte Bevölkerungsvorausschätzung (12th Coordinated Population Projection), cf. Figure 7). This means that the demand for labour will gradually return to the 2008 level in the next few years, and will fall noticeably below the 40-million threshold by 2030 (cf. Helmrich et al., 2012), whereas the number of people who are 65 years and older is greater than the under-15 age-group and this disparity will widen. Progression of the high-birth-rate cohorts towards pension age in the coming years will result in a shift in the average age of the working-age population.

Figure 7 Population development overall and by age-groups
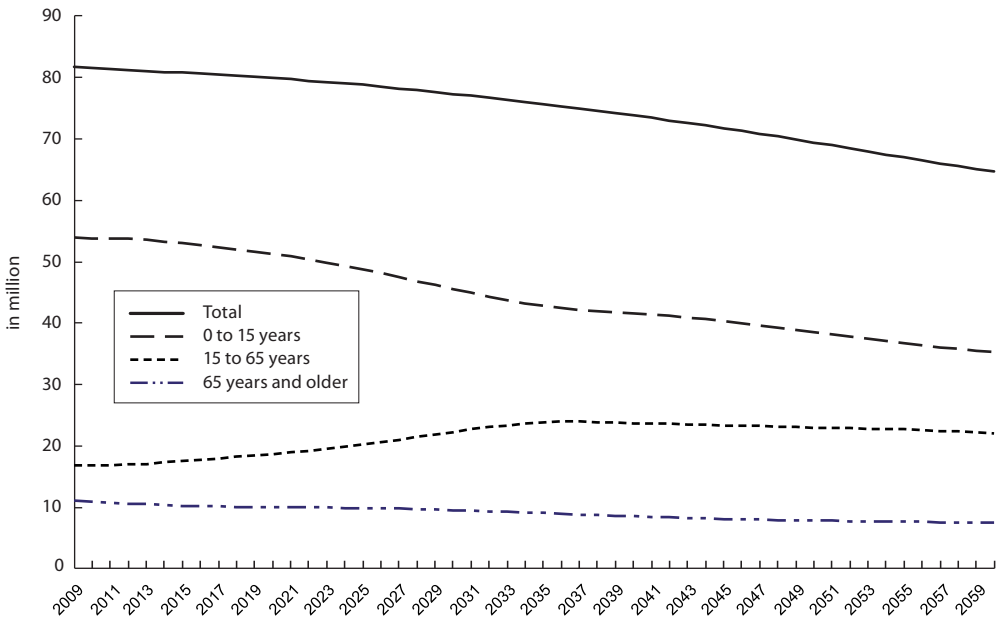
Two variables dominate population development. One is the birth rate which is currently around 1.39 children per woman of childbearing age in Germany (source: Federal Statistical Office; the fertility rate necessary for a society to reproduce itself without immigration is around 2.1). Even if this should rise significantly in the next few years, the impacts on the labour market would be discernible in around 20 years at the earliest – i.e. long after 2030.

In recent years it was generally assumed that around 100 000 more people per year were migrating to Germany than were emigrating. After years of very low net immigration, this level has been significantly exceeded in the last two years (128 000 people in 2010 and close to 280 000 in 2011, a level last matched in 1996). In the long run, therefore, net immigration of between 100 000 and 200 000 could be realistic, and expected net immigration for 2012 supports these assumptions. The rate of population shrinkage will gather pace due to the growing number of mortalities in coming years (the high-birth-rate post-war years just now are gradually reaching pension age) and the continuing fall in the number of births (since today's and prospective parents were born after the demographic contraction associated with the oral contraceptive pill). This growing surplus of deaths over births can only be made up in the long term by immigration of more than 400 000 people per year. In the present projection, a positive migration effect

of 100 000 people per year (net immigration movements) was assumed. However, it is quite questionable where the additional immigrants should come from because the Eastern European nations, whose population typically migrates to Germany, are themselves suffering from massive population shrinkage. In the medium term, immigration is mainly expected to come from non-European regions like Asia or Africa (UN/DESA, 2011).

