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Inhalt

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Despite a growing population, shortages remain in the area of skilled tasks

BIBB-IAB qualifications and occupational field projections up until the year 2035 taking migration of refugees into account

The fourth wave of qualifications and occupational field projections prepared by the Federal Institute for Vocational Education and Training (BIBB) and the Institute for Employment Research (IAB) provide a summary of the German labour market's expected development up to 2035. New challenges are being presented, particularly against the background of the massive refugee migration in 2015. The direct effects of this initial rise in the population figures include higher levels of state spending and changes in the demand for housing and educational services. However, labour supply will only grow with some delay. If current educational and employment patterns continue and working times do not increase, medium-term population growth will not be sufficient to avoid long-term shortages in the area of skilled tasks. This especially affects persons who have completed vocational education and training. On the contrary, in the area of high qualifications, the labour supply shows a stronger long-term increase than demand for skilled workers for complex tasks and highly complex tasks.

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Current developments – long-term effects?

The aim of the basic projection of the BIBB-IAB qualifications and occupational field projections (QuBe Project) is to use dynamic modelling to update observable trends, forms of behaviour, and mutual dependencies on the labour market. This demonstration of a development pathway and of any corrections that may be required (given certain general conditions) appears more meaningful than the "most precise prognosis possible" of a future key indicator, which would be a product of chance anyway. This means that future shocks and/or trend reversals (such as "Economy 4.0", "discontinuance of the EU Refugee Agreement with Turkey" and "Brexit") do not form a component of this basic projection. Thematic areas of this nature need to be analysed and observed in the form of alternative scenarios. For this reason, the effects of migrants on the macro-economic system are evaluated and presented via a separate scenario.[1]

Because general conditions change, there is a need for regular updating and adaptation of the database and potentially of the type of modelling used. This BIBB Report presents the results of the fourth wave of the QuBe Project. Compared to the third wave (Maier et al. 2014a, Maier et al. 2014b), there has been a change in both the general political and economic conditions and in the German classification of occupations. This necessitated adaptations in terms of content and methodology and made further developments possible.

Recent years have seen a further increase in women's participation in employment and a growing propensity towards higher education study by younger cohorts. The minimum wage is also now in place. The above has been mostly taken into account via the updating of the databases in 2013 and 2015.[2] However, the greatest influence on long-term development is being exerted by the change in the size and structure of the population because of the high numbers of migrants, and of refugees in particular.[3] Whereas previous projection waves were based on the 12th Coordinated Population Forecast produced by the Federal Statistical Office, a separate QuBe population projection has been prepared for the fourth wave (Fuchs et al. 2016, Gorodetski et al. 2016, Maier et al. 2016a, Maier et al. 2016b, see methodological box 2). During the course of 2015, it quickly became apparent that, because of the influx of refugees, the migration assumptions included in the updated 13th Coordinated Population Forecast massively underestimated net migration to the country. Against the background of future migration movements, meaningful analyses need to record the places of the origin of migrants and to assess their abilities and qualifications. For the fourth projection wave, the medium and long-term influence of refugees on the population structure and on labour supply is initially estimated on the basis of the assumption of around 1.1 million potential asylum seekers in the year 2015 and with the assistance of a "refugee module" (see methodological box 1: QuBe Population Projection).

The introduction of the 2010 Classification of Occupations (KldB 2010) means that it is necessary to adjust the 54 BIBB occupational fields previously used (Tiemann et al. 2008) to 50 BIBB occupational fields (Tiemann 2016).[4] Alongside the required alterations to technical allocations of individual occupations to occupational fields, the KldB 2010 also records the requirement level directed towards the worker by the job. This makes it possible for the first time to compare the qualifications of the labour supply with the actual work requirements.

We will begin below by presenting the effects of the QuBe Population Projection on the economy as a whole whilst taking current refugee movements into account (basic projection). The basic projection will subsequently be evaluated in accordance with 20 main occupational fields,[5] and the development of the labour supply by qualifications will then be compared with the labour demand by requirement levels.

Effects of the QuBe Population Projection for the economy as a whole

On the basis of data available as of 15 May 2016, the assumption made for the QuBe Population Projection is that around 2.26 million people will seek at least temporary protection in Germany during the period from 2015 to 2020 (the figures for 2015 and 2016 being around 1.1 million and around 0.45 million respectively). From 2016 to 2020, the influxes are in each year reduced by one third compared to the previous year. Although not all persons receive recognition as a refugee or subsidiary protection (§ 3 Paragraph 1 German Asylum Procedure Law, AsylVfG, Article 16a German Basic Law, GG, § 4 Paragraph 1 German Asylum Act, AsylG) or a

1 The representation of a refugee scenario is already included in Chapter A8 of the 2016Data Report to accompany the Report on Vocational Education and Training. A detailed analysis will follow in the form of a BIBB Academic Research Discussion Paper.

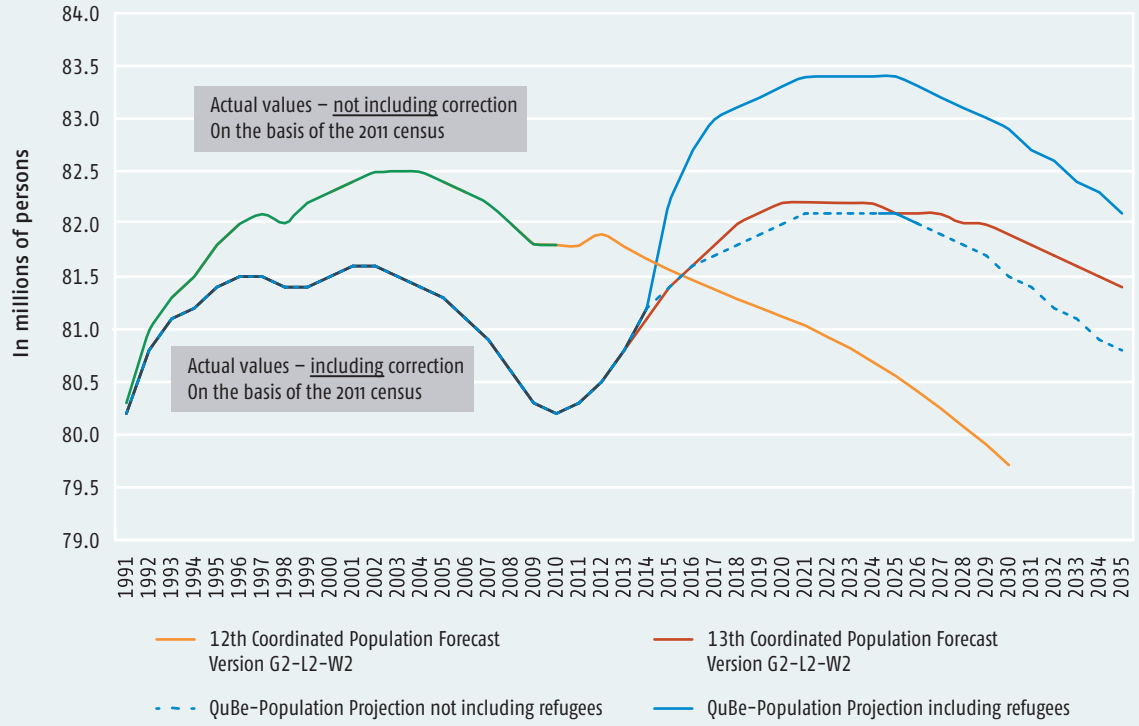
2 The qualifications and employment structure of the population is mapped via the microcensuses of the Federal Statistical Office up until the year 2013. The macro-economic values of the National Accounts and information on participation in education and training are as of the year 2015.

3 Our calculations and assumptions indicate an influx of around 2.17 million persons into Germany in 2015. These include 1.1 million potential asylum seekers from current crisis regions. These influxes contrast with around 0.87 million persons emigrating from Germany in 2015.

4 Occupational fields were collated in the food and beverages sector ("bakers, pastry cooks, production of confectionery goods", "Butcher"", "Beverages, production of luxury foodstuffs, other food occupations"), in the textiles branch ("Textile occupations", "Textile processing, leather manufacture") and in logistics ("Goods testers", "Dispatch processing operatives", "Packers, transport processors").

5 This takes place for reasons of representation. The calculations are conducted on the basis of 50 occupational fields (see http://www.qube-projekt.de).

Figure 1: Population development of the QuBe Population Projection including and not including refugees and variants of the 12th and 13th Coordinated Population Forecast until 2035



12th Coordinated Population Forecast

G1: Approximalte constancy at 1.4 births per woman
L1: Life expectancy of newborns in the year 2060 Boys: 85.0 years; Girls: 89.2 years
W2: Annual net migration 200,000 persons from 2020

13th Coordinated Population Forecast

G2: Rise to 1.6 births per woman by 2028, constant thereafter
L2: Life expectancy of newborns in the year 2060 Boys: 86.7 years; Girls: 90.4 years
W2: Annual net migration decrease from 500,000 in 2014 to 200,000 persons in 2021, constant thereafter

QuBe Population Projection including refugees

G: Rise to 1.5 births per woman in 2035 for German women and constant birth figure of 1.8 for foreign women
L2: Life expectancy of newborns in the year 2035 Boys: 82.1 years; Girls: 86.2 years
W: Rise in Annual net migration to 1,280,000 persons in 2015, thereafter fall to 83,000 by 2035

QuBe Population Projection not including refugees

G: Rise to 1.5 births per woman in 2035 for German women and constant birth figure of 1.8 for foreign women
L2: Life expectancy of newborns in the year 2035 Boys: 82.1 years; Girls: 86.2 years
W: Rise in Annual net migration to 470,000 persons by 2016, thereafter fall to 115,000 in 2035

Source: QuBe Project, fourth wave, Federal Statistical Office

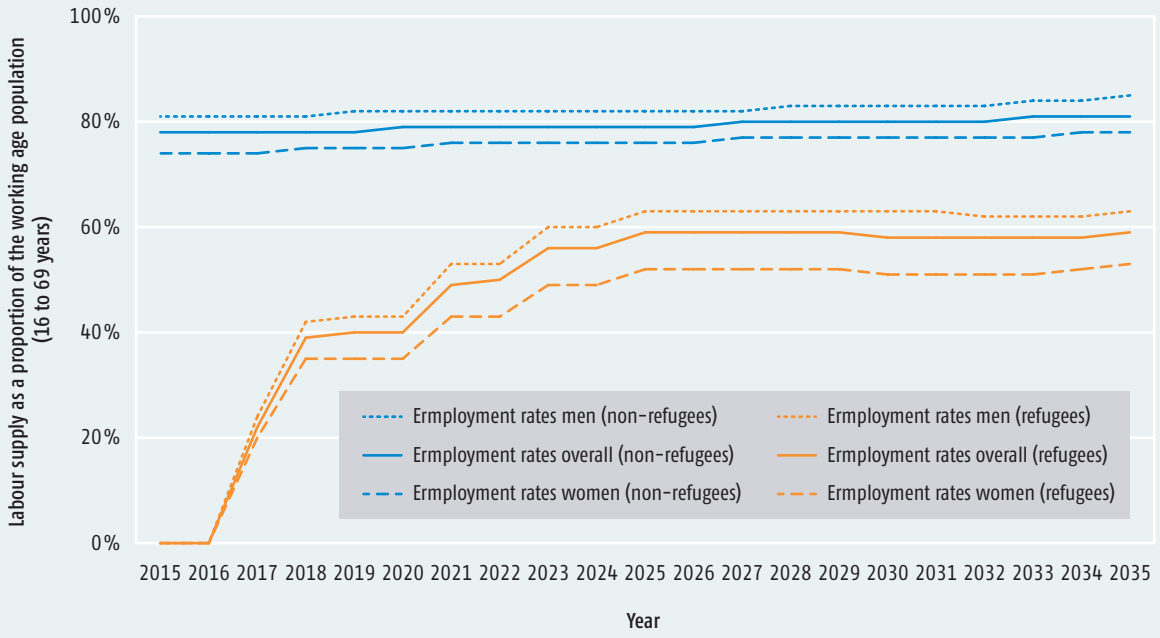
deportation ban pursuant to § 60 Paragraphs 5 and 7 German Residency Act, AufenthG, the assumption is that, up to and including 2020, around 1.4 million people will be recognised as being in need of protection in Germany.

