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Assumptions and modelling of the BIBB supply projection by qualification levels and occupations until the year 2035



Status: 31 October 2018

Remarks:

In order to project labour supply by qualification levels, it is essential to process data and determinants relating to the development of this supply, i.e. population development including migratory movements and education and training behaviour.

The purpose of the present methodological report is to provide a basic summary of the model informing the supply projection of the fifth wave of the BIBB-IAB qualifications and occupational field projections (www.QuBe-Projekt.de, www.qube-data.de) and thus to facilitate a more accessible interpretation of the results

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BGR	National Educational Accounts
EFQBS	Success rate of the vocational schools
EFQDS	Success rate in the dual system
EFQHS	Success rate in the higher education sector
KMK	Standing Conference of the Ministers of Education and Cultural Affairs

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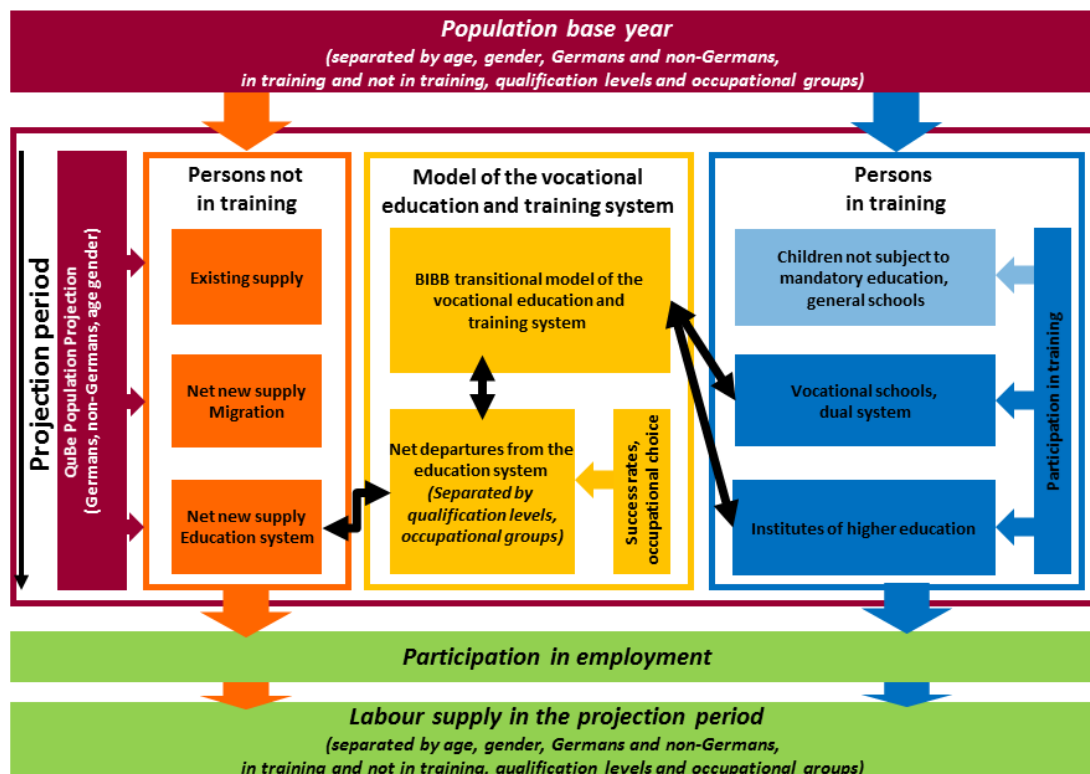
1. Introduction

In order to project labour supply by qualification levels, it is essential to process data and determinants relating to the development of this supply. Population development, which includes migratory movements, persons leaving the education system and the formal vocational skills they obtain, is of particular significance in this regard. Together with migrations, these determine the future qualifications and occupational structure of the population. The purpose of the present paper is to provide a basic summary of the model informing the supply projection (Section 2) and of the assumptions made regarding participation in education and training and in employment (Sections 3, 4 and 5 and Section 6 respectively) and to present results of the supply projection (Sections 7 and 8). The results are part of the fifth wave of the BIBB-IAB qualifications and occupational field projections (Maier, Zika et al. 2018) and are also available on the QuBe data portal (www.qube-data.de).

2. Summary of the model

The BIBB supply model comprises interlinked and cumulative elements. In methodological terms, it is based on prior works conducted in this field (Kalinowski and Quinke 2010).

Figure 1: Summary of the BIBB supply model for the fifth wave



Source: QuBe project, fifth wave, own representation

The foundation for the construction of the model is the division of the entire population into two groups. The first of these consists of all persons who are in education and training (blue box in Figure 1). This group encompasses pupils at general schools (including children not subject to mandatory education), pupils at vocational schools (including healthcare sector schools), trainees in company-based vocational education and training and students at institutes of higher education. The second group contains all other persons (including those completing military and civilian service or taking part in the Federal Voluntary Service). It is referred to in abbreviated form as “Persons not in education and training” (orange box in Figure 1). The arithmetic model is calibrated in such a way so that the benchmark data of the population corresponds to the population forecast and, from the year 2016 onwards, to the QuBe population projection.

Persons in the education system who wish to achieve a vocational qualification are of particular relevance with regard to projection of the new emerging labour supply by occupation in which training has taken place. For this reason, pupils at vocational schools (including healthcare sector schools), trainees in company-based vocational education and training and students at institutes of higher education are modelled in greater detail or accorded differentiated consideration by respective training venues. The model of the so-called “vocational education and training system” (yellow box in Figure 1) determines transitions between the individual educational establishments and the labour market. The assumptions made for the forecast of pupil and student numbers for the purpose of determining the total amounts of persons in the education system (Section 3), success rates (Section 4) and transitions (Section 5) are explained below.

Updating the number of persons outside the educational system (orange box in Figure 1) by Germans and non-Germans, occupational groups, gender and age takes place via a simple equation. The statistical population at the end of the year is the same as the total number of persons of the previous year plus net transitions from the education system, plus net migration and minus deaths. This projection assumes that net migration exhibits the same qualifications and occupational structure as the net number of Germans and non-Germans leaving the education system. The size of the future labour supply is determined with the assistance of updated employment rates (Section 6).

