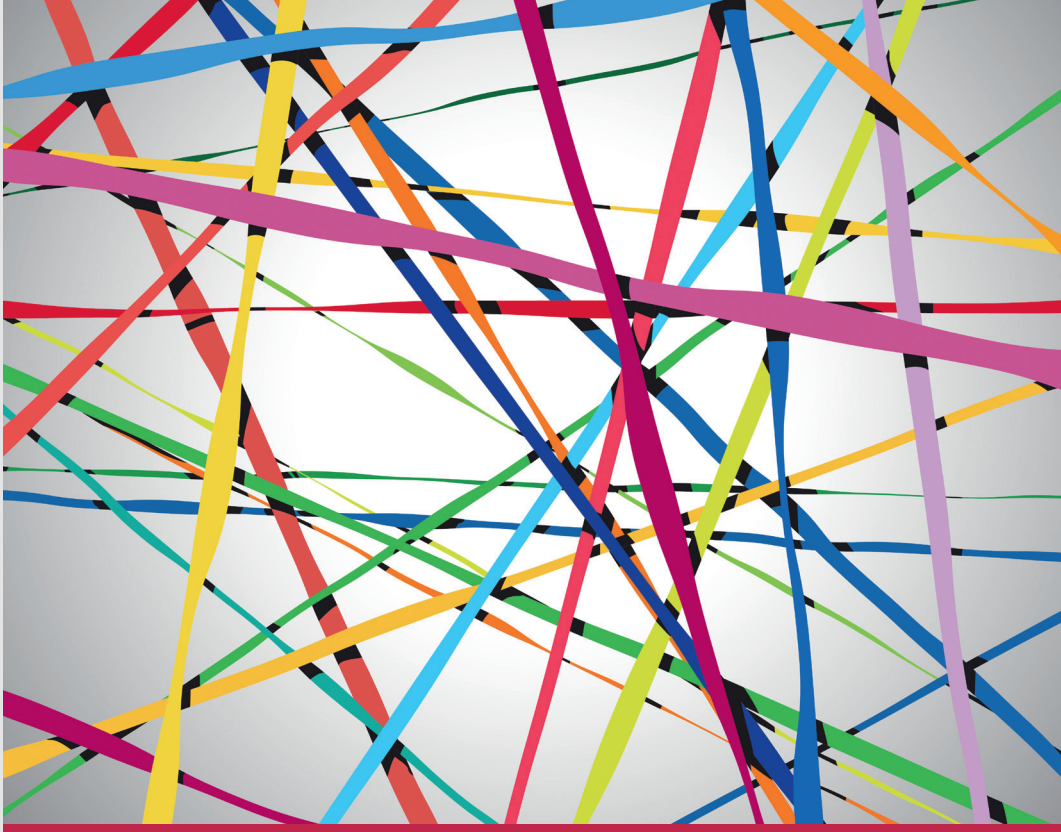
Kurt Vogler-Ludwig, Nicola Düll



The German Labour Market in the Year 2030

A Strategic View on Demography, Employment and Education

ECONOMIX Research & Consulting

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On behalf of the

Bundesministerium
für Arbeit und Soziales

In cooperation with

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Task and methods

The German Ministry for Labour and Social Affairs (BMAS) commissioned Economix on 2nd November, 2011 to undertake the project "Analysis of the future demand and supply of the labour market based on a computerised model". According to the project description set out by BMAS, the project should provide "regular and transparent, detailed and scientifically founded estimations for supply and demand in the labour market in Germany". For this purpose, a forecast model was to be developed which would serve as an early warning system in order to better assess possible labour shortages and to derive targeted measures to safeguard skilled labour. We herewith submit our main report for 2012. It is supplemented by an expert and scenario report and a methodological report.[1]

Taking into account the strong volatility caused by the financial and economic crisis, it was clear that the task set before us could not merely be solved by relying on an econometric model of the past. Instead, we had to proceed on the assumption that there will be various structural upheavals originating from the aftermath of the crisis, the advancing globalisation of the economy and the labour markets, and from social changes. Our methodical answer was thus a combination of qualitative future scenarios and mathematical forecasting procedures so that the forecast of the fundamental changes in the economy and in society could be implemented into robust quantitative projections.

Two alternative scenarios for the future were developed based on the findings of seven expert reports. This included globalisation, technological change, work organisation, climate change and above all the effect of demographic change on educational and employment behaviour of the German population. These findings were discussed in a workshop with the client in April 2012, where they were condensed into scenarios and used as a basis for the quantitative models.