Table 1 Development of immigration and emigration

| Year	Inward Migrations From abroad	Outward Migrations Abroad	Net Immigration Into Germany
2012°	1 081 000	712 000	369 000
2011	958 156	678 949	279 207
2010	798 282	670 605	127 677
2009	721 014	733 796	-12 782
2008	682 146	737 889	-55 743
2007	675 641	632 357	43 284
2006	661 855	639 064	22 791
2005	707 352	628 399	78 953
2004	780 175	697 632	82 543
2003	768 975	626 330	142 645
2002	842 543	623 255	219 288
2001	879 217	606 494	272 723
2000	841 158	674 038	167 120

° Preliminary result.
Source: German Federal Statistical Office

The good news is that purely arithmetically; almost full employment could prevail by 2030. However, this is only true if the future demand for workers can be met not only quantitatively but also in terms of the right qualifications. While the rising demand for workers increases jobseekers' opportunities of finding employment, it also harbours the risk of a skills shortage in specific areas of qualification, branches or occupations. Therefore, education and employment patterns become even more significant.

3.2 Education patterns

Germany is currently undergoing an educational expansion. In 2010, the proportion of university entrants accounted for 45 per cent of an age cohort (Statistisches Bundesamt, 2012). Thus the proportion of those working towards an academic qualification has risen by more than 10 percentage points within 10 years (cf. Figure 8). The university entrant ratio of 55.3 per cent in 2011 is due to the double-cohort of upper secondary school leavers in Bavaria and Lower Saxony and is likely to be repeated in 2012 (double cohorts in Baden-Württemberg, Berlin, Brandenburg, Bremen and parts of Hessen) and especially in 2013 with the double upper secondary cohort in North Rhine-Westphalia and parts of Hessen. Thereafter the university entrant ratio will settle at a little under 50 per cent which is still twice as high as in 1995. While first-semester students are currently overcrowding university lecture rooms, the number of newly concluded training contracts is falling (cf. Figure 9).

Figure 8 University entrant ratios from 1995 to 2012 (in %), university entrants as a proportion of same-aged population cohort
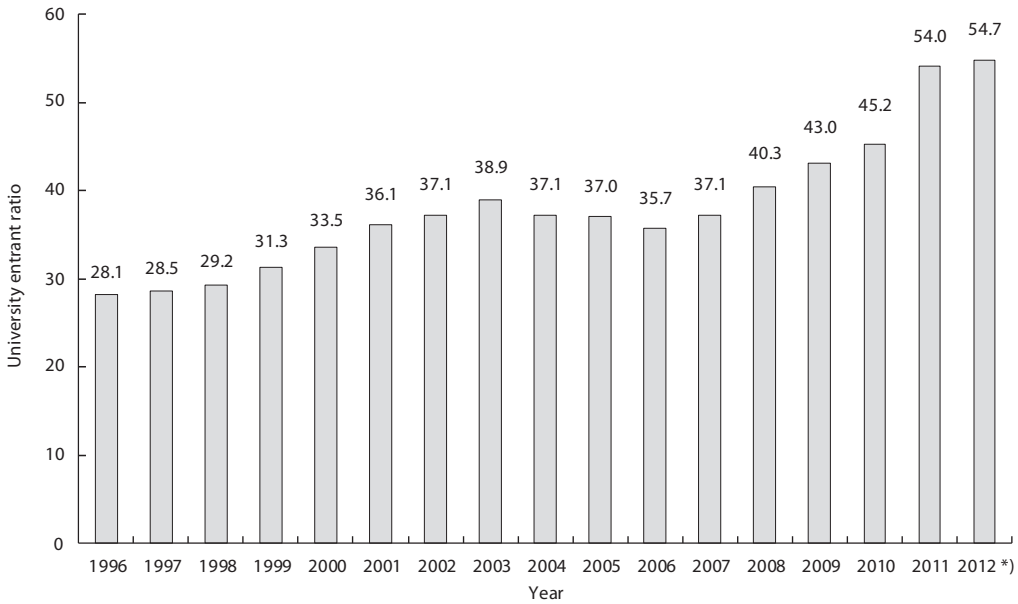
*) Provisional results.
Source: German Federal Statistical Office, 2012, Schnellmeldungsergebnisse der Hochschulstatistik, Vorläufige Ergebnisse (First release of higher education statistics, provisional results) – Winter Semester 2011/2012, presentation by BIBB