3. Forecast of numbers of pupils and students

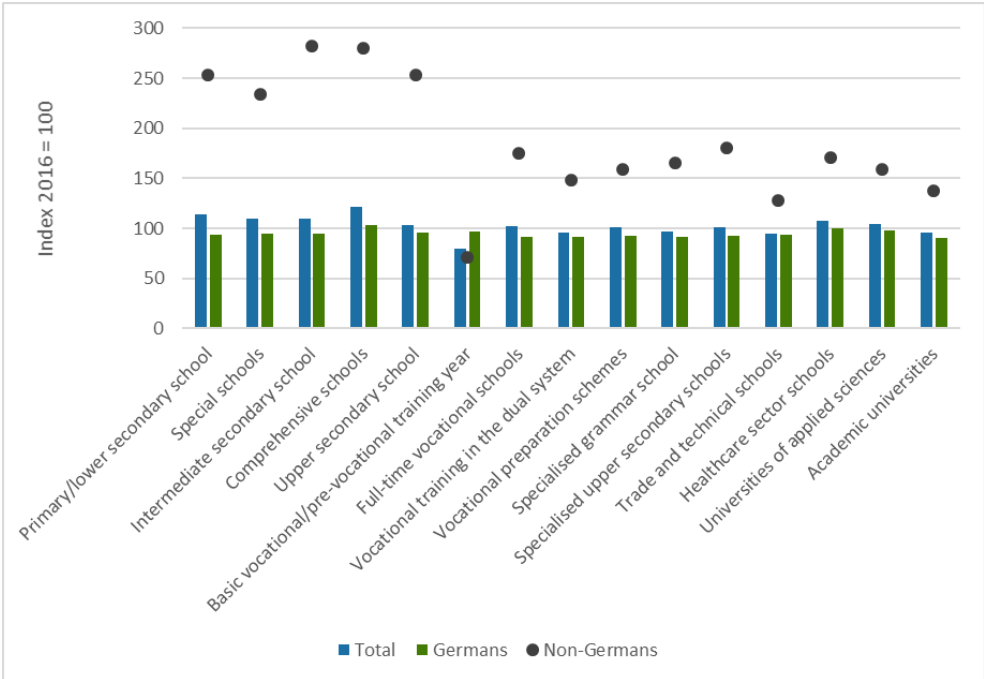
In order to update the population of the base year for the future, use is made of the QuBe population projection, which is based on the IAB population projection (Fuchs, Söhnlein et al. 2016). This indicates the population separated according to age, gender and nationality (German and non-German). In order to derive the resultant number of persons at general and vocational schools, in company-based vocational education and training and at institutes of higher education, assumptions need to be made regarding development of participation in education and training. The assumption which is usually adopted in the case of long-term projections is that educational decisions will remain constant (status quo assumption). The most recent forecasts made by the Standing Conference of the Ministers of Education and Cultural Affairs in the Federal Republic of Germany (KMK) are restricted to indicating the status quo version (vgl. KMK 2014; KMK 2018). The fifth wave of the BIBB-IAB qualifications and occupational field projections is the first forecast to make use of its own estimates regarding numbers of pupils, numbers of persons completing schooling, numbers of persons commencing higher education and numbers of graduates to conduct a status quo version.¹ For this purpose, attendance rates in the school sector for the year 2016 are calculated separately by age, gender and nationality (German and non-German) and multiplied by the future population size in the population projection of the IAB in the years from 2016 to 2035 to produce the number of pupils in the education system. The same approach is selected for the forecast of the number of higher education study entrants. The number of study entrants as a proportion of persons of the same age in the 2016 population is kept constant across the projection period. The statistical population of students in turn results from updating the initial total number of students in 2016 from one year of study to the next using constant transition rates from the year 2016. The projected numbers of higher education entrants commencing their first year of study are taken into account.

Figure 2 shows the resultant development of statistical populations in the education system. Particularly where non-Germans are concerned, a strong increase compared to the year 2016 is identifiable in some cases. This is caused by the rise in the non-German population, particularly amongst the younger age cohorts. Nevertheless, this

¹ Earlier works used forecasts of the number of pupils and number of persons completing schooling made by the Standing Conference of the Ministers of Education and Cultural Affairs (KMK 2013), which were updated from the year 2025 to the end of the projection period using constant rates of participation in education and training. The number of persons entering higher education study was subsequently determined on the basis of the resultant number of persons completing general or vocational schooling having obtained a higher education entrance qualification.

increase exerts only slight effects on the development of the statistical populations in overall terms because the proportion of Germans dominates.

Figure 2: Populations in the education system in 2035, index 2016 = 100



Source: (Statistisches Bundesamt 2017a; Statistisches Bundesamt 2017c; Statistisches Bundesamt 2017b; Statistisches Bundesamt 2017e), QuBe project, fifth wave, own representation

In the dual training sector, the population of trainees in the year 2035 will be slightly below the actual value for the year 2016. The same development is also indicated for the academic institutes of higher education. By way of contrast, the population of students at universities of applied sciences will rise slightly. This means that new supply from the higher education sector can be expected to be marginally higher over the whole of the projection period. The development in the basic vocational training year and pre-vocational training year constitutes an exception because the comparative value from 2016 was relatively high due to the large number of refugees. As the influx of refugees has now declined, the assumption made for the prognosis period is that the education and training participation rates of non-Germans at these training venues will once again fall to the level of 2015 by the year 2021. This means that the statistical populations of non-Germans in the basic vocational training year and pre-vocational training year in 2035 are lower than in 2016.

Table 1 shows the development in the number of study entrants in the higher education sector during the period from 2000 to 2035. The annual average number of persons commencing higher education study in the projection period is thus around 500,000 persons, whilst the statistical population of higher education students is about 2.8 million.

**Table 1: Number of higher education study entrants and student populations
in the period from 2000 to 2035 in thousands of persons**

Year	Numbers of study entrants	Total number of students
2000	315	1,799
2005	356	1,986
2010	445	2,218
2015	507	2,758
2020*	500	2,864
2025*	483	2,807
2030*	497	2,733
2035*	514	2,793

* Forecast values from the year 2017

Source: (Statistisches Bundesamt 2017e), QuBe project, fifth wave, own representation

4. Success rates

Alongside the number of trainees and higher education students, success rates at the training venues are of relevance in terms of determining qualification-specific departures from the education system. Specific success rates (EFQBS) are calculated for the training venues (k) of the vocational schools for the year 2016. These are separated according to nationality (s = German, non-German) and used as the basis for the whole of the projection period. For this purpose, a ratio is established between the number of graduates and leavers in overall terms (Abg).

$$EFQBS_{k,s} = \frac{Abg \text{ with degree certificate}_{k,s}}{Total Abg_{k,s}} * 100$$

Determining the success rate in the dual system (EFQDS) also requires calculating leavers produced indirectly from the change in population compared to the previous year (t-1) and from newly concluded training contracts (New) in the calculation year (t).

$$Abg_{t,s} = Stock_{t-1,s} - Stock_{t,s} + New_{t,s}$$

The number of candidates who have passed their final examination (Pt) is subsequently set in relation to the number of departures calculated.

$$EFQDS_{t,s} = \frac{Pt_{t,s}}{Abg_{t,s}} * 100$$

This method provides an approximation of the success rates in the dual system and is carried out for the purpose of calculating a supply projection. The success rates indicated are therefore not comparable with other calculation methods².

Table 2: Success rates at vocational schools in 2016

Success rates* 2016 in percent	Germans (D)	Non-Germans (ND)	Difference (ND-D)
Full-time vocational schools	80	70	-10
Vocational training in the dual system	77	63	-14
Trade and technical schools	92	85	-7
Healthcare sector schools	93	91	-3
Specialised upper secondary schools	81	69	-12
Specialised grammar school	82	68	-14

* Success rates at vocational schools express the number of leavers achieving a final certificate as a proportion of all leavers. In the dual system, the success rate reflects candidates who have passed the final examination in relation to all leavers indirectly calculated from existing populations and newly concluded training contracts.