These models are based on the labour market models developed by Cambridge Econometrics, the Warwick Institute for Employment Research and the Research Centre for Education and the Labour Market, which are also used for the qualifica-

1 Düll N. (2013a): Arbeitsmarkt 2030 – Fachexpertisen und Szenarien. Trendanalyse und qualitative Vorausschau. W. Bertelsmann Verlag. Bielefeld 2013; Kriechel B., Vogler-Ludwig K. (2013): Arbeitsmarkt 2030 – Methodenbericht. Beschreibung der quantitativen Modelle. W. Bertelsmann Verlag. Bielefeld 2013; published on wbv-open-access.de.

tions forecast of the European Centre for the Development of Vocational Training CEDEFOP. In the model versions which have been specifically developed for Germany, 44 economic sectors, 88 occupational groups and 27 technical fields of vocational training were distinguished.

In total, seven modules of the quantitative model simultaneously estimate labour supply and labour demand and thus, take into account the various interrelations in the labour market. It was important to us to depict the adaptive responses in labour supply caused by changes in labour demand and, likewise, the response of labour demand to emerging bottlenecks. This is the only way to stop the forecast from lapsing into a rigid and increasingly unrealistic world. This also distinguishes our approach from other forecast models, which often use separate supply and demand estimations. By using simulations we have illustrated the effects of the assumed changes in different areas of our investigations.

We have stepped into new territory by measuring labour market flows. This is the first time that they have been shown and predicted in a detailed occupational and qualification-specific classification. The assessment of labour inflows and labour outflows was relevant for measuring the labour shortages and for the analysis of the adjustment process with regard to supply and demand.

Our forecast includes possible reactions of policy actors, companies and workforces with regard to the developments. This especially includes reactions to labour shortages over the next 20 years due to demographics. We therefore expect there to be further efforts to implement the German Ministry's skills strategy *(Fachkräftesicherungskonzept)* which we expect to have a significant impact on female labour participation, the scope of working hours among part time workers, the employment rate of the older population and finally, the volume and structure of immigration. Similarly, we have made assumptions regarding technological development, globalisation strategies within companies as well as specialisation in the international division of labour. Thus, this is no status quo forecast where the response behaviour is stagnant, but rather it is a political forecast which already includes the actions which need to be taken. We therefore regard this report to be a strategic forecast of one of the possible alternatives for the future of the labour market in Germany. We are presenting it as a contribution for further discussion regarding the future of the labour market and not as a conclusion to this debate.

Development of labour supply

Demographic change: challenges due to a declining and ageing population

Even assuming that politics and organisations will do everything to expand labour supply, the number of available workers in the labour market will decline by 2.9 mil-

lion by the year 2030. This is primarily due to demographic trends as the working age population aged between 15 and 74 years old will sink by 4.7 million.

Demographic development could hardly be less favourable: the number of young people will decline considerably, as will the middle-aged generation. The number of older people, however, will significantly increase. This means that the labour force aged between 15 and 24 years old will drop by 980 000 by the year 2030 and the labour force aged between 25 and 54 years old will decrease by 4.8 million. On the other hand, the labour force aged 55 and older will increase by 3 million (Figure 1).

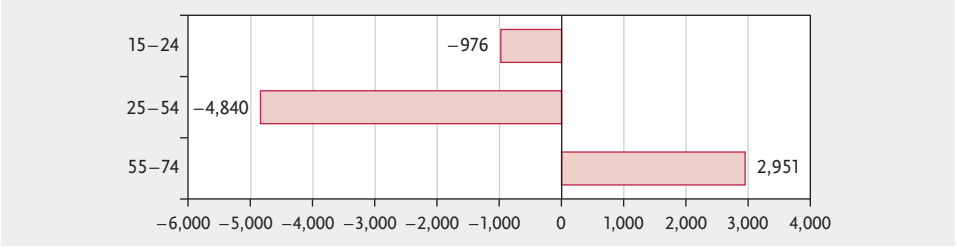

Figure 1 Labour force by age
Change between 2010–2030 (in 1000s)

Source: Economix

These statistics incorporate variant 1-W2 of the 12th coordinated population forecast carried out by the Federal Statistical Office, which assumes a net immigration of 200 000 people from the year 2020 onwards. It also assumes a higher life expectancy and more or less constant birth rates. Demographic change will thus become an inevitable reality in the next 20 years and is something which cannot be fundamentally changed, neither by family policies nor with immigration.

We believe that politics and organisations will face up to the challenges of demographic change so that the existing labour force potential, possibilities for a more highly qualified labour force, as well as the level of potential immigration abroad, will be exhausted. We have embraced BMAS's skills strategy and moreover, we expect organisations to put an increased amount of effort into safeguarding their skilled workforces. Taking the results of our forecast into consideration, we herewith present the necessary measures which need to be taken.