Figure 9 Initial vocational training market: Concluded apprenticeship contracts 1994 to 2010
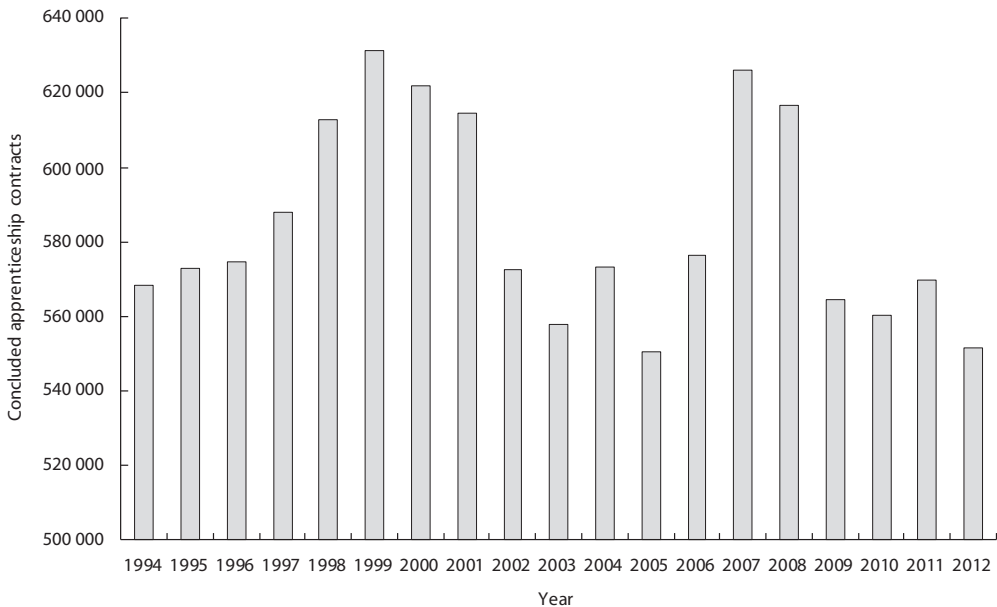
Source: Federal Institute for Vocational Education and Training (BIBB)

The educational development trend is moving unmistakably towards an academisation of the German vocational training sector. At the same time, no trend reversal seems to be in evidence at the other end of the qualification trend, i.e. among young people without a formal qualification (cf. Braun et al., 2013). The rate of unqualified individuals remains constant, as it has for years, at 14.0 per cent of 20- to under 24-year-olds and 14.5 per cent of 20- to 34-year-olds.

Table 2 Development in the shares of unqualified individuals by age-group

	20- to 24-year-olds	20- to 29-year-olds		20- to 34-year-olds	
	Unskilled ratio in %	Unskilled ratio in %	Absolute (in millions, extrapolated)	Unskilled ratio in %	Absolute (in millions, extrapolated)
1996	14.8	14.6	1.57	14.7	2.59
1997	15.1	14.6	1.50	14.3	2.54
1998	15.1	14.7	1.45	14.1	2.34
1999	14.8	14.7	1.40	14.6	2.37
2000	14.4	14.4	1.32	13.9	2.17
2001	14.3	14.5	1.32	14.1	2.15
2002	15.1	15.2	1.37	14.6	2.20
2003	14.6	14.9	1.36	14.6	2.15
2004	14.5	14.9	1.37	14.3	2.05
2005[1]	16.5	16.5	1.57	16.9	2.40
2007	14.5	15.2	1.45	15.3	2.24
2008	15.3	14.9	1.46	14.9	2.16
2009	14.1	14.6	1.44	15.2	2.21
2010	13.9	14.1	1.39	14.7	2.15

[1] Due to a change in survey method, results of the Microcensus from 2005 onward are only comparable with previous years with reservations.
Source: Federal Statistical Office, Microcensus 1996 to 2009, calculations of the Federal Institute for Vocational Education and Training (Braun et al., 2013, p. 291)

Table 3 Continuing vocational education and training (CVET)