Figure 1 shows the actual development up to 2014, the predicted population of the 12th Coordinated Population Forecast, on which assumption the third wave was based (Maier et al. 2014a), the current 13th Coordinated Population Forecast[6] and the results of the QuBe Population Projection both including and not including refugees.[7] Both the amount of net migration and (retrospective) adaptations to the population update in the wake of the 2011 census clearly show that predicted population development deviates from the third wave. Whereas the population amount initially needed to be corrected downwards by 1.4 million persons in 2011 as a result of the census, around 1 million persons arrived in Germany by 2014 via inner-European labour market migration. The additional influx of refugees means that the population amount will rise to around 83.4 million by 2023. After this point, the population will – primarily because of the non-sustainable birth rate (Fuchs et al. 2016) – fall back to 82.1 million persons by 2035. Influxes and departures also mean that the population is becoming relatively younger. In the QuBe Population Projec-

6 The variant presented is the one which is most similar to the QuBe Population Projection by dint of its assumptions (Maier et al. 2016a, Maier et al. 2016b).

7 The Population Projection not including refugees also encompasses asylum seekers and recognised refugees, although only in the amount of the long-term average and not taking current refugee movements into account.

Figure 2: Employment rates of refugees assumed in the basic projection



Source: Microcensus and National Accounts produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave

tion, for example, the mean age for men is 46.6 (including refugees) and 47.0 (not including refugees). In overall terms, however, the population of Germany will continue to age. In 2013, the average age for men was around 44.5 years.[8]

With regard to employment behaviour, the assumption is that the rates of employment for refugees will reach the level of those foreigners who are not refugees after a stay of around ten years in Germany. This makes them lower than the rates of employment of the German population (Brücker et al. 2015). The adjustment takes place on a gradual basis. Figure 2 presents the rates of employment of refugees and non-refugees by gender up to 2035.[9] Female refugees exhibit a lower rate of employment than male refugees throughout.

The number and size of private households is crucial to consumer behaviour. Because of the age and family structure of refugees, the relative number of households in which only one person lives and in which four persons or more are living is rising. These households will not increase their consumer demand until they are more integrated.[10] The transition of refugees to private sector housing will also soon lead to an increase in the demand for housing. However, the backlog of orders in the construction sector caused by low interest rates and infrastructure projects which have already been adopted suggests that additional building of housing will be realised in later years rather than taking place in a manner which is proportionate with the population increase.

Table 1 presents the development of the output side of the gross domestic product and of selected labour market indicators. As of the end of 2015, the influx of migrants and refugees means that the population in the basic projection is 2.1 million persons higher than was the case in the third wave.[11] Imports, exports and consumer spending by the state and private households are all growing accordingly.

In the basic projection in the year 2030, the number of the working age population (persons aged between 15 and 70) is also around three million higher than was assumed in the third wave. This figure will rise more sharply over the coming years as many of the refugees reach the age threshold of 15 years. As the working population increases, the labour supply (labour demand and unemployed persons) also rises.

A look at the overall labour demand shows that labour demand in 2030 is now 2.7 million higher compared to the third wave. One of the main reasons for this is likely to be the domestic demand

8 The mean age for women in the QuBe Population Projection is 48.8 years (including refugees) and 49.0 (not including refugees). The corresponding figure for 2013 was 46.8 years.

9 Refugees who arrived in Germany prior to 2014 can no longer be separated in the modelling and for this reason are treated as "non-refugees".

10 Consumption of private households was corrected downwards in the model since the projection for 2015 would otherwise show values higher than the actual values. In the long term, consumer spending by private households returns towards the known level.

11 Some of the 2015 influx (2.17 million including 1.1 million potential asylum seekers from current crisis regions) emigrated again before the end of 2015 or will do so in the long term in accordance with the departure rates (see methodological box 1).

Table 1: Development of the output side of gross domestic product and selected labour market indicators from 2005 to 2035

Year	2005	2010	2015	2020	2025	2030	2035
GDP in € billions (adjusted for inflation, base = 2010)	2,426.5	2,580.1	2,782.2	2,970.6	3,146.3	3,276.2	3,373.4
GDP per capita (adjusted for inflation, base = 2010)	29,433.9	31,559.8	33,815.9	35,670.1	37,754.1	39,561.5	41,093.3
Consumption of the state in € billions (adjusted for inflation, base = 2010)	446.3	493.3	529.2	566.9	587.8	602.4	620.5
Consumption of private households in € billions (adjusted for inflation, base = 2010)	1,332.7	1,372.9	1,449.2	1,529.6	1,585.7	1,658.7	1,724.0
Construction investments € billions (adjusted for inflation, base = 2010)	228.9	237.1	263.1	260.1	247.8	245.7	249.4
Exports (adjusted for inflation, base = 2010)	866.5	1,067.0	1,324.2	1,605.9	1,899.8	2,188.8	2,478.2
Imports (adjusted for inflation, base = 2010)	719.0	898.8	1,089.8	1,347.4	1,571.5	1,850.6	2,160.5
Population in millions of persons	82.4	81.8	82.3	83.3	83.3	82.8	82.1
Working age population[1] in millions of persons	60.3	58.3	58.5	58.8	57.8	56.2	53.9
Labour supply in millions of persons	43.7	43.8	44.9	45.8	45.7	44.7	43.7
Labour demand in millions of persons	39.2	41.0	43.0	43.5	43.3	42.9	42.3
Employment rate[2]	65.0 %	70.3 %	73.5 %	74.0 %	74.9 %	76.3 %	78.5 %
Unemployment in millions of persons	4.5	2.8	1.9	2.3	2.4	1.8	1.4
Volume of work in millions of hours	55.5	57.0	59.3	59.8	59.5	58.9	58.2
Potential work volume in millions of hours	69.5	64.3	63.7	64.7	64.7	63.3	61.9
Development of the hourly wage[3] (2010 = 100)	92.4	100.0	115.2	125.0	136.5	153.0	170.8
Annual working time in hours	1,323.5	1,309.6	1,303.6	1,298.3	1,297.5	1297.2	1,298.5

[1] Population aged from 15 to 69 [2] Labour demand related to working age population [3] Hourly wage is not adjusted for inflation.

Source: Microcensus and National Accounts produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave

associated with the fact that the population is now larger.[12] However, the basic tendencies towards continuing tertiarisation previously identified continue to be confirmed. The significance of the service sector in relation to the labour demand as a whole is growing on an ongoing basis (Hummel et al. 2010, Maier et al. 2014a), whereas there is a long-term fall in employment in "manufacturing" and in the "construction sector" (cf. Figure 3). The growing population brought about by increased immigration via the influx of refugees and the resultant increased demand for housing will thus only stimulate the "construction sector" in the short to medium term.

However, not all parts of the service sector will see equal growth. Quite the contrary is, in fact, the case. In individual service sectors, such as "commerce, maintenance and repair of motor vehicles and used goods", the amount of the labour force required will increasingly decline despite the increased demand brought about by the accumulated needs of refugees. One of the reasons for this is that the average annual working times produced per worker will not continue to fall over the coming years to the same extent as was the case in recent years.[13] On the other hand, fewer workers will be deployed in the areas of "public administration, defence, social security"despite a slower decrease in the population. This also applies in diluted form to the branch of "other public and private service providers". The fact that the population structure is becoming younger is reflected in the "education and teaching" sector because the larger number of younger persons migrating or fleeing to Germany initially means that more staff will need to be deployed. In the long term, however, demand will also decline in this branch (cf. Figure 3). The labour demand in "healthcare and social services" will continue to rise sharply. Neither will migration reduce the number of older persons. The result of this will be that demand for healthcare services will continue to increase massively, and employment at senior citizen institutions and in outpatient long-term care services will go on ex-

12 A publication on the precise effects on the economy and the labour market of the high immigration will appear in the form of a BIBB Academic Research Discussion Paper.

13 If average annual working time falls (e. g. because of a higher proportion of part-time work), more persons would need to be employed.

Figure 3: Labour demand by economic sectors 2005 to 2035 – in millions of persons in the basic scenario

Source: Microcensus and National Accounts produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave

panding. Childcare will also continue to gain in significance.

The trend towards a service society cannot be equated with de-industrialisation. Gross production in the manufacturing industry will continue to grow at a slightly higher level than average in future. This will also continue to depend upon successful exports. The opportunities for rationalisation within industry permit above-average rises in productivity, particularly in the case of digitalisation of production (Wolter et al. 2015), something which will involve a smaller deployment of labour. In the past, companies have also outsourced production-related services. This means that the added value achieved in these areas is no longer attributed to the manufacturing industry. For example, 56 percent of services provided by the temporary employment sector and 20 percent of the work produced by "freelance, scientific, technical services" are supplied to the manufacturing industry (Federal Statistical Office 2016). For this reason, the prerequisite for strong growth in company-related services is an effective industrial base. The future relationship between industry and services will, therefore, continue to be characterised by complementarity rather than by substitutionality.

Qualifications structure of the labour supply

Because around half of the refugee influx is aged under 25, far more people need to be provided with educational services than has been previously expected on the basis of the decline in the number of young people due to demographic circumstances (Maier et al. 2011). The extent to which and the time at which refugees avail themselves of certain forms of training, the point when they become available to the labour market and the occupational specialism they are able to offer all depend on their language knowledge and prior school and vocational learning.

We are not currently in possession of any data sources which record the qualifications structure of refugees in a representative and detailed manner.[14] Given the high emigration numbers and the humanitarian motives behind the flight, the supposition is that a cross-section of the population of the countries of origin leaves their homeland, rather than merely one qualifications group. For this reason, the assumption is that the qualifications structure of the refugees is in

14 Both school education and vocational education and training are of interest for the projection (Rich 2016).

line with that within the countries of origin (Maier et al. 2016a).

With regard to prospective transitions to the educational systems, use is made of special evaluations of persons migrating from the most common countries of origin between 2011 and 2014[15] prepared in the microcensuses from 2012 to 2014.[16] These valuations indicate that an estimated 45 percent of recognised refugees will be in education and training in the near future. By 2035, they will gradually be distributed across the various places of training in line with the foreign population. During the initial years, however, half of these persons will take part in a basic vocational training year, a vocational preparation year or vocational preparation schemes. Nevertheless, the estimates also show that 35 percent of recognised refugees and persons in need of protection are at risk of not gaining any educational qualification in the long term (Maier et al. 2016a).

For those who are already in possession of fully qualifying vocational education and training or a higher education qualification, the assumption is that the occupational structure follows the structure of the qualifications which the migrants have acquired abroad in their home countries.[17] Compared to the qualifications of German persons not from a migrant background, a stronger concentration is revealed for "teaching occupations", "healthcare professions", "media, humanities, social science and artistic occupations" and "IT and scientific occupations", typical main occupational fields within the academic education system (Figure 4).[18] It is likely that the lower level of dissemination of the dual system in the home countries and the economically-oriented migration of those responding to the microcensus both play a part here. Because assessments indicate that the majority (79 %) of refugees do not hold a full VET qualification and by dint of their young age do not undergo training until they arrive in Germany, the assumption is that the occupational structure of the refugees will only converge with the occupational structure of the indigenous population in the long term.