Safeguarding employment for older workers

As a result of pension reform, the employment rate among older people will rise. This will not solely be the result of the legal retirement age, but rather it will be a labour market policy necessity. The emerging lack of employees will prompt organisations and work policies to keep as many older workers in the labour market as possible. In the form of a large-scale programme created to support employment and promote the participation of older workers, organisations and social partners will develop flexible working time schemes for older people, as well as age-appropriate

personnel concepts. Vocational training will be spread out over the whole of a person's career life and money will be invested in vocational training which will cover all skills levels. Businesses will adapt their work organisation to fit in with the change in age structure and they will organise the transfer of knowledge between their older and younger employees. Under these circumstances, older workers will be more highly valued and will thus be more motivated to work for longer. The threat of old-age poverty will also increase their willingness to work for as long as possible. It is even more important for women to extend their employment life as they usually receive a relatively low pension due to breaks over the course of their working life. At the same time, they more often depend on their own income and thus have to save for their own retirement.

These developments could, however, also take a less favourable route. The labour market could have approximately 1.2 million fewer workers available in the year 2030 if the employment rate of older workers only rises by half of what has been predicted. This could happen if organisations and policies offer inadequate incentives to keep older workers in the workforce, if the necessary jobs for older workers are not available or if workers prefer to take early retirement and exit the labour market because it is better than any of the other incentives being offered.

Balance of job and family life

The forecast is based on the assumption that the employment rate among women will reach the same level as in Denmark, Norway or Sweden. This requires that politics and organisations change their course of action so that the balance of family life and work life is significantly improved. For example, this could include expanding and improving childcare facilities for all ages, increasing school hours and tuition hours and offering incentives for taking shorter paternity leave. We assume that organisations will work closely with social partners. Together they will strive to make better use of the female employment potential in response to the pressures of the skills shortage. Subsequently, this will lead to an increase in flexible working models for men and women and create more part-time or "short" full time jobs, along with a series of other measures which will help to improve the balance of family life and working life.

If we do not succeed in increasing the employment rate of women under 40 years old so that it is level with that of our northern European neighbours, the number of employed persons will fall even further by half a million. The decline between 2010 and 2030 would therefore amount to 3.36 million instead of 2.87 million. That would mean that the drop in the labour force would be almost a fifth higher than what we have predicted in our forecast.

Longer working hours

According to our estimations, the average annual working hours per employed person will rise by 4 % by the year 2030, whereas it fell by 8 % between 1995 and 2010. We believe that this will above all be possible with longer working hours in part-time

employment. Thus, we assume that the scope for marginal employment will decrease and that the working hours of part-time employees who work on a regular part-time basis will increase, so that the average working hours of part-time employees will rise by a sixth. This would mean an increase of 2.8 hours for an average 20-hour week job. This way, the decline in labour supply can be offset by 1.4 million part-time workers or 0.7 million full time workers.

Activation

We presume that the labour market reforms of 2005 concerning benefits will not be reversed. This means that unemployment will continue to be a considerable financial risk for the workforce. Thanks to the demographic effects, the targeted use of instruments in labour market policies (especially with regard to training measures), a more highly qualified population and the ever decreasing number of young people who do not have any qualifications, it may be possible to successfully bring a significant number of unemployed persons into employment during the forecast timeframe. In our forecast model, the number of unemployed persons will thus fall from 3.1 million in 2010 to 1.7 million in the year 2030.

Opportunities from vocational training

The lack of skilled workers will lead to increased investment in human capital. Thus, the structure of labour supply will fit demand better. The overall qualification structure will thus be determined by a chimney effect, wherein at the upper end there is a strong demand for tertiary education graduates and all the other levels are pulled upwards. The population is aware that the only way to get a secure job with a higher salary and less stress is by having a good educational background. This would increase participation in formal vocational training and would reduce the proportion of the unskilled workforce. On the other hand, we presume that politics and organisations will embrace extensive measures in order to increase participation in vocational training and to reduce the proportion of the workforce who do not have any formal training at all.

On considering this, the influx of employees who completed tertiary education will further increase. Due to a decline of the younger population, however, this will happen at a significantly slower pace. The proportion of tertiary education graduates among employed persons will rise from 17 % in 2010 to 26 % in 2030.

These higher qualifications will not be at the expense of those who completed the dual training system. Nevertheless, demographics will cause the number of people with dual training to fall. Dual training will maintain its relative importance if it manages to integrate more youths from educationally disadvantaged backgrounds into the dual training system. This predominantly means that far more young people with immigration backgrounds will be involved in the labour force.