		1996	2000–2002	2007
15 to 24 years		5.6	5.1	4.8
	low (ISCED 0–2)	2.0	1.7	1.6
of which qualif. level…	intermed. (ISCED 3–4)	6.1	5.8	4.9
	high (ISCED 5–6)	10.4	8.0	11.2
25 to 34 years		6.2	5.5	6.8
	low (ISCED 0–2)	1.6	1.1	1.4
of which qualif. level…	intermed. (ISCED 3–4)	5.8	5.1	5.4
	high (ISCED 5–6)	9.8	8.4	11.9
35 to 44 years		3.8	3.2	5.8
	low (ISCED 0–2)	1.3	0.8	1.0
of which qualif. level…	intermed. (ISCED 3–4)	3.0	2.5	4.2
	high (ISCED 5–6)	6.6	5.5	11.1
45 to 54 years		2.6	2.2	5.2
	low (ISCED 0–2)	0.9	0.7	1.1
of which qualif. level…	intermed. (ISCED 3–4)	1.9	1.5	3.4
	high (ISCED 5–6)	5.1	4.2	10.8
55 to 64 years		1.4	1.1	3.9
	low (ISCED 0–2)	0.3	0.3	0.7
of which qualif. level…	intermed. (ISCED 3–4)	1.0	0.7	2.1
	high (ISCED 5–6)	3.0	2.4	8.7

Source: Leszczensky (2010, p. 120)

In 2010, around 1.4 million people aged between 20 and 29 years, or 14.1 per cent, held no formal qualification. Extending this age-group to encompass the 30- to 34-year-olds, the share of individuals without formal qualifications among 20- to 34-year-olds is somewhat under 15 per cent, around 2.2 million people in absolute terms. Over the course of life, this gap widens even more. Since 1996, the low participation in continuing education by women and those with low qualification levels mean that existing disparities in educational level have increasingly been amplified by continuing education.

Aggregating these developments and extrapolating them into the future, the supply of academically qualified new entrants to the workforce shows both a proportional and absolute rise in numbers, whereas the supply in the intermediate-level qualification segment declines both proportionally and in absolute terms. Regarding the share of unqualified people currently, this still must be assumed to remain rather constant into the future.

**Table 4** New supply of economically active people not in training, by qualification levels

Period	without completed IVET qualification (ISCED 1, 2 & 3a)	with completed IVET qualification (ISCED 3b & 4)	Trade & tech. School, master/ tech.eng. qual. (ISCED 5b)	academic qualification (ISCED 5a & 6)	Total
Cumulated new supply of economically active people in 1000					
2010	0	0	0	0	0
2015	559	2 106	334	1 100	4 098
2020	1 041	3 860	699	2 368	7 968
2025	1 536	5 468	1 108	3 670	11 781
2030	2 078	7 007	1 508	4 912	15 504
New supply of economically active people in 1000					
2010–2015	559	2 106	334	1 100	4 098
2015–2020	483	1 754	365	1 268	3 870
2020–2025	495	1 608	409	1 302	3 813
2025–2030	541	1 539	401	1 242	3 723
2010–2030	2 078	7 007	1 508	4 912	15 504
in per cent					
2010–2015	13.6	51.4	8.1	26.8	100
2015–2020	12.5	45.3	9.4	32.8	100
2020–2025	13.0	42.2	10.7	34.1	100
2025–2030	14.5	41.3	10.8	33.4	100

Source: Helmrich et al. (2012)

3.3 Employment patterns

Since 2000, the workforce participation rate, particularly among older people and women, has risen continuously (cf. Figure 10), partially compensating for the demographically induced decline in the supply of labour. A further increase in the coming years can be justified by the tendency for higher rates of workforce participation among the academically qualified and the increasing numbers of people with academic qualifications in future years. To reflect this, the QuBe project also assumes a rise in workforce participation.

Figure 10 Workforce participation rates by selected age-groups (1991 to 2010)
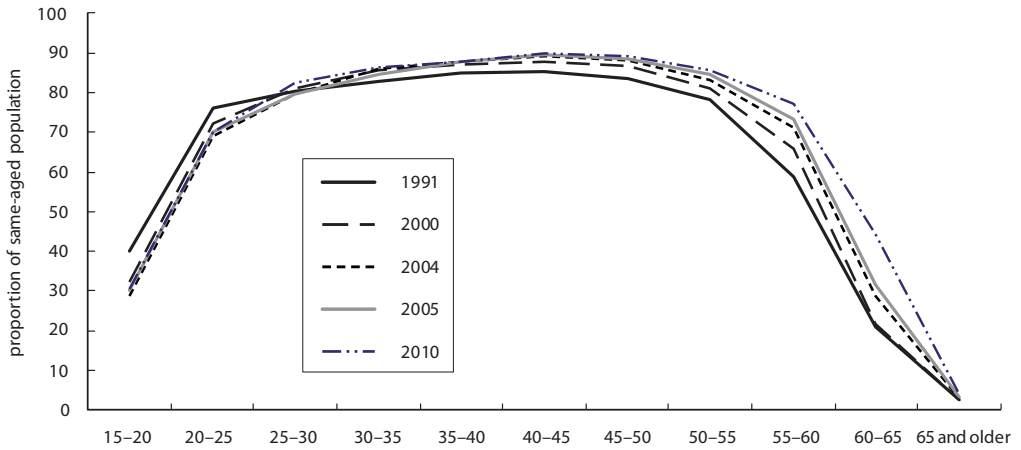
Source: Microcensus of the Federal Statistical Office; Helmrich et al. (2012)