The gradual integration of the refugees into the German educational system will mean that more persons will once again obtain an intermediate vocational education and training qualification in the long term, although the number of those not in possession of a formal VET qualification will still rise in the medium term (Table 2).[19]

Despite an increase in persons without a formal vocational qualification, the basic projection will see an expansion in education (Helmrich/Zika 2010a), and the number of persons entering higher education will remain at a high level. Between the years 2014 and 2035, around 20.2 million persons will leave the labour market, but only 18.8 million will join it (see Table 3). Around 34.5 percent of the new supply have an academic qualification (6.5 million), and around 48.8 percent (9.2 million) have completed vocational education and training. However, by 2035 only 3.8 million (19.1 %) of persons with academic qualifications will retire from working life, whereas the corresponding figure for those in possession of a vocational education and training qualification will be 12.1 million (59.7 %). Although in 2035 the majority of the population will still have completed VET, the proportion of such persons will decrease from just under 52.6 percent in 2014 to around 47.4 percent in 2035. At the same time, the proportion of persons with an academic qualification will rise. This increasing academisation will also transfer to the supply of skilled workers according to occupational fields.

Labour supply and demand by occupations

The migration of refugees means that a larger labour supply can be expected in the future. Nevertheless, the demand for goods and services will also rise, and ongoing economic structural change will alter the demand for occupations. In order to find out the extent to which these changes in demand can be covered by an appropriate labour supply, we need to compare the labour supply at the level of occupations with the demand for labour. In doing so, it should be borne in mind that developments in supply and demand are subject to exchange processes and are by no means static and running independently from one another. Labour demand can, for example, react to skilled workers shortages via wage adjustments, and even the labour supply, within the scope of the possible flexibility within the occupation learned, can migrate to relevant occupational fields that are in greater demand and relatively better remunerated (see methodological box 2). These adjustment reactions are taken into account (as in the third wave of the QuBe Project [Maier et al. 2014c]) insofar as such reactions could also be observed in the past.

In order to identify labour demand for an occupational field, development is evaluated within the economic sectors in accordance with 50 occupational fields at four requirement levels respectively.[20] Growth within a branch, together with the specific mix of occupations, determines the need to expand occupa-

15 Not including the states of the Western Balkans, which were removed from the calculation, these are Afghanistan, Pakistan, Iraq, Iran, Syria, Eritrea and Nigeria.

16 We would like to thank Mr. Herter-Eschweiler from the Federal Statistical Office for the evaluations.

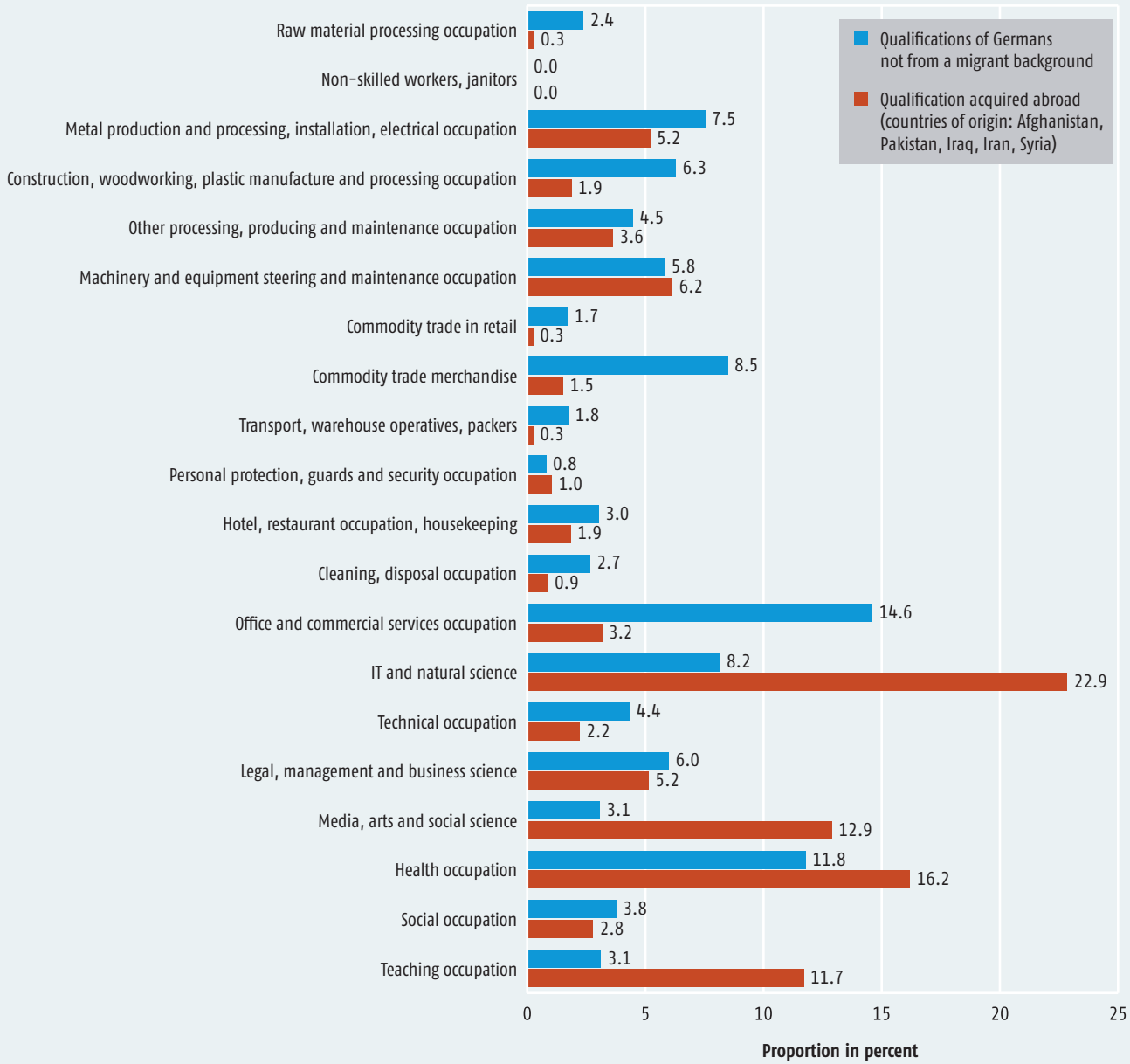
17 No material structural differences by year of influx are revealed.

18 A consideration of the domestic qualifications acquired by persons from the countries of origin stated shows an even higher concentration of these academic main occupational fields.

19 No different drop-out rate within the places of training is assumed between German and refugees.

20 However, not all 200 (= 50 x 4) occupational field requirement combinations are fulfilled in every economic sector.

Figure 4: Comparison of the occupational structure (main occupational fields in which training has taken place) of Germans not from a migrant background and immigrants from the main refugee countries of origin (in percent)



Source: Microcensuses 2011 to 2014 conducted by the Federal Statistical Office, calculations by the Federal Institute for Vocational Education and Training (BIBB), special evaluations by the Federal Statistical Office

tions within an occupational field. On the other hand, this composition of occupations inside a branch may also alter over the course of time. Aspects such as technological trends play a part in this regard. Another factor is wage development in an occupational field, which is in turn influenced by the available supply of labour with the relevant qualifications.

Available labour is determined via the age and gender-specific qualifications structure of the labour supply. Each worker thus enters the labour market with the occupation in which he or she has trained (highest vocational qualification)[21] (Table 4). Within this process, the future supply of occupations is influenced by the higher qualification of the new labour supply in general terms. The development of this new supply is strengthening the secondary service sector occupations in particular. Around 62 percent (1.2 million of 1.9 million persons) of the 2035 labour supply in the main occupational field of "media, humanities, social science and artistic occupations" will not flow onto the labour market until after 2014. By way of con-

21 Persons without a vocational qualification are listed as a separate category.

Table 2: Proportions of persons leaving the educational system up to 2035 in per cent

Period	Not completed VET (ISCED 1, 2 & 3a)	Completed VET (ISCED 3b & 4)	Trade and technical school qualification, master craftsman/Technician (ISCED 5b)	Academic qualification (ISCED 5a & 6)
2011–2015	6.1	56.4	8.8	28.6
2016–2020	8.2	49.3	9.1	33.4
2021–2025	8.8	46.7	9.0	35.5
2026–2030	8.5	47.2	8.9	35.4
2031–2035	7.3	49.8	8.8	34.1

Source: QuBe Project, fourth wave

Table 3: New labour supply and persons leaving working life by qualification level in the projection years 2014 to 2035

Year/period	Not completed VET (ISCED 1, 2 & 3a)	Completed VET (ISCED 3b & 4)	Master craftsman/ technician, advanced training qualifications (ISCED 5b)	Academic qualification (ISCED 5a & 6)	In education and training	in total
	Total labour supply in 000's					
2014	5,618	23,546	3,887	8,488	3,185	44,725
2020	5,376	23,415	4,058	9,447	3,496	45,792
2025	5,139	22,796	4,106	10,213	3,477	45,731
2030	4,785	21,647	4,028	10,726	3,501	44,687
2035	4,427	20,685	3,944	11,131	3,471	43,658
	Persons leaving working life in 000's					
2014–2020	491	2,953	365	882	-	4,692
2020–2025	513	2,796	454	883	-	4,645
2025–2030	653	3,120	565	1,007	-	5,345
2030–2035	672	3,182	569	1,087	-	5,509
2014–2035	2,329	12,052	1,953	3,858	-	20,191
	New labour supply in 000's					
2014–2020	249	2,822	536	1,841	-	5,448
2020–2025	275	2,178	502	1,649	-	4,603
2025–2030	299	1,971	486	1,520	-	4,276
2030–2035	315	2,220	485	1,491	-	4,511
2014–2035	1,138	9,191	2,009	6,501	-	18,839

Source: Microcensus produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave

trast, half of the labour supply trained in a manufacturing occupation will leave working life. Between 2014 and 2035, this will mean the departure of 1.6 million of the 2014 labour supply of 2.8 million persons (57%) in the main occupational field of "metal construction, plant construction, sheet metal construction, installation, fitters, electrical occupations" and of 1.2 million of the 2.1 million workers in "occupations involving the operation and maintenance of machines and equipment" (also approximately 57%). In the case of "technical occupations" and "security and guarding", as many as approximately 59 percent will have left the labour market by 2035.