This is the only way to successfully achieve a considerable reduction in the proportion of the labour force without formal qualifications, namely from 22 % in 2010 to

14 % in the year 2030. This would be in contrast to the past when this proportion remained constant over a long period of time. If, however – contrary to our assumptions – it is not possible to significantly reduce the proportion of people with a low skills level, but nevertheless manage to increase the proportion of highly skilled workers, the unemployment rate would be higher and it would give rise to severe labour shortages in the intermediate skills level.

Lifelong learning will become the most important source of education

In view of the ageing population, the supply of highly skilled workers will only succeed if Germany develops a continuing training scheme with a certified system that has national standards across the whole country. This appears to be all the more urgent as a major part of adjustments in the labour market is due to approximately 2 million people changing occupational careers over the year. Considering the declining working population and the fact that the workforce is aging, it is crucial that this dynamic and flexibility are maintained. We hope that the government will play an active part in this and that the cursory character of continuing training which has been in force until now will be transformed into a solid and clearly structured system with training standards for lifelong learning. This involves updating the knowledge of university graduates as well as supplementing the now highly specialised courses with associated fields of knowledge. It will be the key task of tertiary education institutions to develop appropriate offers. This includes promoting career development by offering suitable courses to graduates from dual vocational training. Modularised systems appear to be most appropriate for increasing participation in lifelong learning. Last but not least, government funding for lifelong learning is also a crucial factor, especially since there will be savings from initial vocational training due to the declining number of children. Increased participation in continued training will not succeed if employees and organisations have to cover all of the direct and indirect costs of the training themselves.

Risk of insufficient training investments

If, contrary to our assumptions, the trend of highly skilled workers does not come into force and the number of graduates from vocational training programmes in all sectors stays constant, the number of graduates from tertiary education will fall by 30 % per year between 2010 and 2030 instead of our estimated 10 %. This may happen because the catch-up effect from the education reform is exhausted, there is no increase in the number of people who completed their school education, the stronger integration of youths from underprivileged backgrounds is not successful or vocational training cannot be developed any further. In return, the fall in the number of people who completed dual vocational training would not be as high – only 20 % instead of 30 %. Yet the number of young people without any vocational training would be 21 % higher than what is stated in the results of our model. This would not only lead to higher unemployment, but would also restrict growth potential of the already strained labour market from being exhausted. We expect that such an unfavourable development would have negative effects on the structural transition of the

German economy towards knowledge-based services, and would encumber productivity of the overall economy and the competitiveness of organisations.

Integration and qualified immigration

In our view, the lack of skilled workers will lead to immigration policies being developed further so that from the year 2020 net immigration will be 200 000 people per year. Most importantly, the rise of highly skilled immigration workers will continue as it has done in the past. If immigration policies make it easier for qualified and highly skilled workers to enter the German labour market, the employment rate among immigrants will rise. As immigration rates are likely to be strongly determined by employers' demands, there will be a more accurate selection procedure from the start which takes the immigrants' occupations into account. This will mean that the gulf between formal qualifications and actual occupational tasks, which has been very distinct until now, will gradually diminish.

Regarding the applicability of qualifications, the forecast assumes substantial and sustainable changes in both education policy and employers' behaviour. This includes the implementation of the law of recognition (*Anerkennungsgesetz*), in-depth consultations with new immigrants, improved validation of foreign degrees and a higher participation rate of immigrants in adaptive vocational training.

If it is not possible to realise the supposed net immigration and the migration balance remains zero over the forecast period, the working age population would be 3.3 million lower and labour supply would fall by around 2.5 million. Politics has the great challenge of setting suitable regulations and conditions in place so that employable immigrant workers are able to use their skills and competencies in the German labour market. Policy actors and labour administration can make a large contribution in this matter by reducing prejudices and helping employers to enhance their knowledge on the specific experiences and competencies of foreign workers. If this is not successfully implemented, unemployment will rise and the supply of highly skilled workers will fall. Thus, the shortages on the supply side of the labour market would intensify.

Effect of the German skills strategy on labour market participation and working hours

The present forecast assumes that the trend of a rising participation rate together with the changes set out above will continue. According to the national accounts concepts[2] which we have used, the overall participation rate will rise from 82.8 % in 2010 to 85.0 % in 2030. The participation rate among women will rise by four percentage points to 81.5 % and among men it will rise by 0.5 percentage points to 88.5 %.

2 In National Accounts the labour force comprises all employed and unemployed persons including marginally employed persons. This group is not more than partially represented in the Labour Force Survey and thus requires additional estimates. The participation rates according to the NA concept are therefore higher.