Staff recruitment shortages, experienced by companies, are rarely a problem of the applicants' qualification levels however and have far more to do with their concrete, job-specific qualifications and competencies. The BIBB-IAB Qualification and Occupational Field Projections therefore also compare the matching of supply and demand on the level of 12 BIBB major occupational fields (MOFs). The attribute of occupational field denotes a cluster of tasks specific to each occupational field. Occupations are homogenous with reference to the tasks within the occupational fields and heterogeneous between occupational fields. Herewith we try to capture the rather occupationally segmented and stratified German labour market in regard to other European Labour markets or the US labour market (Allmendinger, 1989).

Figure 11 Age-dependency of staying in the occupation trained for
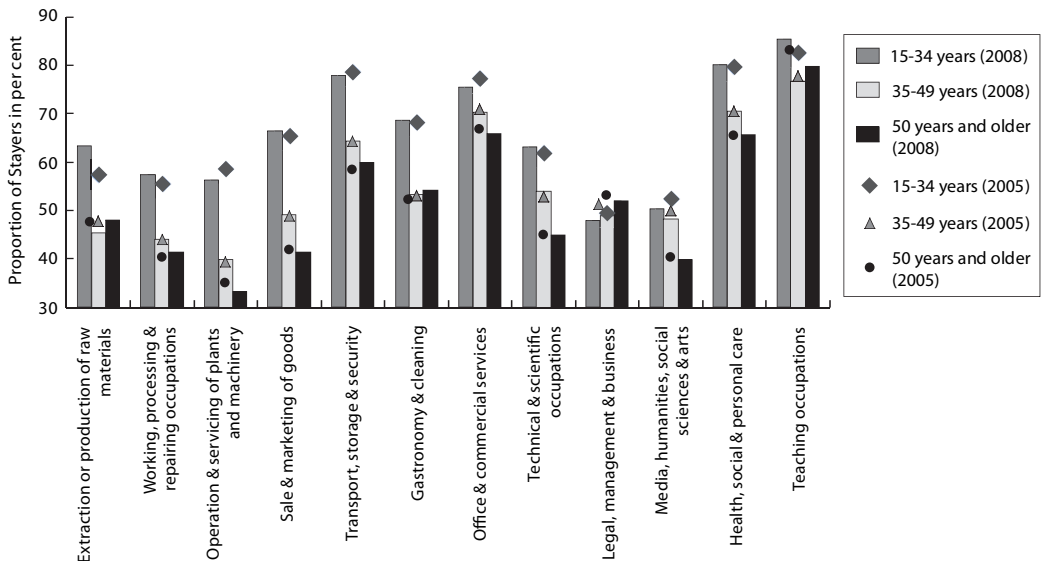
Source: Microcensus of the Federal Statistical Office; own calculations

Above all, the occupations that operate in a restrictive labour market and only have limited recruitment options will have to take care not to lose their potential skilled workers to other occupations. In this way, the proportion of "stayers" in the individual occupational fields – i.e., individuals still working in the occupation they trained for – declines progressively with rising age. In the first few years after qualifying in a "Health and social care" occupation, around 80 per cent of appropriately qualified individuals still work in that sector, compared to only 70 per cent in the 35- to 49-year-old age-group and just 65 per cent in the over-50 age-group (cf. Figure 11).

Besides measures to increase population figures (rising birth rates and more immigration) and the necessary recognition of qualifications obtained abroad, it is mainly measures of education policy which are called for in order to meet qualification needs. The aim is not a one-sided increase in the numbers of graduates, as the OECD urges, but primarily a reduction in the numbers of school-leavers without a formal qualification and in drop-out rates both in the vocational and the academic segments (cf. Maier et al., 2012). A further imperative is to foster the attractiveness of vocational education and training and second-chance qualification also for older economically active people (including those with non-formal qualifications). Young people with 'poor' starting conditions especially should be brought to the point of achieving a vocational qualification and the availability and take-up of continuing education and advanced vocational training opportunities should be increased.