Source: (Statistisches Bundesamt 2017b; Statistisches Bundesamt 2017c), calculations and representations of the QuBe Project, fifth wave

Calculation of the success rate in the higher education sector (EFQHS) fundamentally involves determining the number of graduates who commenced their studies in a year t as a proportion of study entrants beginning their studies in year t . Because no sufficient individual data is available for the clear alignment of graduates and study entrants who commenced their programme of study in the same year, the calculation conducted also represents an approximation of the success rates. This is necessary because these success rates and projected study entrants and student populations must make it possible to calculate graduates in the projection period.

To calculate the success rate, a ratio is established between the number of study entrants (Stanf) and the number of graduates (Abs) following completion of the usual periods of study (x). Average periods of study are used in order to produce an approximate alignment of graduates to study entrants commencing their course in the same year. For bachelor programmes at universities of applied sciences, the average period of study is seven semesters. Bachelor degrees at a university are usually of a duration of six semesters (HRK 2016). In the case of longer courses of study leading to the German "Diploma", an average period of eight semesters at universities of applied sciences and ten semesters at universities was assumed because no current data is available.

² For more information on problems with calculating the success or drop-out rates in the dual system see (Uhly 2014).

$$EFQHS_{t,s} = \frac{Abs_{t,s}}{Stanf_{t-x,s}} * 100$$

Another exacerbating factor is that study entrants commencing a master's programme cannot be clearly delineated in the higher education statistics. This means that this calculation is only possible for bachelor and Diploma qualifications. When calculating the success rates for Diploma programmes, a strong degree of switching between Diploma and bachelor qualifications must also be expected (Statistisches Bundesamt 2018). For this reason, the success rate indicated for university Diploma qualifications via this calculation method is relatively low. Success rates for master's programmes are based on the most recent graduate survey at the time when the projection was drawn up (Heublein, Richter et al. 2014). The data status currently means that no separation can be made between Germans and non-Germans in the calculation.

Table 3: Success rates in the higher education sector in 2016

Success rates 2016 in percent	Universities of applied sciences	Universities
Bachelor*	81	74
Diploma*	71	54
Master**	93	89

* In the case of the bachelor and Diploma qualification, success rates correspond to the number of graduates in the calculation year commencing their programme of study in year X as a proportion of study entrants in year X. Average usual periods of study are used to determine year X in the case of the graduates.
 ** Results from the latest graduate survey (Heublein, Richter et al. 2014)

Source: (Heublein, Richter et al. 2014; Statistisches Bundesamt 2017d; Statistisches Bundesamt 2017e), QuBe project, fifth wave, own representation

5. Transitional model of the vocational education and training system and the institutes of higher education

The BIBB transitional model of the vocational education and training system and the institutes of higher education is based on methods and results of the former National Educational Accounts (BGR) of the IAB (Reinberg and Hummel 2002). The conventions of the BGR dictate that numbers of persons are recorded at the beginning and end of the year and that these persons must be allocatable to a population account or to a training venue. The population accounts are listed in Table 4. Clear alignment requires an arithmetic model which is consistent over the course of time and facilitates an overall consideration of populations and movements in the education system. The use of different data sources necessarily leads to double counts and thus to inconsistencies in population data during the actual period. An RAS algorithm (Bachem and Korte 1979) is initially used to cleanse the double counts from the statistical population data of the BGR and to adapt it to the actual population structure at the end of the year and to the statistical populations in the respective accounts. This statistical population data (Figure 2) forms the basis for the determination of the transitions between the individual status accounts and thus constitutes the empirical foundation for the

further calculations. In the projection period, this arithmetic model is calibrated to the forecast statistical populations in the education system whilst the transition structures between the respective population accounts are kept constant.

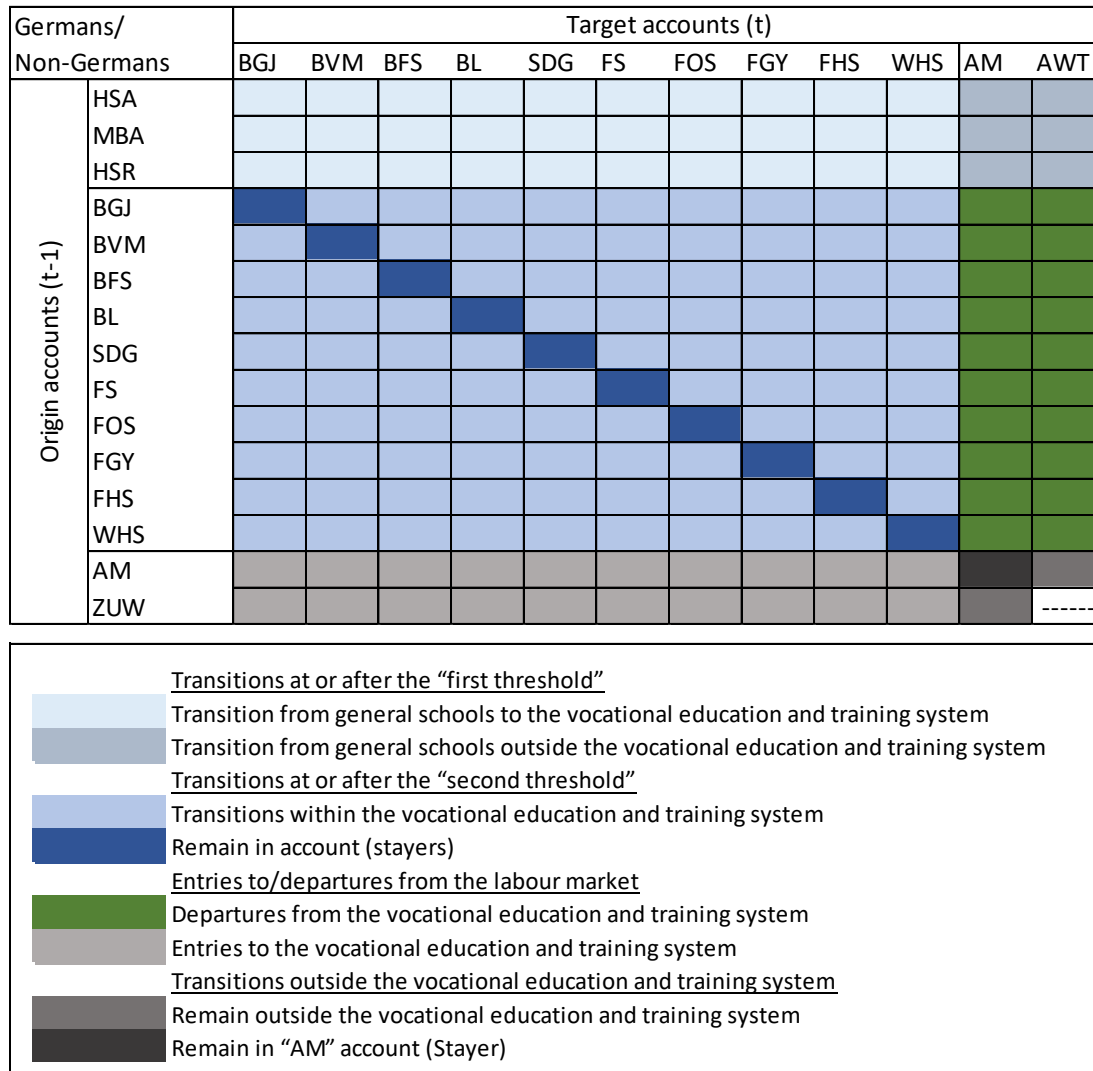
Unlike the BGR, the primary objective of the BIBB transitional model of the vocational education and training system and the institutes of higher education is to map departures from and entries to the education system and thus project net new supply on the labour market from the respective training venues.