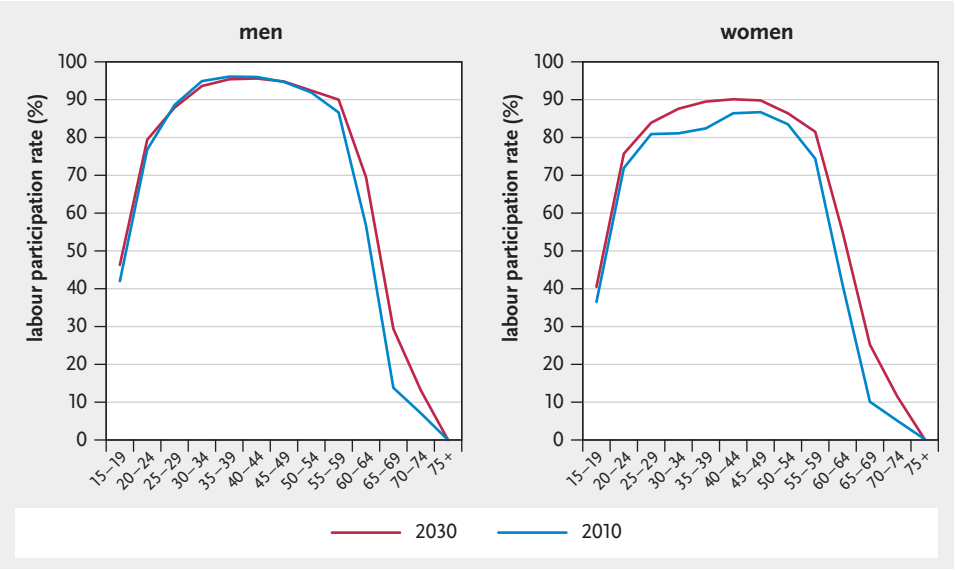

Figure 2 Participation rate according to age and gender according to VGR-definition

Source: Economix

We assume that the participation rate among older men and women will significantly increase (Figure 2). Thus, the participation rate of 60–64 year old men will rise by 12.8 percentage points to 69.5 % by the year 2030 and for women in this age group it will rise by 13 percentage points to 55 %. Labour market participation will rise in much the same way among workers who are older than this. Among younger people, it will almost exclusively be women who contribute to the expansion of labour supply. In the age group of 30 to 40 year olds, participation rates will rise by approximately 7 percentage points to almost 90 %. While childcare facilities are being expanded, falling participation rates among women with young children, which has become the norm over several decades, will disappear by the year 2030, but the quota will still remain lower than for men. The male participation rate for this phase will be slightly lower.

A rising participation rate is of major significance for the development of labour supply. Labour supply will decline by a further 1.7 million if the higher rate among women under 40 does not come about, if the rise in the participation rate among older men and women is only half of what we have calculated and if higher participation among immigrants does not occur. This means that there will be a total loss of 4.4 million by the year 2030 which will have noticeable effects on economic growth due to the lack of skilled labour. According to our calculations, economic growth will slow down by 0.2 percentage points to 1.3 % per year.

Working hours for women who work part-time will also have a similar effect on economic growth: if working hours are not successfully increased as we have assumed they will be, economic growth will be 0.1 percentage points lower. Conversely, the rise in employment and the extension of working hours for part-time workers will result in a growth of 0.3 percentage points. In view of the already slow growth, this effect would not be insignificant.

Demand for workers

Supply restrictions determine growth

Even by implementing a proactive policy, the growth potential of the German economy over the next 20 years will increasingly be determined by labour shortages. The shrinking population will continue to have a lack of suitably skilled staff, as can already be seen today. Organisations will react to labour shortages and – despite a considerable increase in productivity – they will not be able to fully realise their expansion plans. They will import services and primary products and/or outsource abroad where the workers they need can be found. Under these conditions, domestic growth will be determined by the growth in labour productivity, and organisations will do everything they can to, at least partly, compensate for the falling number of available workers. As a consequence of these alternatives that organisations will revert to, labour shortage is not fully measureable as a gap. Rather, it is expressed as missed opportunities for growth.

Based on the strength of today's German economy, we estimate that GDP growth will be comparatively high but will then ease off because of labour shortages. We have calculated an average of 1.5 % real GDP growth per year until the year 2030. Productivity growth will be approximately 1.7 % per year. However, demographic decline will mean that real income per capita will increase by 1.9 % per year. The prosperity of the population is not jeopardised in any way, although it will take a lot to increase productivity.

As described above, the decline in economic growth may be much more extreme if it is not possible to limit labour shortages and if labour productivity is not successfully increased. It would also be more extreme if the economy were not restructured into a knowledge-based economy. Finally, we have also assumed in our forecast that the risks of the euro crisis, risks of intensifying conflicts in the Middle East, risks of climate change and other currently unknown crises will be able to be kept under control. Understanding the need for multilateral compromises will – hopefully – keep national interests within limits and ensure that major crises can be avoided.