The *occupational flexibility* linked with the occupation learned shows employment opportunities in other occupational fields on the basis of activity-specific knowledge and thus ultimately displays the labour supply that may be potentially available to an occupational field. For the purpose of the projection, consideration is accorded to the fact that these oc-

Table 4: New labour supply and persons leaving working life by main occupational fields in thousands of persons

Year	2014	2035		
	Total labour supply	New labour supply (cumulated since 2014)	Total labour supply	Left working life (cumulated since 2014)
raw material processing occupation	**832**	237	**599**	470
non-skilled workers, janitors	**23**	6	**10**	19
metal production and processing, installation, electrical occupation	**2,804**	943	**2,150**	1,598
construction, woodworking, plastic manufacture and processing occupation	**2,205**	502	**1,527**	1,179
Other processing, producing and maintenance occupation	**1,684**	438	**1,181**	942
machinery and equipment steering and maintenance occupation	**2,129**	765	**1,672**	1,222
commodity trade in retail	**537**	219	**489**	267
commodity trade merchandise	**2,847**	1,267	**2,735**	1,379
transport, warehouse operatives, packers	**699**	401	**728**	372
personal protection, guards and security occupation	**252**	122	**227**	148
hotel, restaurant occupation, housekeeping	**1,946**	737	**1,865**	818
cleaning, disposal occupation	**130**	113	**188**	55
office and commercial services occupation	**4,916**	2,019	**4,373**	2,562
IT and natural science	**3,183**	2,510	**4,254**	1,440
Technical occupations	**1,567**	595	**1,231**	931
Legal, management and business science	**2,295**	1,688	**3,157**	826
media, arts and social science	**1,202**	1,208	**1,936**	474
health occupation	**4,211**	2,277	**4,714**	1,774
social occupation	**1,287**	966	**1,691**	561
Teaching occupations	**1,058**	738	**1,202**	594
No completed vocational training or vocational school	**5,733**	1,088	**4,261**	2,560
In training	**3,185**	0	**3,471**	–
Total	**44,725**	18,839	**43,658**	23,377

Source: Microcensus produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave

cupational flexibilities may be changeable via ageing processes or wage adjustments on the part of employers due to of shortages of workers. Table 5 presents the flexibilities empirically identified for the year 2013. Because of the necessary restructuring of the occupational fields pursuant to the 2010 KldB, the flexibility matrix is not comparable with the matrix from the third wave (Maier et al. 2014a, Maier et al. 2015). The most frequent switches are to be found in the manufacturing industry, where the proportion of stayers (see the diagonal in Table 5) is often relatively low. A change of occupation is most likely to occur within the manufacturing occupations and in "occupations involving traffic, warehousing, transport". The highest proportions of stayers are shown in "healthcare professions" (74.5 %), "social occupations" (76.0 %), "security and guarding occupations" (79.8 %) and in "teaching occupations" (71.8 %), in which there is a high proportion of civil servants. Because of occupational loyalty, the labour supply in these main occupational fields will in future strongly depend upon how many persons complete training in an occupation in them. By way of contrast, a greater role in main occupational fields with a low proportion of stayers will be played by wage developments to compensate for shortages and recruit workers.

Figure 5 presents an evaluation of labour demand and supply by main occupational fields. It takes into account the

Table 5: Occupational flexibility matrix in 2013

	Main occupational field learned	Main occupational field exercised (Percentages for the frequency of a switch from the occupation in which training has taken place to the main occupational field)																				To-tal
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Example: 10.8 percent of the labour supply who have trained in "technical and scientific occupations" are in "legal, management and economic occupations".																						
1	raw material processing occupation	50.3	4.1	0.9	2.2	0.6	3.2	1.4	3.7	12.6	1.6	3.8	3.8	3.8	1.4	1.2	1.5	0.8	1.7	0.8	0.7	100
2	non-skilled workers, janitors	0.7	24.9	5.7	3.7	2.6	12.1	0.7	8.5	8.8	2.6	1.4	6.2	3.3	4.2	4.4	6.1	1.5	1.4	0.0	1.3	100
3	metal production and processing, installation, electrical occupation	1.2	6.2	34.2	2.3	2.8	11.1	1.1	3.8	10.7	2.6	1.5	2.6	3.5	4.0	6.9	2.7	1.1	0.7	0.4	0.7	100
4	construction, woodworking, plastic manufacture and processing occupation	2.2	7.9	1.7	41.7	1.9	6.2	1.1	3.2	15.7	2.3	1.8	1.9	2.5	1.7	3.1	2.1	1.0	0.7	0.4	0.8	100
5	Other processing, producing and maintenance occupation	1.8	4.3	4.5	2.1	29.2	10.8	1.8	4.2	15.5	2.2	2.0	1.7	3.7	2.2	6.1	3.2	1.0	2.1	0.5	1.1	100
6	machinery and equipment steering and maintenance occupation	1.1	4.2	2.6	1.7	1.8	36.0	2.4	4.8	9.6	1.5	5.8	6.5	5.0	2.2	6.4	2.3	2.0	2.6	1.0	0.6	100
7	commodity trade in retail	1.0	1.5	0.3	0.3	0.3	1.7	39.3	12.9	5.7	0.8	7.5	6.1	11.2	0.6	0.8	2.7	1.3	4.1	1.6	0.4	100
8	commodity trade merchandise	0.9	1.3	0.3	0.3	0.2	1.2	10.4	38.0	6.3	1.1	5.8	4.0	16.8	1.2	0.7	5.5	2.0	2.2	1.1	0.6	100
9	transport, warehouse operatives, packers	1.1	3.1	1.1	1.6	0.6	3.1	1.0	6.4	59.3	1.8	2.2	2.9	6.7	1.4	1.8	2.1	0.9	1.1	0.6	1.3	100
10	personal protection, guards and security occupation	0.6	0.5	0.2	0.7	0.2	0.8	0.3	1.2	2.7	79.8	1.2	0.7	6.5	0.6	0.4	1.3	0.3	1.2	0.2	0.6	100
11	hotel, restaurant occupation, housekeeping	2.6	2.9	0.5	1.0	0.5	2.8	4.3	5.9	8.7	1.6	48.4	5.4	5.6	0.8	1.0	2.3	1.1	2.7	1.3	0.7	100
12	cleaning, disposal occupation	1.2	3.6	7.7	1.5	0.7	5.1	1.5	2.7	9.2	2.7	4.5	43.0	3.3	2.2	3.4	4.1	1.3	1.6	0.4	0.3	100
13	office and commercial services occupation	0.5	0.6	0.2	0.2	0.1	0.6	1.5	6.7	2.9	1.8	2.7	1.5	64.7	1.5	0.6	8.5	2.1	1.7	1.0	0.7	100
14	IT and natural science	1.4	0.7	1.0	0.7	0.3	1.1	0.5	5.1	1.6	1.3	1.1	0.5	6.8	51.8	4.7	10.8	6.5	1.3	0.6	2.3	100
15	technical occupation	0.7	2.1	6.7	2.5	2.2	4.5	1.2	4.9	4.5	1.8	1.6	1.1	6.7	7.5	41.2	6.5	1.6	1.1	0.6	1.3	100
16	legal, management and business science	0.5	0.3	0.2	0.2	0.1	0.4	1.1	9.5	1.3	0.9	1.6	0.5	26.2	3.4	1.2	44.2	5.6	1.1	0.5	1.3	100
17	media, arts and social science	0.5	0.5	0.3	0.5	0.4	1.2	1.4	5.1	1.6	1.2	2.1	0.8	13.3	3.0	2.6	7.1	38.2	2.6	5.2	12.7	100
18	health occupation	0.5	0.6	0.1	0.1	0.2	0.5	1.4	2.7	1.6	0.5	2.9	2.2	6.4	0.6	0.3	1.4	1.1	74.5	1.6	0.8	100
19	social occupation	0.4	0.5	0.1	0.1	0.1	0.4	0.7	1.6	1.1	0.4	2.7	1.5	4.7	0.3	0.3	1.6	1.7	3.9	76.0	2.2	100
20	teaching occupation	0.2	0.4	0.1	0.2	0.1	0.5	0.6	2.4	1.3	0.3	1.9	1.0	5.7	1.2	0.3	2.2	3.7	2.5	3.7	71.8	100
21	No vocational qualification	2.9	8.1	1.6	3.3	1.1	6.3	3.4	6.3	15.5	1.9	14.2	13.6	7.6	1.3	1.6	2.0	2.2	4.2	2.3	0.8	100
22	At school/in training/in higher education	1.8	0.9	5.6	3.2	3.4	3.9	3.6	9.3	5.4	1.5	9.5	1.2	17.3	4.1	2.7	2.5	5.6	11.0	4.6	3.0	100
	Total	2.2	2.8	3.6	3.3	2.1	4.9	2.9	7.5	7.7	1.9	6.6	3.7	15.1	5.7	3.7	6.2	3.5	9.7	3.7	3.2	100

Source: Microcensus and National Accounts produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave

occupational flexibility of the labour supply produced by changes to its gender, age and qualifications structure as well as presenting the result of relative wage changes caused by worker shortages.[22]

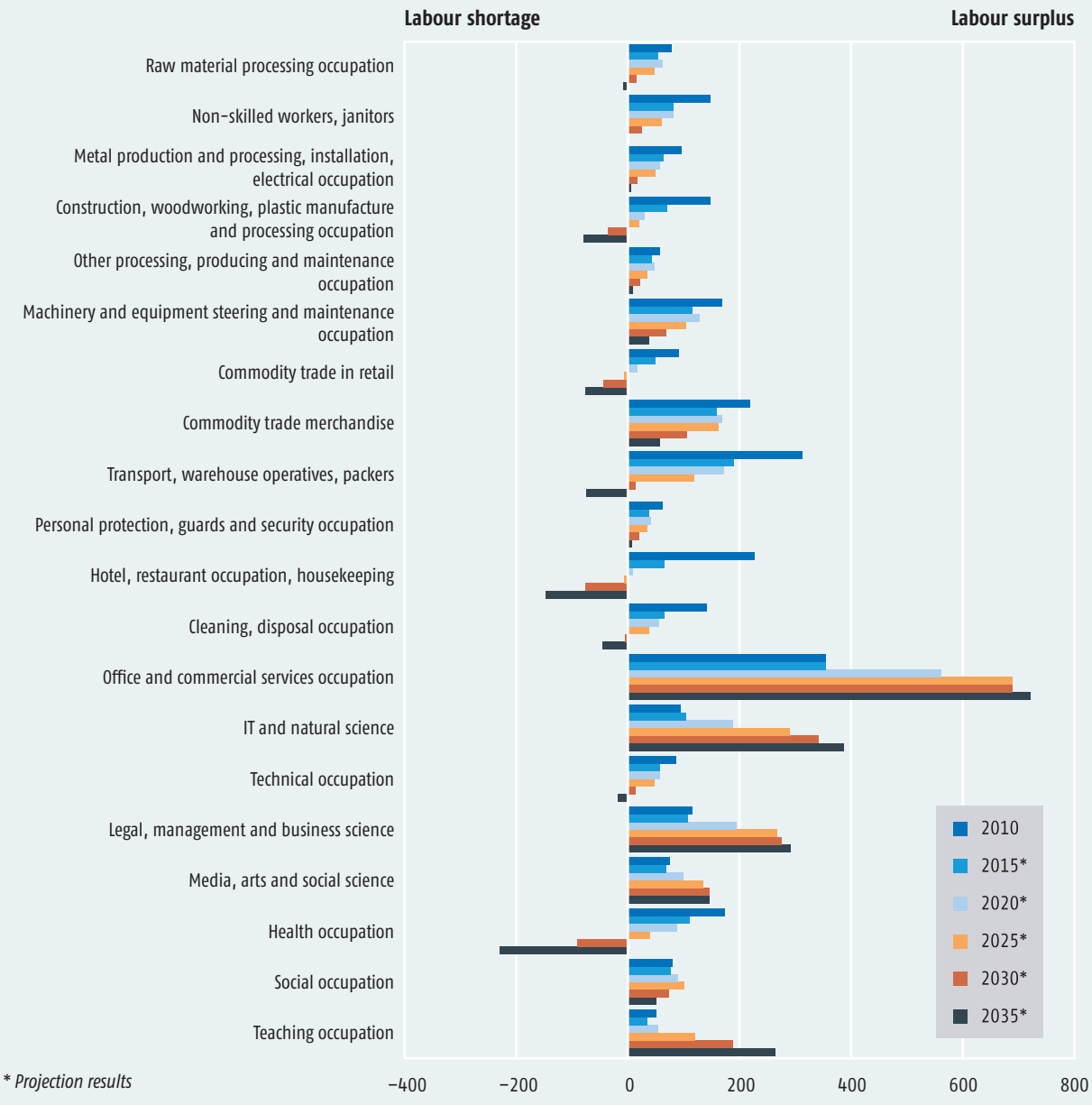
Whereas Figure 5 reports a past value for the year 2010, projection results are presented for the subsequent years. It is revealed that matching problems between supply and demand at the skilled level will increase if previous developments and existing behaviours of the economy and of the labour supply continue. Whereas shortages in the healthcare sector have already been shown in earlier projections, the discrepancy between available and required labour in "construction, woodworking, plastics manufacture and processing occupations" is in particular a new finding. At the end of the projection period, the baby boomer generation will have gone into retirement. The new supply of workers streaming onto the labour market will not be able to close this gap (Table 4) despite the fact that the labour demand in this main occupational field between 2015 and 2035 will decline from around 1.4 million to 1.25 million persons following an interim rise lasting until 2018. The causes of the shortages include higher flexibility and a comparatively less dynamic wage development in the occupational field. If an evaluation on the basis of persons is undertaken, future shortages will also arise in "raw material extraction occupations", "sales assistant occupations (retail)", "occupations involving traffic, warehousing, transport", "hotel and restaurant occupations", "cleaning and disposal occupations" and "technical occupations". By way of contrast, labour supply will grow more strongly than labour demand in "commercial office-based occupations" and in the main occupational fields that are predominantly characterised by academic qualifications.