Table 4: Accounts of the BIBB transitional model

Abbreviation	Description
HSA	Persons completing the general lower secondary sector with or without a lower secondary school leaving certificate
MBA	Persons completing the general intermediate secondary sector with or without an intermediate school leaving certificate
HSR	Persons completing the general upper secondary sector and obtaining a higher education entrance qualification
BGJ	Basic vocational training year, pre-vocational training year on a full-time basis
BVM	Vocational preparation schemes offered by the Federal Employment Agency, vocational education preparation programmes
BFS	School-based VET (full-time and part-time), vocational preparatory schools (full-time) and vocational colleges in NRW on a part-time basis
BL	Dual system (company-based apprenticeship)
SDG	Healthcare sector schools
FS	Trade and technical schools (including master craftsman and technician schools) on a full-time basis, academies and universities of cooperative education
FOS	Specialised upper secondary schools (full-time and part-time), vocational colleges in NRW on a full-time basis
FGY	Specialised grammar schools
FHS	Universities of applied sciences
WHS	Academic institutes of higher education (universities)
AM	Persons not in training
ZUW	Arrival from outside Germany
AWT	Emigrations and deaths

Source: QuBe project, fifth wave, own representation

Figure 3: Accounts system of the BIBB transitional model



Source: QuBe project, fifth wave, own representation

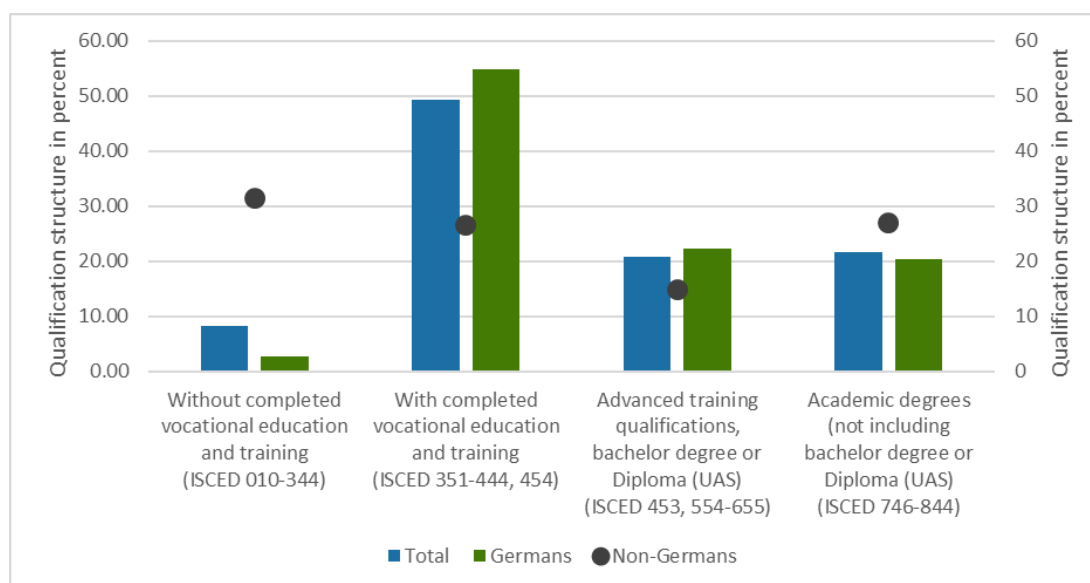
The qualification-specific net new supply (net outflow from the education system) is defined as the balance between departures from and entries to the same qualification level (q).

$$net\ outflow_q = \sum_{kh=1}^{13} departures_q - \sum_{kz=1}^{10} entries_q$$

In order to determine the qualification-specific net new supply, the first stage is to identify the qualification structure of leavers from the education system with the assistance of success rates. In the case of entries to the education system, the qualification level achieved to date is taken into account. With regard to the net new supply, an unequal distribution of the qualification structure between Germans and non-Germans can be observed in the projection period. Compared to the German net new supply, the non-German net new supply displays a high proportion of persons without

a full vocational qualification and a relatively low proportion of persons who have completed vocational education and training. This is caused by the lower success rates achieved by non-Germans at vocational schools. By way of contrast, differences are significantly smaller at the two highest qualification levels. This is also due to an absence of differentiation thus far in the success rates in the higher education sector.

Figure 4: Qualification structures of net departures from the education system, average for the years 2016–2035



Source: QuBe project, fifth wave, own representation

The occupational structure of net departures is determined on the basis of the main field of study (occupation learned) from the microcensus. Proportions of occupation in which training has taken place observed since the 1996 year of qualification are updated by qualification levels, gender and Germans and non-Germans using a logarithmised and expiring time trend.

6. Participation in employment

In order to determine the future labour supply, employment rates are used to separate the updated population into economically active and economically inactive persons. Employment rates, which are defined as the proportion of the population which makes up the labour supply, are estimated by Germans and non-Germans in the fifth wave of the QuBe projection. The previous differentiation (Maier, Zika et al. 2016) by age, qualification and gender remains in place. Differentiation by Germans and non-Germans takes account of the observation that there are discernible differences between nationalities in participation in employment. The updating of employment rates takes place via a logarithmised and therefore expiring time trend. A further assumption is made that, from the 55 to 59 age group, the employment rates of the previous age groups may not be exceeded.

7. Qualification structure of the labour supply

The updating of total amounts of person explained in Section 2 and subsequent determination of the labour supply from projected participation in employment, cf. Section 6, results in the projection of labour supply by qualification levels (Table 5). A slight increase in the labour supply is revealed up until the year 2025. This is followed by falling numbers until 2035, although existing labour supply will be around 0.5 million higher in 2035 than in the starting year of 2015. This development is largely demographically driven, because average net annual migration of around 300,000 persons is assumed in the projection period. Gains from migration will, however, be larger at the beginning of the projection period. This positive effect of a “rejuvenation” of the population via immigration, especially in the under-30 age group, will weaken towards the end of the projection period.