Structural change – from a service economy into a knowledge-based economy

Germany will evolve into a service economy. In the business services sector alone, we calculate that 750 000 jobs will be created by the year 2030. As a result of this,

jobs will be created in the financial services sector and the social services sector (education, healthcare and social affairs). However, there will be a significant loss of jobs in the manufacturing sector, trade and transport sector and in the public administration sector. The manufacturing sector alone will cut back on 770 000 jobs, the trade and transport sector will cut 610 000 jobs and the public administration sector will cut 460 000 jobs. The construction industry, energy, water and recycling and agriculture will not generate many new jobs.

There are numerous reasons for these structural shifts in employment:

- The growing success of China and India in the high technology industries will force German industry to further reduce domestic production capacity and, at the same time, expedite specialisation in technical services. This will substantially contribute to stronger employment growth in the business services sector.
- At the same time, industrial companies will secure their leading role in the global value chains with financial investments abroad. The German economy will become an investor rather than a producer and will thus follow USA and Great Britain down the route of de-industrialisation. In parallel, growing personal assets will call for competent financial services and both of these are likely to lead to a rebound in the financial business.
- Information technology will boost its rationalization effects. There will be advancements in digitalising information, networking will grow and the automation of processing information will increase. This will have an impact on sectors with large administrative departments, and especially on commerce, publishing and the media sector. The production effects of information technology will, however, arise in other parts of the world.
- The growing importance for environmental protection will limit jobs in the energy sector. Rising energy prices will set further incentives to improve energy efficiency. Positive employment effects will be visible in construction, agriculture and electrical engineering.
- The shrinking population will have a negative impact on a range of economic activities, for example the building and housing sector, education and other public sectors. On the other hand, the ageing population and the development of childcare facilities will contribute to the expansion of welfare and healthcare services. We assume that the population will politically assert their strong interest for state financed personal services and thus, the negative employment effect of depopulation will partly be compensated for in these areas.

Germany's comparative advantage is seen as increasingly being in knowledge-based services. Human capital is the resource of the future, which does not only promise success in international markets but also triggers the strongest development effects in domestic markets. The structural change that we are counting on is therefore strongly linked to human capital investments by all stakeholders, the state, businesses and the population. This therefore needs to be the central point of the structural policy. In contrast, personal and social services will remain expensive and will need

to be financed by governmental redistribution if broad segments of the population are to be serviced.

Structural change by occupations

Sectoral restructuring will be a heavy burden for employees who work in manufacturing jobs as well as for those in administrative and office jobs. In manufacturing occupations, employment will fall by approximately one million and in administrative and office jobs it will fall by 800 000. In comparison, the number of managers and senior officials will rise by 170 000. This seems to be typical for technical and organisational advancement, which tends to save on low-skilled labour while favouring more complex tasks.

The decline in manufacturing jobs in a situation of general labour shortage means that in these occupational segments business will see the biggest opportunities to economise on workers. Further automation in industrial production and increased use of information and communication technology will form the foundation for this. Production and services will be outsourced abroad more and more. Administrative and office jobs will not escape. Furthermore, this process will be strengthened by rising imports of high quality industrial goods and services. Yet the number of technical jobs will increase. The globalisation link can also be seen here, whereby technical services become the most important product in the industry. The volume of trading goods will increase as part of globalisation (but also as a result of growing e-commerce) and this will require more people to be employed in transport jobs. Finally, the number of salesmen in various fields (trade, transport, finance etc.) will also increase.

In the education sector and the social sector, we estimate that the number of employees will fall by 80 000. This will only negatively affect teachers (-180 000), whereas the number of employed workers in social care and welfare jobs will increase (+120 000) due to a high demand for nursing and care services. For the same reasons, we estimate that there will be a significant increase of 180 000 in healthcare jobs and 110 000 in personal service jobs. The number of creative jobs (artists, journalists) will, in our opinion, increase by 90 000 because art and culture have an ever-increasing importance in growing prosperity.

This upgrading of the overall employment profile will only be possible if the number of workers without a specific occupation, that is, without any particular vocational training, declines. With intensified activity in the so-called transitional system for vocational training, and with the help of advancing professional validation, we assume that the number of workers without a specific occupation can be reduced by 170 000.

The qualification-specific restructuring

We expect that both economic restructuring and the pressure to increase productivity will lead to enhanced qualifications among workers by the year 2030. Employment

of workers with a degree from tertiary training will rise by 3 million, giving a total of 10.4 million (Figure 3), which is a 40 % increase. Also, the number of persons employed with dual vocational training will remain significant and will only marginally drop by 210 000 giving a total of 20.5 million (-1 %). On one hand, redeployment will be achieved by reducing the number of employees with technical college training. In this segment, we expect a decline of 780 000 employees (-19 %). On the other hand, the number of employed persons with no formal training will drop by 3.4 million giving a total of 5 million (-41 %). Training efforts will focus attention on the lower end of the qualification spectrum. This means that increased effort will be put into integrating youths from educationally deprived backgrounds, as well as building on continued training. These are the prerequisites which will enable the economy to transform its skill requirements into effective labour demand.