▸ Hidden potential – desired working hours

In the year 2035, shortages are revealed in nine of 20 main occupational fields (see Figure 5). If the number of working hours required by the employer side is compared to potential work volume, a slightly relativising picture of the shortage situation emerges. Potential work volume, which was first calculated by Zika et al. (2012) (see definitions), takes account of the number of hours a person is prepared to work. Whereas the labour supply underwent a virtually continuous growth from 43.7 million persons to 44.5 million persons between 2005 and 2013, the labour market potential during the same period fell from 66.9 billion hours to 63.0 billion hours. Although employment has increased, in

22 22) Because of the necessary restructuring of the occupational fields pursuant to the 2010 KldB, the flexibility matrix is not comparable with the matrix from the third wave (Maier et al. 2014a, Maier et al. 2015).

Figure 5: Difference between labour supply and labour demand by main occupational fields from 2010 to 2035, taking occupational flexibility into account, in thousands



Source: Microcensus and National Accounts produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave

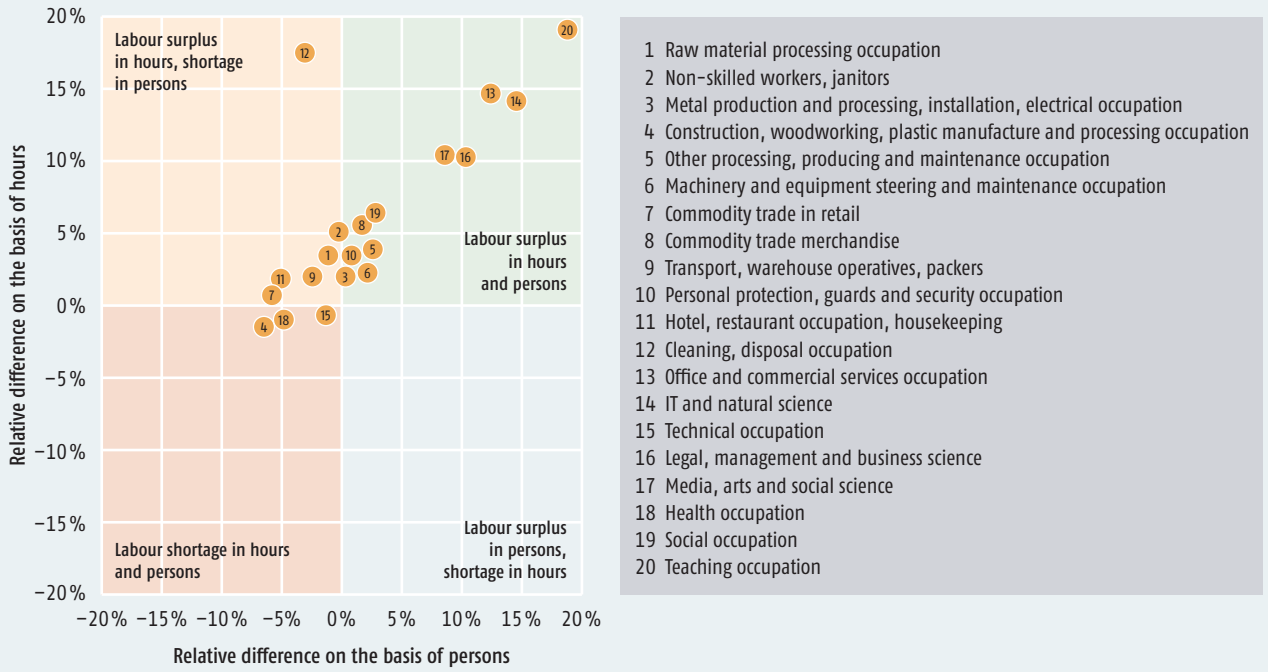
average terms the labour force works and/or wishes to work fewer hours compared to 2005 and does not desire to work beyond the agreed weekly hours. The potential work volume for 2013 is viewed as constant for the future.[23]

If the number of hours is considered, a higher labour supply is revealed, especially in occupations with a larger extent of part-time employment, than if a per capita approach is adopted. Figure 6 compares the relative deviation between supply and demand by main occupational fields at the level of the person in 2035 to the relative deviation between supply and demand on the basis of hours. If the number of available hours of work is considered, supply outstrips demand in the main occupational fields of "hotel and restaurant occupations", "cleaning occupations", "occupations involving the trading and sale of goods – sales occupations (retail)" and "raw material extraction occupations".

In the main occupational fields of "construction, woodworking, plastics manufacture and processing occupations", "technical occupations" and "healthcare professions", the labour supply is unable to cover demand even if considerations are based on numbers of hours. These results show that the trend towards fewer working hours cannot be retained in

23 In the interests of simplification, the results are only presented here at the level of the 20 BIBB main occupational fields. Results by the 50 BIBB occupational fields are available at http://www.qube-projekt.de.

Figure 6: Evaluation at main occupational field level by persons and hours in the year 2035



Source: Microcensus and National Accounts produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave

future if labour demand is to be met in all occupational fields. If, for example, the same (desired) hours of work as in 2005 were to be assumed instead of the (desired) hours of work in 2013, labour volume potential would be twelve percent higher on average.

Labour supply by qualifications and labour demand by requirement levels

The labour supply projections reveal an increasing academisation. Despite a continuing structural change which brings a higher demand for service occupations in its wake, demand for occupations in which persons with academic qualifications are predominantly employed is not rising to the same extent as supply. At the same time, we know that there is a strong correlation between rates of unemployment and a formal vocational qualification (Hausner et al. 2015). How, therefore, will persons in possession of an academic qualification be accommodated on the labour market in the future? The KldB 2010 offers for the first time a workplace-related characteristic to map the complexity of the tasks to be performed in the form of the requirement level. In earlier projections, it was only possible to consider the proportion of persons with a certain qualifications level within an occupational field whilst implicitly assuming that all persons were working in a way that was commensurate with their qualification.

The requirement level is a key indicator of the complexity of the task exercised. It is always typical of a certain occupation and is also independent of a person's formal qualification. Although the formal qualifications required for the exercising of the occupation are taken into account for the purpose of categorisation, informal training and/or occupational experience are also of significance for this alignment. In the KldB 2010, this dimension is reflected via the 5th position (type of occupation) of the classification indicator allocated. Four requirement levels are differentiated.

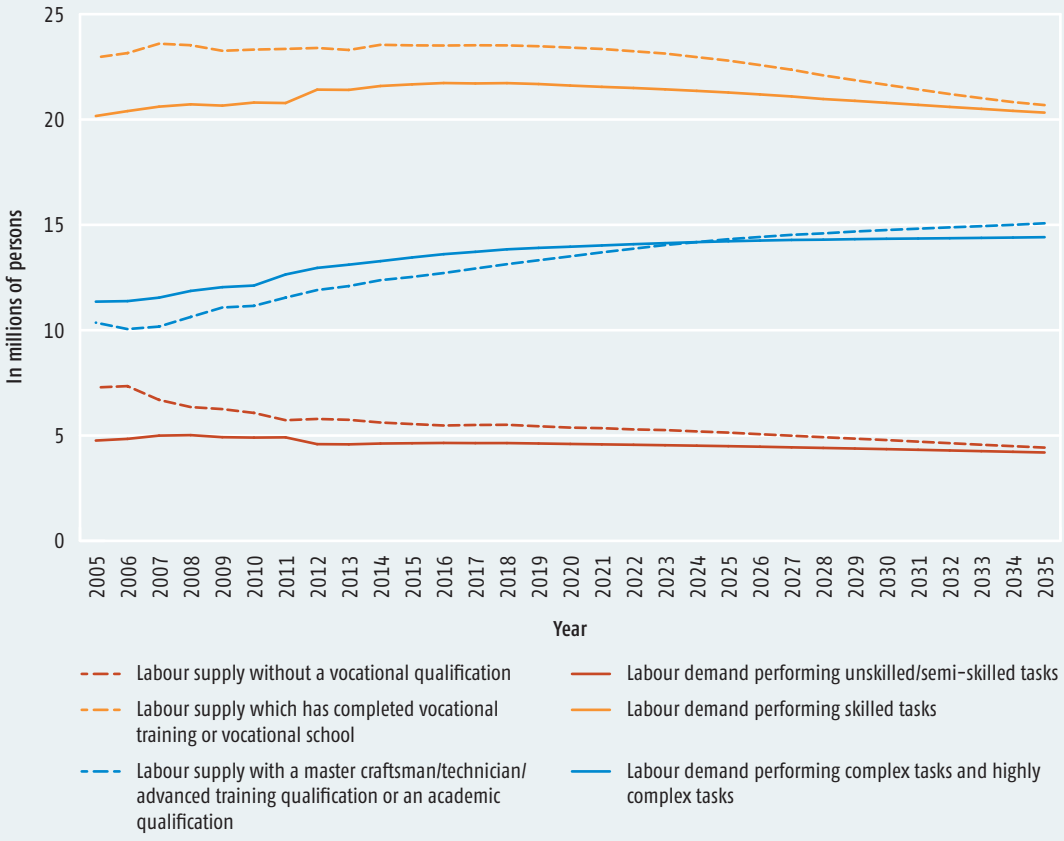
Table 6 presents the distribution of the labour supply by qualification levels to the relevant requirement levels in the year 2013 whilst taking unemployment into account. If persons are employed at a level commensurate with their qualification, those without a vocational qualification should be working in unskilled or semi-skilled jobs, those who have completed VET should be performing skilled tasks, persons with a master craftsman/technician/advanced training qualification should be involved with complex skills and those with academic qualifications should be carrying out highly complex skills. However, in 2013, persons in education and training, those who had not completed vocational education and training and persons with a master craftsman/technician/advanced training qualification were all most likely to be employed in skilled tasks. Just over ten percent of persons who had completed VET were performing unskilled or semi-skilled tasks, whilst the same proportion was also involved in complex tasks. Those with academic qualifications are predominantly found in jobs involving highly complex tasks. However, 15 percent were performing skilled tasks spe-

Table 6: Distribution of the labour supply by qualification levels to requirement levels in 2013 (in percent)

	Unskilled or semi-skilled tasks	Skilled tasks	Complex tasks	Highly complex tasks	Unemployed	Total
Not completed vocational education and training	33.7	44.4	5.0	4.9	11.9	100.0
Completed vocational education and training	10.2	68.3	10.9	6.0	4.7	100.0
Master craftsman/technician/advanced training qualification	3.3	44.9	38.0	11.8	2.0	100.0
Academic qualification	1.8	14.9	18.3	62.8	2.2	100.0
In education and training	13.3	65.8	9.3	9.3	2.4	100.0
Total	11.3	53.1	13.7	17.2	4.8	100.0

Source: Microcensus and National Accounts produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave

Figure 7: Labour demand by requirement levels and labour supply by qualifications 2005 to 2035



Source: Microcensus and National Accounts produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave. Data leaps in 2011 are due to the conversion between occupational classifications.

cialist tasks and 18.3 percent were in complex tasks. Because of the formal equivalence of the educational level of persons with advanced training qualifications and Bachelor degrees, a complex specialist task may be viewed as not commensurate for higher education/University of Applied Sciences graduates with a Bachelor qualification.