Table 5: Projection of labour supply by qualification levels

Period	Without completed vocational education and training (ISCED 010-344)	With completed vocational education and training (ISCED 351-444, 454)	Advanced training qualifications, bachelor degree or Diploma (UAS) (ISCED 453, 554-655)	Academic degrees (not including bachelor degree or Diploma (UAS)) (ISCED 746-844)	In education and training	Total
Total labour supply in 1000 persons						
2015	5,999	22,448	7,963	5,322	3,208	44,940
2020	6,016	22,727	8,499	6,129	3,149	46,519
2025	5,833	22,329	8,796	6,696	3,152	46,807
2030	5,548	21,530	8,891	7,090	3,199	46,257
2035	5,211	20,590	8,940	7,419	3,327	45,487
Change to starting year in percent						
2020	0.3	1.2	6.7	15.1	-1.8	3.5
2025	-2.8	-0.5	10.5	25.8	-1.7	4.2
2030	-7.5	-4.1	11.7	33.2	-0.3	2.9
2035	-13.1	-8.3	12.3	39.4	3.7	1.2
Qualification structure (not including labour supply in training) in percent						
2015	14.4	53.8	19.1	12.8	---	100
2020	13.9	52.4	19.6	14.1	---	100
2025	13.4	51.1	20.1	15.3	---	100
2030	12.9	50.0	20.6	16.5	---	100
2035	12.4	48.8	21.2	17.6	---	100

Source: Research Data Centre of the Federal Statistical Office and the statistical offices of the federal states, microcensuses 1997–2015, projections from 2016, calculations and representations from the QuBe Project, fifth wave

As in previous projections, a shift in the qualification structure towards academic qualifications is discernible. The proportion of the labour supply with a higher education qualification (not including bachelor degrees or degrees from universities of applied sciences) rises from 12.8 to 17.6 percent. There is also an increase in the proportion of the labour supply completing upgrading training (e.g. master craftsman, technician or certified senior clerk) and a bachelor degree or a Diploma degree from a university of applied sciences. In the latter case, a rise from 19.1 to 21.2 percent is recorded. By way of contrast, the proportion of the labour supply which has completed vocational education and training falls from 53.8 to 48.8 percent. This qualification level will, however, continue to be the most dominant by some distance. The proportion of the labour

supply which has not completed vocational education and training also declines slightly from 14.4 percent to 12.4 percent in 2035.

The development of the labour supply which is not in training can be separated into the development of existing supply and new labour supply from a domestic source and from immigration. This enables a detailed consideration of the various determinants of the future labour supply. The development of existing labour supply in Table 6 shows which proportion of the labour supply from the base year of 2015 will remain active on the labour market during the course of the projection period.

Table 6: Existing labour supply (not in training) by qualification levels

Period	Without completed vocational education and training (ISCED 010-344)	With completed vocational education and training (ISCED 351-444, 454)	Advanced training qualifications, bachelor degree or Diploma (UAS) (ISCED 453, 554-655)	Academic degrees (not including bachelor degree or Diploma (UAS) (ISCED 746-844)	Total
Existing labour supply in 1000 persons					
2015	5,999	22,448	7,963	5,322	41,732
2020	5,711	20,254	7,499	4,973	38,436
2025	5,198	17,540	6,676	4,424	33,838
2030	4,612	14,613	5,659	3,830	28,713
2035	3,994	11,552	4,596	3,224	23,366
Persons leaving working life in 1000 persons					
2016–2020	289	2,194	464	349	3,296
2020–2025	512	2,715	823	548	4,598
2025–2030	587	2,927	1,017	595	5,125
2030–2035	618	3,061	1,063	606	5,347
2016–2035	2,006	10,896	3,366	2,098	18,366
Proportion of starting population in percent					
2015	100	100	100	100	100
2020	95.2	90.2	94.2	93.4	92.1
2025	86.7	78.1	83.8	83.1	81.1
2030	76.9	65.1	71.1	72.0	68.8
2035	66.6	51.5	57.7	60.6	56.0

Source: Research Data Centre of the Federal Statistical Office and the statistical offices of the federal states, microcensuses 1997–2015, projections from 2016, calculations and representations from the QuBe Project, fifth wave

As we move away from the base year, this population reduces because of declining participation in employment in older age and increased risk of death. Persons leaving working life show the replacement need in order to maintain existing labour supply in the starting year. This means that the existing labour supply account maps two essential determining factors. These are the decline in the labour supply caused by demographic reasons and the influence of projected participation in employment. The proportion of the starting population which the existing supply is calculated to constitute makes the qualification-specific developments clear. Compared with the overall development of the existing supply, persons in the labour supply who have completed vocational education and training are more likely to depart working life because of the age structure of the starting population and due to a stronger decrease in participation

in employment with advancing age. Precisely the opposite occurs in the case of the labour supply that is in possession of academic qualifications.

The cumulative new supply from a domestic source and from immigration presented in Table 7 needs to be contrasted against the existing labour supply. The new supply of persons is fed by leavers from the vocational education and training system minus persons with the same qualification returning to this system and net migration³ to Germany. The model of the vocational education and training system forms the basis for calculation of the domestic new supply of persons. The new supply of persons from migration is produced by the amount of net migration and exhibits the same qualification structure as leavers from the vocational education and training system. The projected rates of employment are used to calculate the new labour supply from the total numbers of persons.

Table 7: New labour supply (not in training) by qualification levels

Period	Without completed vocational education and training (ISCED 010-344)	With completed vocational education and training (ISCED 351-444, 454)	Advanced training qualifications, bachelor degree or Diploma (UAS) (ISCED 453, 554-655)	Academic degrees (not including bachelor degree or Diploma (UAS) (ISCED 746-844)	Total
Cumulated new labour supply in 1000 persons					
2015	0	0	0	0	0
2020	305	2,472	1,000	1,156	4,934
2025	635	4,790	2,120	2,272	9,816
2030	936	6,917	3,232	3,260	14,345
2035	1,218	9,038	4,343	4,195	18,794
New labour supply in 1000 persons					
2016–2020	305	2,472	1,000	1,156	4,934
2020–2025	330	2,317	1,120	1,116	4,883
2025–2030	302	2,127	1,112	988	4,529
2030–2035	281	2,121	1,111	935	4,449
2016–2035	1,218	9,038	4,343	4,195	18,794
In percent					
2016–2020	6.2	50.1	20.3	23.4	100
2020–2025	6.7	47.5	22.9	22.9	100
2025–2030	6.7	47.0	24.5	21.8	100
2030–2035	6.3	47.7	25.0	21.0	100
2016–2035	6.5	48.1	23.1	22.3	100

Source: Research Data Centre of the Federal Statistical Office and the statistical offices of the federal states, microcensuses 1997–2015, projections from 2016, calculations and representations from the QuBe Project, fifth wave

A decline in the proportion of the new labour supply of persons with a vocational qualification contrasts with a slight rise of around three percentage points in the proportion of those with upgrading training (e.g. master craftsman, technician or certified senior

³ Net migration is the number of migrants arriving in Germany minus the number leaving the country.

clerk) and a bachelor's degree or a Diploma degree from a university of applied sciences. At the other qualification levels, there is no appreciable change in the qualification structure of the new supply during the projection period.

If a direct comparison is made between the new supply and persons in the labour supply leaving working life, this provides a good opportunity to interpret the development of the individual qualification levels, cf. Table 8.