Lawyers, economists and social scientists will take the majority of additional jobs in tertiary education. 1.3 million of the 3 million newly created tertiary jobs will be allotted to these occupations. Management and finance will be the core competencies of economy-oriented occupations. We also expect a significant increase in employment in the fields of mathematics and natural sciences, while the number of engineers will only increase slightly. This is associated with the growing importance of research and development compared to the production of goods. Furthermore, the demand for humanities and cultural studies experts will rise, as will the number of physicians.

Technical college graduates will, in our opinion, increasingly be replaced by bachelor graduates. At the same time, technical jobs will be adapted so that they fit the competence profile of the higher proportion of graduates. Organisations will make use of graduates' theoretical knowledge and the broader spectrum of university training to a greater extent than they have done to date. Due to a competency-based upgrading, a

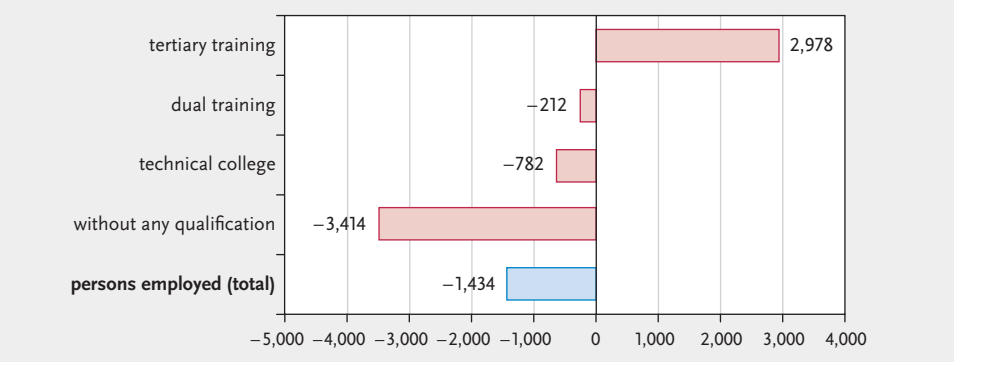

Figure 3 Persons employed by field of vocational training
Changes between 2010–2030 (in 1000s)

Source: Economix

proportion of workers from the dual training system will also be affected in that they will need to carry out more complex and demanding tasks.

The dual training system

Among the employees who completed the dual training programme, there will be a considerable increase in demand for employees who have been trained in healthcare and social care. Furthermore, we expect a growing demand for trained staff in the fields of body care, guest relation, domestic and cleaning jobs. Contrary to this, there will be a sharp decline in demand for trained staff in organisation, administration and office jobs. In comparison, there will not be much change in the number of employees who were trained for manufacturing jobs. However, we anticipate a significant upgrade regarding the range of training offered and the tasks executed in these occupations.

It is vital to develop the dual training system further in three directions:

- In order to cover the need for skilled workers, it will be necessary to make the dual training programme more widely accessible for youths who have an immigration background. Dual training needs to be suitably adapted to fit the educational backgrounds of these groups of people.
- There needs to be more permeability in the vocational training system in order to achieve the desired chimney effect. Currently, for the majority of people with dual vocational training, it is a dead end that only a few people manage to find their way out of. It is important to have a better comparison of training programmes and to be able to more easily transfer skills to other occupations and to higher education.
- The lower inflow of young people has to be compensated by adults participating in vocational training. In particular, people without any vocational training need to be won over and convinced that they should complete the dual training programme. Therefore, a dual training programme for adults needs to be created.

This means that the dual training programme has to stop focusing on initial training and needs to be developed into a modular system, whereby adults can develop their skills further. Successful examples for this can be found in the Netherlands and in Australia.

Replacement demand

The fall in the employment rate does not mean that there will be no labour demand. Taking demand into consideration, for those who switch to non-employment or change their occupation, we estimate that every year around 7 million workers will be needed to replace these outflows. Regarding employed workers, we estimate that every year 14.6 % of workers will leave their job and will be replaced.

The long-term, demographically induced replacement demand will lead to a permanent withdrawal of 1.2 million workers a year. That is the equivalent of 2.9 % of persons employed. Even with declining employment, the overall annual demand for

miners, building material manufacturers, as well as occupations in the building industry will be particularly high. In general, we expect a relatively high overall demand in the manufacturing sector (3.1 % of employment), whereas in service occupations it will be somewhat lower (2.6 %).