As Figure 7 shows, the demand in the past for workers with complex specialist tasks and highly complex tasks was higher than the supply of persons with academic qualifications or a master craftsman/technician/advanced training qualification. The main reason for this is that, although there were slightly more persons with academic qualifications performing highly complex tasks, far fewer persons with an advanced training qualification were involved with complex tasks. If both groups are conflated (complex tasks and highly complex tasks and persons with a higher education/University of Applied Sciences qualification), labour supply will ex-

Table 7: Qualifications structure of unemployed persons and of the labour demand differentiated by requirement levels in 2013 (in percent)

	Unskilled or semi-skilled tasks	Skilled tasks	Complex tasks	Highly complex tasks	Unemployed	Total
Not completed vocational education and training	38.6	10.8	4.8	3.7	32.2	12.9
Completed vocational education and training	47.2	67.4	41.6	18.3	51.9	52.4
Master craftsman/technician/advanced training qualification	2.5	7.3	23.8	5.9	3.6	8.6
Academic qualification	2.9	5.2	24.9	68.1	8.5	18.6
In education and training	8.7	9.2	5.0	4.0	3.7	7.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Microcensus and National Accounts produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave

ceed demand in arithmetical terms from approximately 2023.

On the other hand, the supply of persons who have completed vocational education and training is falling more sharply than the demand for skilled tasks, and the demand for unskilled and semi-skilled tasks is decreasing less strongly than the supply of persons who have not completed VET. Nevertheless, employment opportunities for the latter group of persons were the lowest (see Table 6), because over 60 percent of unskilled and semi-skilled tasks are exercised by persons who have at least completed vocational education and training or who are still in training (see Table 7).

▶ How could employment by qualifications level develop?

The nature of the qualifications structure of the labour demand in future will manly depend on the attitude towards recruitment adopted by the companies. This in turn will be influenced by the requirement profile of the job to be filled and by the structure of the existing labour supply. If (in contrast to Table 6) we direct our attention to the extent to which employers have recourse to workers from the different qualifications levels for a certain requirement level rather than focusing on the requirement levels at which persons with a certain qualifications level are accommodated, we see that in the year 2013, for example, almost 42 percent of complex tasks were exercised by persons who had completed vocational education and training. In the case of the highly complex tasks, the proportion of this group of persons was still as high as 18 percent. Conversely, just under three percent of unskilled or semi-skilled tasks were performed by a person with an academic qualification.

No judgement can currently be made with regard to the extent to which the recruitment behaviour of companies will alter in the light of an increasing supply of persons with academic qualifications. On the basis of the low unemployment rates of persons with academic qualifications and the existing demand for complex tasks and highly complex tasks, one possible scenario would be that persons with academic qualifications will be recruited for specialist tasks and highly complex tasks to a greater extent than has previously been the case and that they will replace persons who have completed VET or advanced training in these positions in the long term, such as when post holders enter retirement. In order to calculate such an "adapted recruitment behaviour" scenario, it is assumed that the 2013 qualifications structure of unemployed persons (cf. Table 7) will not have changed by 2035. An iterative margin adjustment procedure can be used to determine the qualifications structure of the labour demand up to 2035 (upper half of Table 8). This shows that companies would be able to have greater recourse to persons with academic qualifications in complex tasks and highly complex tasks, whereas persons with an advanced training qualification would be employed to a greater extent in skilled tasks, although the same proportions of the latter group would still be involved in complex tasks. Persons with a vocational qualification would be displaced from more complex tasks. Those who have not completed vocational education and training would have the same opportunities for employment in line with the assumptions, because persons with a qualification are preferred for unskilled and semi-skilled tasks.

If we turn our attention to the distribution of the labour demand by qualifications level to different requirement levels (bottom half of Table 8), this adaptation scenario would only display marginal changes compared to 2013. Because the number of unemployed persons falls in overall terms, the risks of unemployment are lower for all qualifications groups in 2035. The employment opportunities in highly complex tasks for persons with an advanced training qualification would fall compared to 2013, whereas they would rise in skilled tasks.

Table 8: Possible distribution of qualifications and requirement levels of the labour demand and unemployed persons in 2035

	Proportion of qualifications levels amongst the labour demand by requirement levels and amongst the unemployed											
	Unskilled and semi-skilled tasks		Skilled tasks		Complex tasks		Highly complex tasks		Unemployed		Total	
		Difference to 2013 in % points		Difference to 2013 in % points		Difference to 2013 in % points		Difference to 2013 in % points		Difference to 2013 in % points		Difference to 2013 in % points
Not completed vocational education and training	32.9%	-5.8	9.3%	-1.5	3.5%	-1.3	1.6%	-2.1	32.2%	0.0	10.1%	-2.8
Completed vocational education and training	49.0%	1.8	64.2%	-3.2	36.3%	-5.2	9.6%	-8.7	51.9%	0.0	47.4%	-5.0
Master craftsman/ technician/advanced training qualification	3.4%	0.8	8.8%	1.6	23.3%	-0.5	3.1%	-2.8	3.6%	0.0	9.0%	0.5
Academic qualification	4.7%	1.8	7.0%	1.7	31.7%	6.9	83.4%	15.2	8.5%	0.0	25.5%	6.9
In education and training	10.1%	1.4	10.6%	1.4	5.1%	0.1	2.4%	-1.6	3.7%	0.0	8.0%	0.5
Total	100.0%	0.0	100.0%	0.0	100.0%	0.0	100.0%	0.0	100.0%	0.0	100.0%	0.0
	Distribution of the labour demand by qualifications levels to requirement levels and unemployment											
	Unskilled and semi-skilled tasks		Specialist tasks		Complex tasks		Highly complex tasks		Unemployed		Total	
Not completed vocational education and training	34.6%	0.9	47.9%	3.5	5.0%	-0.1	3.1%	-1.8	9.4%	-2.5	10.1%	-2.5
Completed vocational education and training	11.1%	0.9	70.7%	2.4	11.0%	0.2	4.0%	-2.0	3.3%	-1.5	47.4%	-1.5
Master craftsman/ technician/advanced training qualification	4.0%	0.6	50.9%	6.0	37.1%	-0.9	6.8%	-5.0	1.2%	-0.8	9.0%	-0.8
Academic qualification	2.0%	0.2	14.2%	-0.7	17.9%	-0.4	64.9%	2.1	1.0%	-1.2	25.5%	-1.2
In education and training	13.6%	0.3	69.8%	3.9	9.3%	0.0	6.0%	-3.3	1.4%	-1.0	8.0%	-1.0
Total	10.7%	-0.6	52.1%	-1.0	14.4%	0.7	19.8%	2.7	3.0%	-1.8	100.0%	0

Source: Microcensus and National Accounts produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave

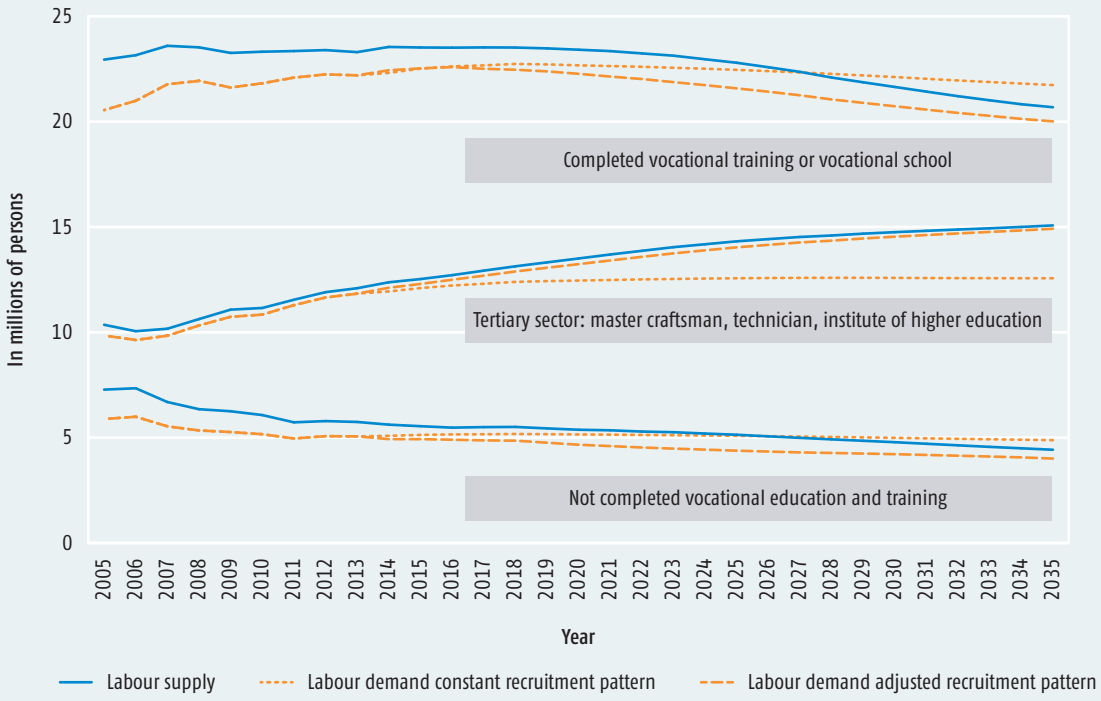
Figure 8 presents the development of the demand for qualifications in accordance with two different variants. In the scenario "constant recruitment behaviour", the assumption is that the qualifications structure of the labour demand within a requirement level does not alter after 2013 (Table 7). If this were the case, the labour supply of persons which have completed vocational education and training would continue to exceed "demand" in the medium term, but would fall below the "demand" level from 2026. In the tertiary area, which comprises persons with a master craftsman/technician/advanced training qualification and those with an academic qualification, supply would, however, exceed "demand" by about 2.5 million persons in 2035. There would also be fewer persons than required who have not completed vocational education and training, because "demand" for those who have not completed VET would remain constant.

As described above, the "adapted recruitment behaviour" scenario assumes that employers make greater use of persons with higher qualifications, if such persons are available on the labour market, thus meaning that persons with academic qualifications continue to exhibit a lower risk of unemployment. Despite the observable educational expansion and the clear signs of a sharp decrease in supply at the medium qualifications level, this shows that a balanced labour market with regard to formal qualifications levels is possible in purely arithmetical terms. Accordingly, jobs involving complex tasks and highly complex tasks could increasingly be occupied in future by persons who have acquired the relevant formal qualification, to the detriment of persons who have completed VET or who are in possession of an advanced training qualification. It is, however, also possible that, in the wake of the digitalisation of the economy, activity requirements made of the labour supply will change and result in a different demand for formal qualifications.

Conclusion

Because of the influx of migrants and refugees in particular and the fact that this will result in the population becoming younger, the population of Germany will not see a long-term decrease to the extent expected in earlier projections. The number and structure of the labour supply and labour demand will change. Because of the significance of migration both in terms of amount and structure, a

Figure 8: Labour demand and labour supply by qualifications levels in millions of persons (basic projection)



Source: Microcensus and National Accounts produced by the Federal Statistical Office, calculations and representations QuBe Project, fourth wave. Not including persons in training.

separate QuBe population projection has been drawn up. The assumption is that the 1.1 million refugees who arrived in Germany in 2015 already represents the largest part of the influx and that those persons who are recognised as asylum seekers or in need of protection will remain in Germany for the long term. This projection is designated as the basic projection for the fourth wave.