Table 8: New labour supply and persons in the labour supply leaving working life by qualification levels

Period	Without completed vocational education and training (ISCED 010-344)	With completed vocational education and training (ISCED 351-444, 454)	Advanced training qualifications, bachelor degree or Diploma (UAS) (ISCED 453, 554-655)	Academic degrees (not including bachelor degree or Diploma (UAS) (ISCED 746-844)	Total
New labour supply in 1000 persons					
2016–2020	305	2,472	1,000	1,156	4,934
2020–2025	330	2,317	1,120	1,116	4,883
2025–2030	302	2,127	1,112	988	4,529
2030–2035	281	2,121	1,111	935	4,449
2016–2035	1,218	9,038	4,343	4,195	18,794
Persons leaving working life in 1000 persons					
2016–2020	289	2,194	464	349	3,296
2020–2025	512	2,715	823	548	4,598
2025–2030	587	2,927	1,017	595	5,125
2030–2035	618	3,061	1,063	606	5,347
2016–2035	2,006	10,896	3,366	2,098	18,366
Difference					
2016–2020	17	279	536	806	1,638
2020–2025	-183	-398	297	568	285
2025–2030	-285	-799	95	393	-596
2030–2035	-337	-939	49	329	-898
2016–2035	-788	-1,858	977	2,097	428

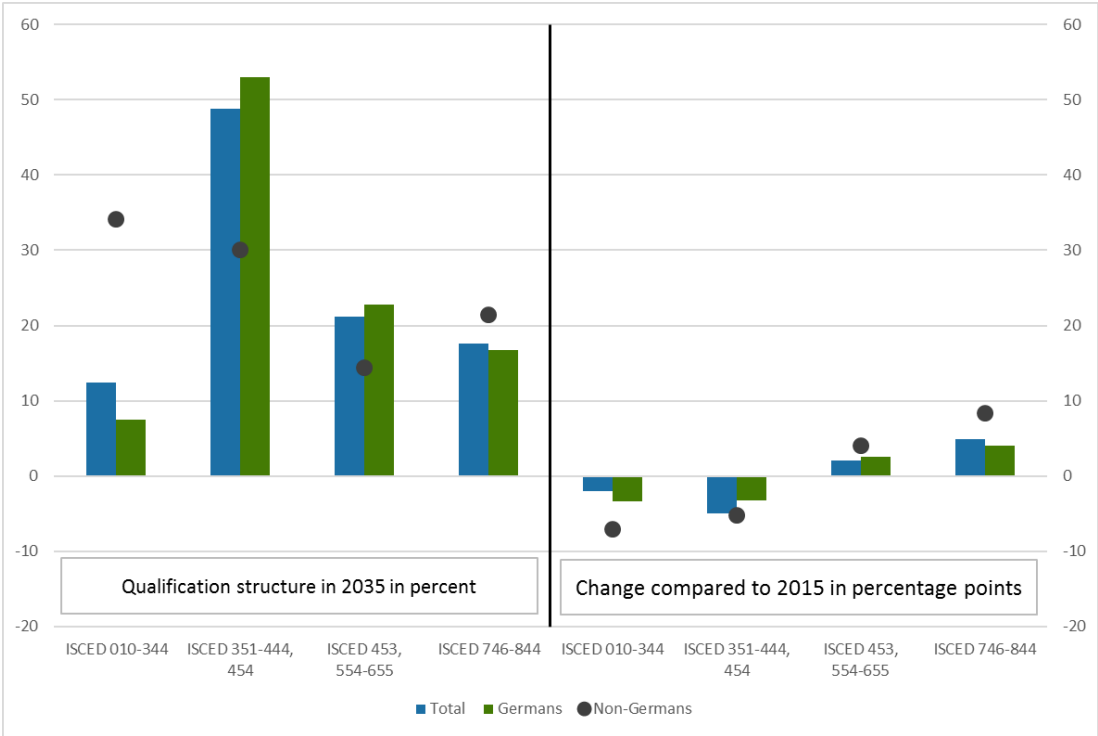
Source: Research Data Centre of the Federal Statistical Office and the statistical offices of the federal states, microcensuses 1997–2015, projections from 2016, calculations and representations from the QuBe Project, fifth wave

The increase in the highly qualified labour supply, which has been discernible since the first projection wave (Kalinowski and Quinke 2010), also exerts an effect on the base projection of the fifth wave because the number of higher education entrants remains at a high level, cf. Table 1. This means that new supply at the qualification levels of upgrading training, bachelor, Masters and Diploma degree stays high during the projection period. Although the number of persons in the labour supply leaving working life increases across the projection period as a whole, it does not exceed new supply. This leads to a rise in the labour supply at these two qualification levels of 977,000 and 2,097,000 persons respectively. Precisely the opposite development can be identified in the qualification levels of completed vocation education and training and not completed vocational education and training. In this case, demographic reasons dictate that the number of persons in the labour supply leaving working life

clearly predominate, and this leads to a decrease in the labour supply at these two qualification levels of -788,000 and -1,858,000 persons.

If development of the qualification structure of the labour supply is considered by German and non-Germans separately, it is possible to identify a decrease in persons in the labour supply not in possession of a full vocational qualification and with a vocational qualification. Nevertheless, around one third of non-German persons in the labour supply will not hold a full vocational qualification in the year 2035.

Figure 5: Qualification structure of the labour supply until 2035, separated by Germans and non-Germans



Guide to ISCED levels

- 010-344: Without completed vocational education and training
- 351-444, 454: With completed vocational education and training
- 453, 554-655: Advanced training qualifications, bachelor degree or Diploma (UAS)
- 746-844: Academic degrees (not including bachelor degree or Diploma (UAS))

Source: Research Data Centre of the Federal Statistical Office and the statistical offices of the federal states, microcensuses 1997–2015, calculations and representations from the QuBe Project, fifth wave

8. Occupational structure of the labour supply

Development of the labour supply by occupational main groups until the year 2035 is extremely heterogeneous. Whereas occupational main groups in the area of production-related occupations in particular are characterised by a drastic reduction in total labour supply in some cases, occupational groups in the secondary service sector show an increase in labour supply by 2035 (cf. Table 9). In the same way as the consideration of labour supply by qualification levels undertaken in Section 7, a comparison between the number of persons in the labour supply leaving working life

(Table 10) and the new supply (Table 11) is able to show the reasons for the developments identified in the total labour supply.

In almost all occupational groups in the manufacturing sector, over half of the labour supply with a vocational qualification will leave working life between the years 2015 and 2035 (Table 10). “(23) Occupations in paper-making and processing, printing, and in technical media design” and “(27) Occupations in technical research and development, construction, and production planning and scheduling” are the only occupational main groups in which new supply from the education system with the same qualification level will be able to offset skilled workers leaving working life. This means that the supply of vocationally qualified skilled workers in these occupational main groups will rise slightly. The largest reductions in quantitative terms are revealed in the occupational main groups “(24) Occupations in metal making and -working, and in metal construction” (-0.5 million persons between 2015 and 2035, or -27%), “(28) Occupations in textile- and leather-making and -processing” (-0.3 million, -52%) and “(11) Occupations in agriculture, forestry, and farming” (-28%). The occupational main groups “(25) Technical occupations in machine-building and automotive industry” (-9%) and “(32) Occupations in building construction above and below ground” (-27%) will each employ around 0.2 million persons fewer in the year 2035.