4 MATCHING DEMAND AND SUPPLY. WHEN WILL THE SKILLS SHORTAGE OCCUR – OR WON'T IT COME TO THAT?

Based on the reference scenario of the QuBe, we will now compare the projection of demand for employees with the projected supply of economically active people. . On the occupational level this is possible because an occupational flexibility matrix is part of the analysis. As mentioned above, this flexibility matrix transforms the supply of trained labour into a potential supply of people for specific occupations (Maier et al., 2010). This potential supply of labour for a specific occupation can subsequently be compared to the demand of labour in this specific occupation.
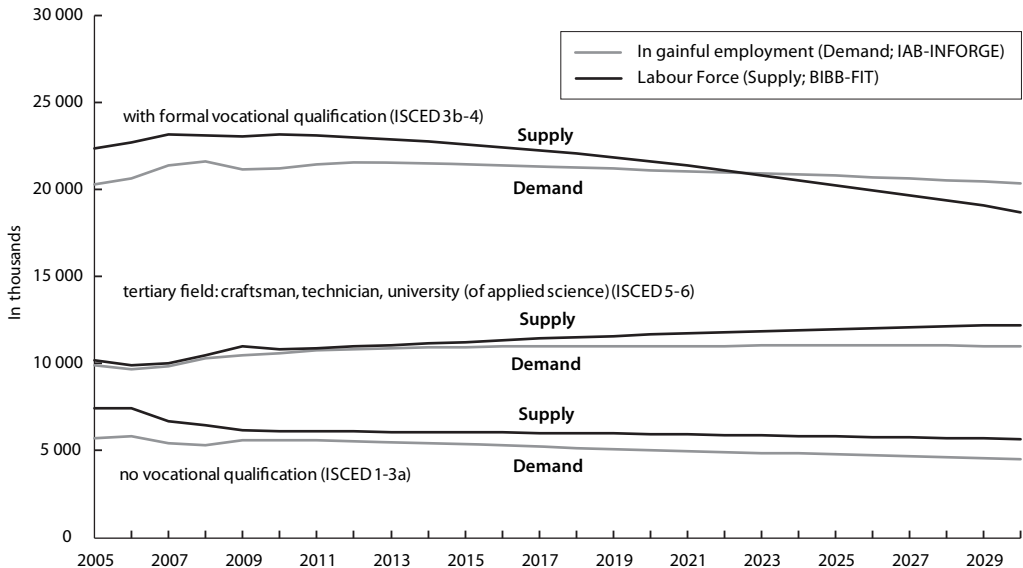
4.1 On the level of qualification levels

The supply of individuals with a completed initial vocational qualification will fall primarily for demographic reasons and, provided that patterns remain stable on the workforce demand side, will no longer fully meet demand towards the end of the projection period (cf. Figure 12). Even before that point in time, a rapidly growing skilled-worker shortage will be confronted at this qualification level, mainly because supply will not match demand, particularly from the viewpoint of job specialisation. The demand for skilled workers with a completed vocational qualification will only fall minimally which will mainly be attributable to the wage increases that become achievable due to shortages in the labour market (c.f. Helmrich, 2012, Maier et al., 2012).

In the tertiary sector, both supply and demand will continue to rise – they are already quite close together today. Among university graduates, the expected demand is made up of replacement demand and new demand induced by economic structural change in roughly equal shares. Replacement demand will grow very markedly from the end of the second decade (from 2020) as the high-birth-rate cohorts (known as the "baby boomer generation") approach retirement. The slight oversupply of graduates is based on the current tendency towards more academic qualifications. Growth in this area has picked up momentum in recent years, while growth in company demand is rising but not in the same order of magnitude.

At this point, adaptation and equilibrium processes with the intermediate qualification segment can be expected. Bachelor degrees should be especially affected by this, but no adequate empirical data is available yet on their opportunities and destinations in the labour market.