In interpreting this basic projection, however, consideration needs to be accorded to the fact that only types of behaviour previously demonstrable are projected into the future. Changes in behaviour not identifiable in the past thus do not form part of the basic projection. This also applies in particular to the currently observable phenomenon of "Industry 4.0/Economy 4.0", i.e. the increasing digitalisation of trade and industry and of the labour market. If it should emerge that "Economy 4.0" is effectively bringing about a "revolution" in production or business rather than being an evolutionary process, i.e. a process which pursues a development pathway identifiable in the past, it is likely that the labour market of the future will be different, at least in part. Initial investigations in this regard have shown, for example, that demand for workers would be somewhat lower (Wolter et al. 2015). The qualifications and occupational field structure of the labour demand would, however, also alter. Irrespective of this, the educational system will face new challenges because of the age structure of the refugees and also due to their prior school learning and previous vocational qualifications. Although the expectation is that the influx of refugees will cause an imminent rise in the number of persons leaving the educational system without a vocational qualification, in the long term the growth in the population will mean that more persons who have completed vocational education and training will be available to the labour market than would have been the case without the high level of migration. Nevertheless, considerable endeavours will be necessary in order to help refugees to achieve a vocational qualification and thus increase their opportunities for employment. Because there is a long-term shortage of workers for skilled tasks in particular, training for refugees offers areas of potential for bottleneck occupations. However, the prerequisite for this is appropriate integration into the German labour market, a process which may run more quickly or more slowly than assumed in this basic scenario. In order to conduct a more detailed investigation of the effects of refugees on the macro economy, we need assumptions on the employment and consumption behaviour of refugees and assumptions relating to a counter-factual development in which no additional influx of almost 1.1 million refugees took place alongside "normal" migration in the year 2015. Within this process, account must also be taken of possible political developments and especially of the necessary educational policy measures.

Stronger academisation is revealed at the occupational field level. In occupational fields in which recruitment can take place via the higher education/Uni-

versity of Applied Sciences sector, future supply will be sufficient in arithmetical terms to satisfy demand. On the other hand, shortages will become discernible around the year 2035 in"construction, woodworking, plastics manufacture and processing occupations", "technical occupations" and "healthcare professions". In contrast to previous projections, the hours of work offered by the labour supply (work volume potential) are not sufficient to assuage labour demand. The main reason for this is that both average hours worked and desired number of working hours have fallen virtually continuously since 2005. One thing which remains unclear is the extent to which additional investments in digitalisation of the value-added chain may make the labour demand and working hours required calculated in this basic projection appear obsolete because of extra increases in productivity.

On the basis of the new 2010 Classification of Occupations, which necessitated a realignment of the BIBB occupational fields, this project wave is the first which is able to indicate the requirement level of tasks on the demand side. This reveals that the value of a task cannot be directly transferred to formal qualifications levels. Persons with a vocational education and training qualification are involved in the areas of unskilled and semi-skilled tasks and complex tasks, whereas persons in possession of an academic qualification perform highly complex tasks, complex tasks and skilled tasks. Provided that the qualifications structure does not change within a requirement level from 2013 ("constant recruitment behaviour"), the labour supply of persons who have completed VET would exceed demand in the medium term. From 2026, however, supply would fall below "demand" at this qualifications level. In the tertiary area, which comprises persons with a master craftsman/technician/advanced training qualification and those with an academic qualification, supply would, however, exceed "demand" by about 2.5 million persons in 2035.

However, if we assume that companies make greater use of persons with higher qualifications, if such persons are available on the labour market, labour demand would approximate supply at all qualifications levels. Jobs involving complex tasks and highly complex tasks would then in future be increasingly filled by persons in possession of the relevant higher formal qualifications, and persons with academic qualifications would continue to run a lower risk of unemployment.

Methodological box 1 – QuBe Population Projection

The QuBe Population Projection is based on the population projection of the *integrated labour supply and population model* developed by the Institute for Employment Research (IAB). The specific characteristics of this model are that it differentiates between German, non-German, recognised and non-recognised refugees, and that it estimates and updates individual components (birth figures, survival probabilities, influxes and outfluxes and naturalisations) using analytical methods based on time series. The modelling of the individual components, which are also used for the QuBe Population Projection, is briefly outlined below. A detailed model description for the *integrated labour supply and population model* (IAB model) is available in Fuchs et al. (2016).

Birth figures

The age-specific birth figures (15 to 49 years) are separately determined for German and foreign women using a main component analysis. For German women, this produces a slight rise in the collated birth figure (TFR = total fertility rate) from 1.4 today to 1.5 in the year 2035. For foreign women, the birth figure remains virtually constant at approximately 1.8.

Survival probabilities

Survival probabilities by individual age (here from 0 to 90 years and older) are also estimated using the main component analysis, separately for men and women. This produces a life expectancy of 86.1 years for women in 2035 (men: 82.1 years).

Migration

In contrast to the IAB model, migration in the QuBe Population Projection is determined via the TINFORGE model (Wolter et al. 2014) rather than being estimated using main components. A decision is taken for every country of origin of the migrants as to whether emigration from their homeland is motivated by the local demographic, socio-economic or political situation. This approach has the following consequences for the modelling (Gorodetski et al. 2016).

- *Demographic*

Migration from the countries of origin to Germany is solely driven by demographic development in these countries of origin. This means that the larger the proportion of younger population classes in the countries of origin, the stronger the tendency towards mobilisation will be in these countries.

► *Socio-economic*

Migration from the country of origin takes place on the basis of the local socio-economic situation. This is, for example, clearly visible in respect of countries in southern Europe in the wake of the financial and economic crisis. The assumption here is that these influxes will once again approximate the average in the long term.

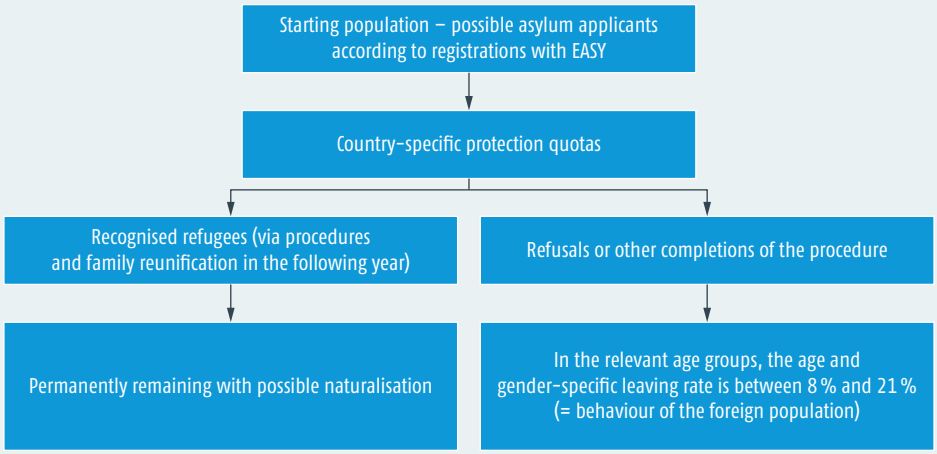
► *Political*

Emigration takes place because of the insecure political and societal situation in the country of origin. This may, for example, be estimated via the Fragile State Index. Politically-motivated reduction of barriers to trade, such as free trade agreements, may also increase mobility between Germany and partner states. In such cases, the trend previously observable towards inclination to emigrate to Germany is continued.

Refugee module

For the purpose of the QuBe Population Projection, influxes from the current main countries of origin are separately modelled in addition to estimated assumed immigration in the System for the Initial Distribution of Asylum Seekers (EASY) on the basis of a "*Refugee Module*". This approach is adopted due to the circumstance that there is no valid predominant knowledge regarding the duration of the war in Syria and also because it is currently difficult to estimate which medium and long-term control mechanisms for the influx of refugees will be initiated in Europe or in individual EU member states. The assumptions take account of the data status up until 16 May 2016. The Asylum Statistics (Asylgeschäftsstatistik 4/2016) determine the calculation of protection rates and the division of the refugees by country of origin. The data contained in the Central Register of Foreign Nationals (AZR), which serves as a starting point for the gender and age structure of the refugees by countries of origin, is based on a cut-off date of 31 December 2015. Figure 9 provides a brief summary of the modelling assumptions of the "Refugee Module".

Figure 9: Modelling assumptions of the Refugee Module



Emigration

The IAB model is used to calculate age and gender-specific departure rates (0 to 90 years and older) separately for German and foreigners via a main components analysis using the departures from the migration statistics and the Population Forecast of the Federal Statistical Office and is updated for the future. The only exception is formed by recognised refugees and persons in need of protection, for whom the assumption is that they will remain in Germany permanently. The departure behaviour of non-recognised refugees is in line with that of all other non-Germans (see Figure 9).

Naturalisations

Age and gender-specific naturalisation rates of foreigners are estimated in the same way as the emigrations. Nevertheless, non-recognised refugees do not have the option of seeking naturalisation.

Methodological box 2 – QuBe Project

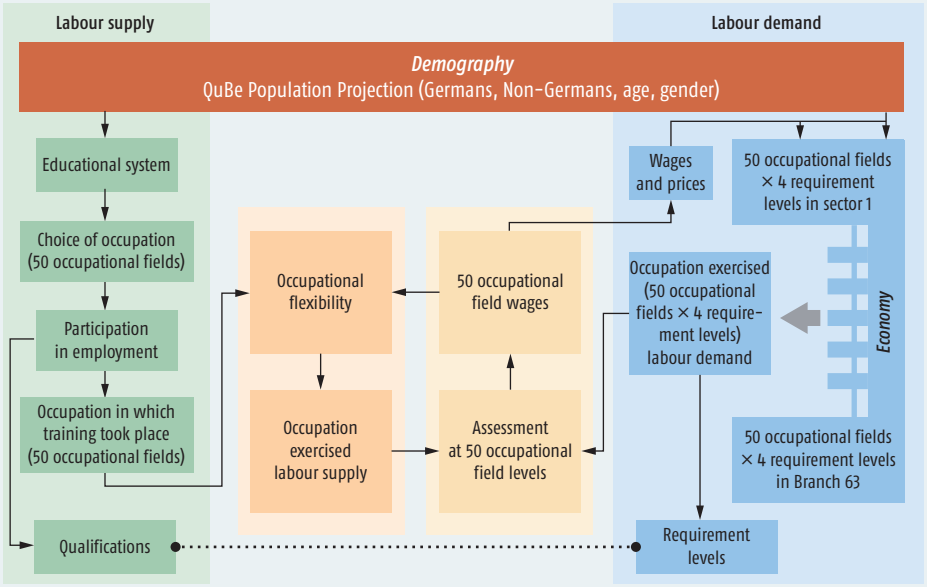
The qualifications and occupational field projections (QuBe Project), which are conducted in conjunction with the Institute of Economic Structural Research (GWS) and the Fraunhofer Institute for Applied Information Technology (FIT), use model calculations as a basis for showing how the supply of and demand for qualifications/requirement levels and occupations may develop on a long-term basis. The database is formed by the microcensus (in the present projection up to 2013) – official annual representative statistics on the population and labour market produced by the Federal Statistical Office in which one percent of all households in Germany take part, adjusted to the benchmarks of the National Accounts (in the present projection up to the year 2014). Wage information is taken from the Employee History Data of employees subject to mandatory social insurance contributions (in the present projection up to the year 2013). As far as occupational differentiation is concerned, a uniform occupational field system has been developed by BIBB which groups occupations in accordance with their activities at three-figure code level within the Classification of Occupations (Tiemann et al. 2008). For the purpose of easier representation, these 50 occupational fields are aggregated to 20 main occupational fields.