In the case of the service sector occupations, the occupational group “(62) Sales occupations in retail trade” – in which qualification is also predominantly acquired via vocational education and training – will lose around 250,000 trained workers (- 11%) between the years 2015 and 2035. Otherwise, a growth in the number of skilled workers can be identified in almost all occupational main groups in the service sector. The highest quantitative rises in numbers of skilled workers until 2035 will be recorded in “(81) Medical and healthcare occupations” (13%), “(91) Occupations in philology, literature, humanities, social sciences, and economics” (49%) and “(43) Occupations in computer science, information and communication technology” (69%). Each of these will see an increase in the labour supply of around 0.4 million persons. Over the past few years, a strong increase in training and higher education study provision has taken place in the latter two of these occupational main groups in particular. By way of contrast, these comparatively new training pathways mean that the number of persons who have trained in one of these occupations, are already in working life and will retire over the next 20 years is very small.

Table 9: Projection of labour supply by occupational main groups in which training has taken place, in thousands of persons

Occupational main groups (Classification of Occupations 2010)	Year					Change
	2015	2020	2025	2030	2035	2015-2035
01 Military	15	15	15	15	15	-0
11 Occupations in agriculture, forestry, and farming	648	617	577	519	468	-180
12 Occupations in gardening and floristry	370	388	391	377	359	-10
21 Occupations in production and processing of raw materials, glass- and ceramic-making and -processing	144	132	118	106	95	-49
22 Occupations in plastic-making and -processing, and wood-working and -processing	654	679	685	669	643	-11
23 Occupations in paper-making and -processing, printing, and in technical media design	413	443	469	484	496	83
24 Occupations in metal-making and -working, and in metal construction	1,801	1,711	1,587	1,442	1,311	-491
25 Technical occupations in machine-building and automotive industry	2,549	2,589	2,547	2,448	2,332	-217
26 Occupations in mechatronics, energy electronics and electrical engineering	2,086	2,133	2,109	2,063	2,007	-78
27 Occupations in technical research and development, construction, and production planning and scheduling	467	495	506	504	504	37
28 Occupations in textile- and leather-making and -processing	591	517	442	361	283	-308
29 Occupations in food-production and -processing	1,141	1,161	1,145	1,096	1,037	-103
31 Occupations in construction scheduling, architecture and surveying	529	565	577	568	558	29
32 Occupations in building construction above and below ground	875	842	785	707	637	-238
33 Occupations in interior construction	781	807	805	781	755	-26
34 Occupations in building services engineering and technical building services	637	650	637	610	580	-57
41 Occupations in mathematics, biology, chemistry and physics	819	937	1,009	1,054	1,085	266
42 Occupations in geology, geography and environmental protection	139	165	185	201	209	70
43 Occupations in computer science, information and communication technology	603	745	860	949	1,020	417
51 Occupations in traffic and logistics (without vehicle driving)	693	737	761	771	773	80
52 Drivers and operators of vehicles and transport equipment	241	227	211	189	173	-68
53 Occupations in safety and health protection, security and surveillance	280	285	285	283	286	6
54 Occupations in cleaning services	58	58	58	57	54	-4
61 Occupations in purchasing, sales and trading	632	654	666	671	670	38
62 Sales occupations in retail trade	2,266	2,258	2,201	2,114	2,021	-245
63 Occupations in tourism, hotels and restaurants	653	743	808	848	874	221
71 Occupations in business management and organisation	4,114	4,351	4,448	4,457	4,398	284
72 Occupations in financial services, accounting and tax consultancy	1,204	1,252	1,260	1,247	1,224	20
73 Occupations in law and public administration	1,730	1,835	1,869	1,865	1,828	98
81 Medical and health care occupations	3,167	3,430	3,551	3,576	3,582	415
82 Occupations in non-medical healthcare, body care, wellness and medical technicians	1,258	1,349	1,393	1,402	1,398	141
83 Occupations in education and social work, housekeeping, and theology	1,547	1,658	1,697	1,713	1,728	181
84 Occupations in teaching and training	1,070	1,120	1,171	1,231	1,291	221
91 Occupations in in philology, literature, humanities, social sciences, and economics	908	1,059	1,173	1,263	1,351	443
92 Occupations in advertising and marketing, in commercial and editorial media design	198	235	265	283	302	104
93 Occupations in product design, artisan craftwork, fine arts and the making of musical instruments	246	266	279	286	286	40
94 Occupations in the performing arts and entertainment	210	245	275	298	317	107
Labour supply not completed training in an occupation	5,999	6,016	5,833	5,548	5,211	-788
Labour supply in training	3,208	3,149	3,152	3,199	3,327	119
Total (rounded values)	44,940	46,519	46,807	46,258	45,488	548

Source: Research Data Centre of the Federal Statistical Office and the statistical offices of the federal states, microcensuses 1997–2015, projections from 2016, calculations and representations from the QuBe Project, fifth wave

Table 10: Persons in the labour supply leaving working life (not in training) by occupational main groups in which training has taken place, in thousands of persons

Occupational main groups (Classification of Occupations 2010)	Period				
	2016–2020	2020–2025	2025–2030	2030–2035	2016–2035
01 Military	2	2	2	2	8
11 Occupations in agriculture, forestry, and farming	83	95	108	100	386
12 Occupations in gardening and floristry	24	37	52	56	169
21 Occupations in production and processing of raw materials, glass- and ceramic-making and -processing	25	26	23	22	96
22 Occupations in plastic-making and -processing, and wood-working and -processing	48	67	84	91	289
23 Occupations in paper-making and -processing, printing, and in technical media design	34	40	44	46	164
24 Occupations in metal-making and -working, and in metal construction	242	272	282	269	1,065
25 Technical occupations in machine-building and automotive industry	249	319	350	360	1,278
26 Occupations in mechatronics, energy electronics and electrical engineering	213	278	282	284	1,057
27 Occupations in technical research and development, construction, and production planning and scheduling	41	58	65	62	226
28 Occupations in textile- and leather-making and -processing	99	103	106	102	410
29 Occupations in food-production and -processing	91	121	148	157	517
31 Occupations in construction scheduling, architecture and surveying	39	62	74	74	249
32 Occupations in building construction above and below ground	103	124	138	127	491
33 Occupations in interior construction	64	87	103	105	358
34 Occupations in building services engineering and technical building services	55	80	90	90	315
41 Occupations in mathematics, biology, chemistry and physics	60	97	105	114	376
42 Occupations in geology, geography and environmental protection	7	16	16	21	60
43 Occupations in computer science, information and communication technology	10	36	50	66	162
51 Occupations in traffic and logistics (without vehicle driving)	48	72	80	87	287
52 Drivers and operators of vehicles and transport equipment	35	38	40	34	147
53 Occupations in safety and health protection, security and surveillance	33	40	39	33	145
54 Occupations in cleaning services	5	7	7	9	29
61 Occupations in purchasing, sales and trading	57	68	72	78	275
62 Sales occupations in retail trade	226	263	282	293	1,063
63 Occupations in tourism, hotels and restaurants	14	35	55	68	172
71 Occupations in business management and organisation	295	422	475	542	1,734
72 Occupations in financial services, accounting and tax consultancy	104	137	150	159	550
73 Occupations in law and public administration	124	190	213	246	773
81 Medical and health care occupations	170	305	377	397	1,248
82 Occupations in non-medical healthcare, body care, wellness and medical technicians	81	124	150	166	521
83 Occupations in education and social work, housekeeping, and theology	103	176	189	194	661
84 Occupations in teaching and training	136	143	122	117	518
91 Occupations in in philology, literature, humanities, social sciences, and economics	52	88	95	92	327
92 Occupations in advertising and marketing, in commercial and editorial media design	6	16	21	21	63
93 Occupations in product design, artisan craftwork, fine arts and the making of musical instruments	20	30	31	38	119
94 Occupations in the performing arts and entertainment	14	22	23	24	82
Labour supply not completed training in an occupation	280	503	583	620	1,986
Total (rounded values)	3,292	4,596	5,125	5,365	18,377