Figure 12 Labour force (supply) and number of people in gainful employment (demand) by qualification 2005–2030, in thousands

In gainful employment (Demand; IAB-INFORGE)
Labour Force (Supply; BIBB-FIT)

with formal vocational qualification (ISCED 3b-4)

Supply

Demand

tertiary field: craftsman, technician, university (of applied science) (ISCED 5-6)

Supply

Demand

Supply

Demand

no vocational qualification (ISCED 1-3a)

Source: Helmrich et al. (2012)

The demand for workers without a completed initial vocational qualification will fall slightly. For its part, the corresponding supply will diminish somewhat more slowly which will slightly augment the existing oversupply. Thus, the labour market offers no improvement in their employment opportunities to this group of people, even in future. Nevertheless, this is an obvious opportunity for early intervention, particularly to help new entrants and younger members of the economically active population, e.g. through second-chance training programmes to unlock potential at the intermediate skilled-worker level.

4.2 Supply-demand analysis by major occupational fields

Provided that vocational training patterns continue to develop under status quo conditions, a few major vocational fields will experience a massive workforce shortage as early as 2030, whereas others are characterised by a supply surplus (cf. Figure 13).

According to the findings, a supply surplus in the following occupations is expected:
- Occupations involving the operation and servicing of plants and machinery (MOF 3),
- Office, commercial, service occupations (MOF 7),
- Legal, management and business occupations (MOF 9).

A strained labour market situation is arising in the following major occupational fields even though projected supply still meets demand in purely arithmetical terms:
- Occupations involving the extraction or production of raw materials (MOF 1),
- Transport, storage and security occupations (MOF 5),
- Technical and scientific occupations (MOF 8),
- Teaching occupations (MOF 12).

An arithmetical workforce shortage arises in the major occupational fields for which the projections reveal the supply of workers to be inadequate in quantitative terms. These include:
- Working, processing and repairing occupations (MOF 2),

- Occupations involving the sale and marketing of goods (MOF 4),
- Hotel/restaurant and cleaning occupations (MOF 6),
- Occupations in the media sciences, humanities, social sciences or arts (MOF 10),
- Health, social and personal care occupations (MOF 11).

Figure 13 Difference between number of people in the economically active age and number of people in gainful employment by major occupational field, in 1 000s of people
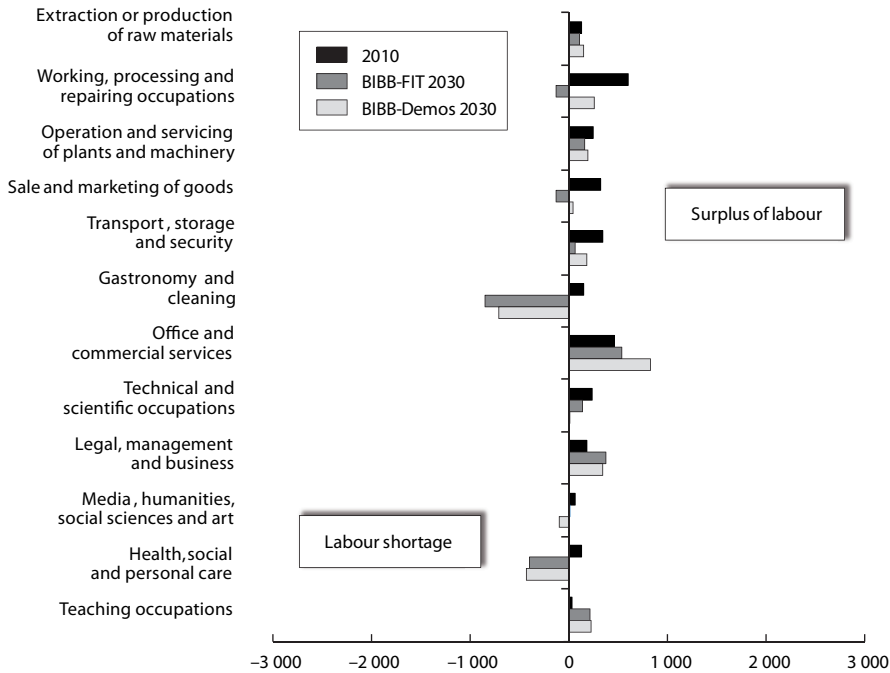
Source: Helmrich et al. (2012)

It should be noted that these results assume the continuation of the status quo. Naturally, in reality this need not be the case. Gaps and overhangs in the workforce can be mitigated by companies' anticipatory and adaptive reactions on the demand side and by young people's changing IVET and occupational choices on the supply side, as well as possible political interventions. In addition, shortages may develop both regionally and within the major occupational fields presented here, yet not occur on the higher aggregate levels. Furthermore, we did not consider work-time volume in the calculations presented. If we consider that unskilled labour is not always employed in the desired amount of hours, we could possibly overcome labour shortages in the field of "Hotel/restaurant and cleaning occupations" (Zika et al., 2012).