The present results are based on the basic projection of the fourth projection wave. This builds upon the methodologies used for the first wave (Helmrich/Zika 2010b, Maier u. a. 2014b), the second wave (Helmrich et al. 2012, Zika et al. 2012) and the third wave (Maier et al. 2014b) whilst also incorporating further new developments. On the demand side, the occupationally-specific labour supply available is taken into account per capita and by hour with regard to the determination of wages for the occupational fields. Development within each economic sector is estimated by 50 occupational fields each with four requirement levels. On the supply side, wage dependencies of occupational flexibility are modelled so as to facilitate a reaction of the labour supply to the changing wages in the occupational fields. An evaluation of the labour market can thus take place both from a specialist point of view by comparing labour supply and labour demand by occupational fields and from a qualifications perspective by comparing the formal qualifications level of the labour supply with the requirement level for the labour demand.

The basic projection of the QuBe Project pursues an empirically-based concept. Only types of behaviour previously demonstrable are projected into the future. Changes in behaviour not identifiable in the past thus do not form part of the basic projection. The same also applies in respect of the market adaptation mechanisms modelled. The following figure provides a rough overview of how the model works.

Further information is available at http://www.QuBe-Projekt.de.

Figure 10: Model structure of the BIBB-IAB qualifications and occupational field projections



Literature

Brücker, Herbert; Hauptmann, Andreas; Vallizadeh, Ehsan: Flüchtlinge und andere Migranten im deutschen Arbeitsmarkt: Der Stand im September 2015 *[Refugees and other migrants on the German labour market – the status in September 2015]*. In: IAB Aktuelle Berichte *[IAB Current Reports]* 14/2015

Fuchs, Johann; Söhnlein, Doris; Weber, Brigitte; Weber, Enzo: Ein integriertes Modell zur Schätzung von Arbeitsangebot und Bevölkerung *[A integrated model for the estimation of labour supply and population]*. Nuremberg: IAB-Forschungsbericht *[IAB Research Report]* 10/2016

Gorodetski, Kristina; Mönnig, Anke; Wolter, Marc Ingo: Zuwanderung nach Deutschland. Mittel- und langfristige Projektionen mit dem Modell TINFORGE *[Migration to Germany. Medium and long-term projections using the TINFORGE model]*. Osnabrück 2016

Hausner, Karl Heinz; Söhnlein, Doris; Weber, Brigitte; Weber, Enzo: Qualifikation und Arbeitsmarkt: Bessere Chancen mit mehr Bildung *[Qualifications and the labour market. Better opportunities with more education]*. In: IAB-Kurzbericht *[IAB Brief Report]* 11/2015

Helmrich, Robert; Zika, Gerd: Beruf und Qualifikation in der Zukunft. BIBB-IAB-Modellrechnungen zu den Entwicklungen in Berufsfeldern und Qualifikationen bis 2025 *[Occupations and qualification in the future. BIBB-IAB model calculations in occupational fields and qualifications until 2025]*. In: Helmrich, Robert; Zika, Gerd (Eds.): Beruf und Qualifikation in der Zukunft. BIBB-IAB-Modellrechnungen zu den Entwicklungen in Berufsfeldern und Qualifikationen bis 2025 *[Occupations and qualification in the future. BIBB-IAB model calculations in occupational fields and qualifications until 2025]*. In: 2010a, pp. 13–62

Helmrich, Robert; Zika, Gerd: Beruf und Qualifikation in der Zukunft. BIBB-IAB-Modellrechnungen zu den Entwicklungen in Berufsfeldern und Qualifikationen bis 2025 *[Occupations and qualification in the future. BIBB-IAB model calculations in occupational fields and qualifications until 2025]*. In: Bonn 2010b

Helmrich, Robert; Zika, Gerd; Wolter, Marc Ingo; Schandock, Manuel; Maier, Tobias; Kalinowski, Michael; Hummel, Markus; Hänisch, Carsten; Drosdowski, Thomas; Bremser, Felix; Bott, Peter: Engpässe auf dem Arbeitsmarkt: Geändertes Bildungs- und Erwerbsverhalten mildert Fachkräftemangel. *[Shortages on the labour market – changes in education and employment will mitigate shortages of skilled workers]*. Bonn 2012

Hummel, Markus; Thein, Angela; Zika, Gerd: Der Arbeitskräftebedarf nach Wirtschaftszweigen, Berufen und Qualifikationen bis 2025. Modellrechnungen des IAB *[Labour demand by economic sectors, occupations and qualifications until 2025. Model calculations of the IAB]*. In: Helmrich, Robert; Zika, Gerd (Eds.): Beruf und Qualifikation in der Zukunft. BIBB-IAB-Modellrechnungen zu den Entwicklungen in Berufsfeldern und Qualifikationen bis 2025 *[Occupations and qualification in the future. BIBB-IAB model calculations in occupational fields and qualifications until 2025]*. In: 2010, pp. 81 –102

Maier, Tobias; Zika, Gerd; Wolter, Marc Ingo; Kalinowski, Michael; Helmrich, Robert: Engpässe im mittleren Qualifikationsbereich trotz erhöhter Zuwanderung. Aktuelle Ergebnisse der BIBB-IAB-Qualifikations- und Berufsfeldprojektionen bis zum Jahr 2030 unter Berücksichtigung von Lohnentwicklungen und beruflicher Flexibilität *[Shortages in the medium qualifications area despite increased immigration. Latest results from the BIBB-IAB qualifications and occupational field projections up until the year 2030 taking wage developments and occupational flexibility into account]*. In: BIBB Report 23/14, 2014a, pp. 1–16

Maier, Tobias; Neuber-Pohl, Caroline; Kalinowski, Michael; Quack, Lara; Wolter, Marc Ingo; Sonnenburg, Anja; Söhnlein, Doris; Zika, Gerd: Ergebnisse der BIBB-IAB-Qualifikations- und Berufsfeldprojektionen *[Results from the BIBB-IAB qualifications and occupational field projections]*. In: Bundesinstitut für Berufsbildung [Federal Institute for Vocational Education and Training] (Ed.): Datenreport zum Berufsbildungsbericht 2016: Informationen und Analysen zur Entwicklung der beruflichen Bildung *[Data Report to accompany the 2016 Report on Vocational Education and Training. Information and analyses on the development of vocational education and training]*. Bonn 2016a, pp. 268–284

Maier, Tobias; Neuber-Pohl, Caroline; Mönnig, Anke; Wolter, Marc Ingo: Erwerbsverhalten, berufliche Flexibilitäten, Arbeitsvolumenpotenzial und Pendelbewegungen auf regionaler Ebene *[Employment behaviour, occupational flexibilities, labour volume potential and commuter movements at a regional level]*. In: Zika, Gerd; Maier, Tobias (Eds.): Qualifikation und Beruf in Deutschlands Regionen bis 2030 *[Qualifications and occupation in Germany's regions until 2030]*. Bielefeld 2015, pp. 167–203

Maier, Tobias; Troltsch, Klaus; Walden, Günter: Längerfristige Entwicklung der dualen Ausbildung. Eine Projektion der neu abgeschlossenen Ausbildungsverträge bis zum Jahr 2020 *[Longer term development of dual training. A projection of newly concluded training contracts up to the year 2020]*. In: Berufsbildung in Wissenschaft und Praxis *[Vocational Training in Research and Practice]* 40 (2011) 3, pp. 3–6

Maier, Tobias; Wolter, Marc Ingo; Zika, Gerd: Auswirkungen von Geflüchteten auf Arbeitsangebot und -nachfrage in der mittleren und langen Frist – die QuBe-Bevölkerungsprojektion *[Effects of refugees on labour supply and demand in the short and medium term – the QuBe Population Projection]*. In: Wirtschaft und Statistik *[Economics and Statistics]*. 2016b, pp. 113–124

Maier, Tobias; Zika, Gerd; Mönnig, Anke; Wolter, Marc Ingo; Kalinowski, Michael; Hänisch, Carsten; Helmrich, Robert; Schandock, Manuel; Neuber-Pohl, Caroline; Bott, Peter; Hummel, Markus: Löhne und berufliche Flexibilitäten als Determinanten des interaktiven QuBe-Arbeitsmarktmodells. Ein Methodenbericht zur Basisprojektion der 3. Welle der BIBB-IAB-Qualifikations- und Berufsfeldprojektionen *[Wages and occupational flexibilities as determinants of the interactive QuBe labour market model. A methodological report on the basic projection of the 3rd wave of the BIBB-IAB qualifications and occupational field projections]*. Bonn 2014b

OECD, Organisation for Economic Co-Operation and Development: Classifying Educational Programmes. Manual for ISCED-97 Implementation in OECD Countries. 1999 Edition. Paris 1999

Rich, Anna-Katharina: Sozialstruktur, Qualifikationsniveau und Berufstätigkeit. Asylerstantragsteller in Deutschland im Jahr 2015 [*Social structure, qualification level and occupational activity. Asylum applicants in Germany in 2015]*. BAMF-Kurzanalyse *[BAMF Brief Analysis]* 2/2016.

Statistisches Bundesamt [Federal Statistical Office]: Volkswirtschaftliche Gesamtrechnung. Input-Output-Rechnung 2012 *[National Accounts. Input-Output Accounts 2012]*. Specialist Publications Series 18, Series 2. Wiesbaden 2016

Tiemann, Michael: Die BIBB-Berufsfelder in der Klassifikation der Berufe 2010 *[The BIBB occupational fields in the 2010 Classification of Occupations]*. (Awaiting publication). In: Forschungsdatenzentrum der Rentenversicherung [Pension Insurance Research Data Centre] (Ed.): Berufsangaben *[Occupational information]*. Berlin 2016

Tiemann, Michael; Schade, Hans-Joachim; Helmrich, Robert; Hall, Anja; Braun, Uta; Bott, Peter: Berufsfeld-Definitionen des BIBB auf Basis der KldB1992 *[Occupational Field definitions of BIBB on the basis of the 1992 Classification of Occupations]*. Bonn 2008

Wolter, Marc Ingo; Grossmann, Anett; Mönnig, Anke; Wiebe, Kirsten S.: TINFORGE – Trade for the INterindustry FORecasting GErmany Model. Osnabrück 2014

Wolter, Marc Ingo; Mönnig, Anke; Hummel, Markus; Schneemann, Christian; Weber, Enzo; Zika, Gerd; Helmrich, Robert; Maier, Tobias; Neuber-Pohl, Caroline: Industrie 4.0 und die Folgen für Arbeitsmarkt und Wirtschaft: Szenario-Rechnungen im Rahmen der BIBB-IAB-Qualifikations- und Berufsfeldprojektionen *[Industry 4.0 and the consequences for the labour market and the economy. Scenario calculations within the scope of the BIBB-IAB qualifications and occupational field projections]*. In: IAB-Forschungsbericht *[IAB Research Report]* 8/2015

Zika, Gerd; Helmrich, Robert; Kalinowski, Michael; Wolter, Marc Ingo; Hummel, Markus; Maier, Tobias; Hänisch, Carsten; Drosdowski, Thomas: In der Arbeitszeit steckt noch eine Menge Potenzial. Qualifikations- und Berufsfeldprojektionen bis 2030 *[Working time offers plenty of potential. Qualifications and occupational field projections until 2030]*. In: IAB-Kurzbericht *[IAB Brief Report]*, 18/2012, pp. 1–12

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