Source: Research Data Centre of the Federal Statistical Office and the statistical offices of the federal states, microcensuses 1997–2015, projections from 2016, calculations and representations from the QuBe Project, fifth wave

Table 11: New labour supply (not in training) by occupational main groups in which training has taken place, in thousands of persons

Occupational main groups (Classification of Occupations 2010)	Period				
	2016–2020	2020–2025	2025–2030	2030–2035	2016–2035
01 Military	2	2	2	2	8
11 Occupations in agriculture, forestry, and farming	53	55	50	49	206
12 Occupations in gardening and floristry	42	40	38	39	159
21 Occupations in production and processing of raw materials, glass- and ceramic-making and -processing	12	12	11	11	47
22 Occupations in plastic-making and -processing, and wood-working and -processing	74	72	67	65	279
23 Occupations in paper-making and -processing, printing, and in technical media design	64	66	59	58	247
24 Occupations in metal-making and -working, and in metal construction	152	147	137	137	574
25 Technical occupations in machine-building and automotive industry	289	278	251	243	1,061
26 Occupations in mechatronics, energy electronics and electrical engineering	260	254	236	229	979
27 Occupations in technical research and development, construction, and production planning and scheduling	69	69	63	62	263
28 Occupations in textile- and leather-making and -processing	26	27	25	24	102
29 Occupations in food-production and -processing	111	106	98	98	413
31 Occupations in construction scheduling, architecture and surveying	75	74	66	63	279
32 Occupations in building construction above and below ground	70	67	60	57	254
33 Occupations in interior construction	90	85	79	78	332
34 Occupations in building services engineering and technical building services	68	67	63	60	258
41 Occupations in mathematics, biology, chemistry and physics	178	169	150	145	642
42 Occupations in geology, geography and environmental protection	34	36	32	29	131
43 Occupations in computer science, information and communication technology	153	151	139	136	579
51 Occupations in traffic and logistics (without vehicle driving)	92	95	90	89	366
52 Drivers and operators of vehicles and transport equipment	20	22	19	18	79
53 Occupations in safety and health protection, security and surveillance	38	40	36	36	150
54 Occupations in cleaning services	6	6	6	6	25
61 Occupations in purchasing, sales and trading	79	80	77	76	312
62 Sales occupations in retail trade	218	206	195	199	819
63 Occupations in tourism, hotels and restaurants	104	100	94	95	393
71 Occupations in business management and organisation	533	519	484	483	2,018
72 Occupations in financial services, accounting and tax consultancy	152	145	136	136	570
73 Occupations in law and public administration	229	224	210	209	872
81 Medical and health care occupations	433	426	402	402	1,663
82 Occupations in non-medical healthcare, body care, wellness and medical technicians	172	168	159	162	661
83 Occupations in education and social work, housekeeping, and theology	214	214	206	208	842
84 Occupations in teaching and training	186	194	182	177	739
91 Occupations in in philology, literature, humanities, social sciences, and economics	203	203	185	180	770
92 Occupations in advertising and marketing, in commercial and editorial media design	43	46	40	39	167
93 Occupations in product design, artisan craftwork, fine arts and the making of musical instruments	40	43	38	38	159
94 Occupations in the performing arts and entertainment	49	52	45	43	190
Labour supply not completed training in an occupation	296	320	298	284	1,198
Total (rounded values)	4,930	4,880	4,529	4,467	18,805

Source: Research Data Centre of the Federal Statistical Office and the statistical offices of the federal states, microcensuses 1997–2015, projections from 2016, calculations and representations from the QuBe Project, fifth wave

9. Conclusion

The BIBB supply projection for the fifth wave is the first to determine labour supply separately by Germans and non-Germans. This means that all determinants of the labour supply take account of the strong rise in the non-German population during the projection period from 10.5 percent in 2015 to 16.5 percent in 2035. With regard to development of statistical populations in the education system, a very strong increase in non-Germans in particular can in some cases be identified compared to the year 2016. This is a result of the disproportionate rise in younger age cohorts in the non-German population over the projection period. At the same time, the vocational education system reveals significant differences in the success rates of German and non-German pupils and of female and male trainees (Table 2). An increase in the success rates of non-Germans would help to counter the decrease in the labour supply at the intermediate qualification level which is caused by demographic reasons.

The future development of the qualification structure of the labour supply in the projection period confirms the results of past calculations. There is, therefore, a particular expectation that labour supply at the intermediate qualification level will decline whereas the number of persons in the labour supply with a higher education qualification will continue to increase. The fifth wave of the BIBB-IAB qualifications and occupational field projections is the first to calculate and report labour supply by occupation in which training has taken place at the level of occupational groups (3-digit code) in the 2010 German Classification of Occupations (KldB 2010). This paper presents labour supply by main occupational groups (2-digit code). Results by occupational groups may be accessed [here](#).⁴

Finally, the imponderability of the projection must be pointed out. Whereas falling or rising birth rates or expected mortality rates will exert a scarcely discernible impact on the number of persons in the labour supply in the year 2035 in the case of the population projection, the balance of arrivals and departures to and from Germany will influence labour supply considerably. Projections in the education sector are also associated with uncertainties. Both the forecast of higher education study entrants and the statistical populations of students and graduates in the higher education sector which are derived from this forecast assume structural consistency in the education system and must be interpreted as a status quo projection. It is, for example, currently unclear whether further federal states will decide to return to a 9-year upper secondary school model. This could lead to a partial absence of upper secondary cohorts and

⁴ Labour supply by occupations taking account of occupational flexibilities and demand for workers may be viewed at www.qube-data.de.

consequently also to lower numbers of higher education study entrants. Future development in the vocational school system is also only predictable to a limited extent because this is heavily dependent on the future willingness of trade and industry to provide training and is further influenced by possible substitution effects between academic and vocational training. Appropriate scenario calculations are required in order to quantify the unpredictabilities stated.

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