CONCLUSION AND OUTLOOK

In our article, we first explained the need for an integral and simultaneous modelling approach as well as the need for a consistent data set and a high transparency and interdisciplinary. We think that the QuBe-modelling framework presented in this article reflects those expressed requirements. After explaining the assumptions that drive our model, we first focused on the demand side and thereafter on the supply side. Due to the consistent data set and the same taxonomy on the demand and supply side, we were able to contrast the future development of supply and demand in major occupational fields and qualification levels.

The results of our projections shows that Germany will expect skill shortages on the medium skill level and in "Working, processing and repairing occupations (MOF 2)", "Occupations involving the sale and marketing of goods (MOF 4)", "Hotel/restaurant and cleaning occupations (MOF 6)", "Occupations in the media sciences, humanities, social sciences or arts (MOF 10)" and "Health, social and personal care occupations (MOF 11)" if relationships that can be found in the past can also be extrapolated to the future. However, we are aware of the fact that labour-force shortages and surpluses in reality will not occur like the present.. A change in the responses of companies to market, educational and occupational choices of young people and also political interventions may mitigate labour shortages. Additionally, shortages may only be specific to particular occupations in certain regions or occur due to a mismatch of desired and actual hours worked.

What implications do our results have in practice? First of all, it should be clear that projections cannot picture the real future, but a consistent and possible future. Therefore, it is up to the researchers to provide a high transparency so that the reader can comprehend the assumptions behind the calculations. Furthermore, scenario calculations should be provided to give an idea about the different impact of the assumptions made. Furthermore, projections should continuously being updated to keep an eye on the sometimes marked changes in education and employment patterns at the current margin. Moreover, updates always give rise to new learning. The more frequently and regularly that systems are implemented, the greater the gain in knowledge. With this article we gave an overview on our leading assumptions and the greatest driver of our demand and supply forecast of qualifications and occupations. However, there are still two major points missing that have been addressed shortly in the paragraph above. One point is the interdependence of demand and supply and the other point is the regionalisation of the projection.

If the demand of an occupation increases faster than the potential supply of people with a qualification for this occupation, we should expect a wage increase in this occupation In consequence, we will have on the one hand a feedback on unit labour costs, prices, productivity and income, and therefore adaption processes within the enterprises to ensure productivity and on the other hand we could expect a reaction of occupational mobility behaviour and employment rates. However, this is only working in non-regulated labour markets. Labour markets with institutional restrictions, e.g. the health care sector, can probably not be solved through an increase in relative wage. In this case, other solutions are needed such as, for example, migration. This has to be considered when developing an interdependent demand-supply-model of the labour market.

The other aspect that cannot be addressed with a federal state model is that mismatches mainly happen on the regional level. This is why the regional level is becoming a major focus of attention. Important dimensions in this respect are demography, economic development by branches, and flexibility by occupational fields. Figure 2 could also be drawn for each of the German federal states. There are two further items to include: the consistency requirements on the supply side and, on the demand side, that people can move within Germany, but the sum of all net migration balances must be zero and the economic output calculated for the whole of Germany must be equal to the aggregated economic output of the individual federal states. One region's gains are always at another region's cost, unless the national result itself is amended. To model the regional demand, we will fall back on the LÄNDER model, a model in existence since 2001 that was developed within the framework of the IAB/GWS cooperation. In the LÄNDER model, developments in the sectors have been consistently linked with development at the national level. As well as sector-specific information, it also incorporates federal-state-specific information, so that data is already available on the development of demand for employees by location. Another existing model is PANTA-RHEI-Region, a model for every county district of Germany which has been used especially to ascertain different site uses (including industrial sites). On the supply side, population projections as well as the different mobility patterns of people with different formal qualifications are still to be discussed. Education is a competence devolved to the German federal states: differences within

the education and training system will have to be taken into account when creating a model. Some clear variations in employment patterns are also apparent by age and gender.

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