Labour market performance and the shortage of skilled workers

Overall economy

The implementation of the German skills strategy by companies and political organisations will mean that the number of persons employed will not fall as sharply as labour supply. Under these circumstances, the unemployment rate will fall from 5.3 % in 2012 to 4.2 % in the year 2030 (Figure 4).

Nevertheless, we do not foresee any return to a situation of full employment, as Germany experienced in the 1960s. The skills gaps between supply and demand will remain too large, companies' requirements will change too quickly with regard to employees' performance and commitment and it will be too easy to outsource abroad. The German labour market will be increasingly interconnected with the global economy, meaning that the balance of supply and demand in the labour market will be even less secure than it has been until now.

Shortage of skilled workers

In our forecast, we expect that over the forecast period the economy will not be able to escape the prevailing labour shortages. This runs the risk that, by the year 2030, the economy will have adjusted to the shortage of workers, its labour demand will have been reduced and a possible sub-optimal equilibrium will have been established. This is the core of our labour market forecast, which results in the decline of overall employment by 1.4 million by the year 2030.

Alternative calculations which rely on a slower adjustment of labour supply would show: without adjusting the demand structure, almost 2 million workers who are tertiary education graduates would be missing; and, in contrast, there would be a surplus of 2.2 million workers who did not participate in any vocational training. In particular, we expect that with a delayed adjustment there will be labour shortages in the fields of medicine, law, economics, social sciences, as well as in mathematics and natural science. In addition, there will be too few people who completed the dual training programme in the fields of nursing and healthcare.

A corresponding picture can also be seen in the calculation of the virtual shortage of skilled workers by occupations, which shows, over a five-year period, the difference between a hypothetical supply structure which is kept constant and the results of our model projections (Figure 5). A constant surplus of skilled workers in the manufac-

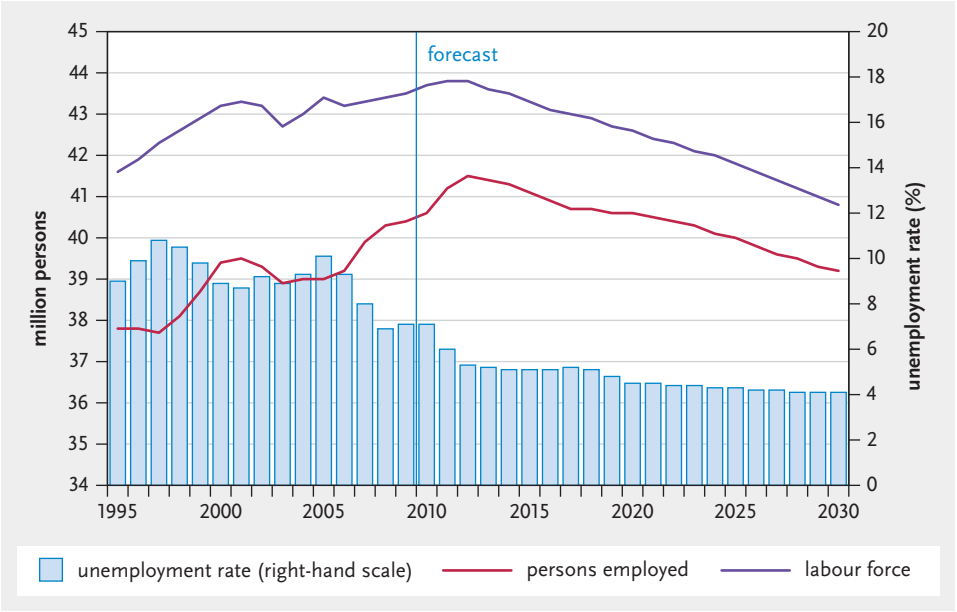

Figure 4 Overall development of the German labour market

Sources: Federal Statistical Office (NA, population forecast), Economix

turing sector would, under the set assumptions, mean a shortage in technical occupations, scientists, managers/senior officials, salesmen and commercial and financial professionals, as well as in health occupations.

Our calculations show that shortages will arise, particularly at the tertiary education level. This is because of the strong demand for workers with a tertiary education who, despite an increase in vocational training participation, do not entirely fulfil the requirements. All fields of specialisation are affected to a different extent. However, we do not see any general bottlenecks at the intermediate skills level, neither for workers with dual vocational training nor for workers with specialised technical training. Bottlenecks are most likely to arise in this segment in occupations where almost all of the workers are from the dual training system and are highly specialised in a certain area. This usually consists of jobs in the manufacturing sector. Despite restrictions in labour supply, the bottlenecks are much less pronounced than for workers with a tertiary education degree because as supply declines, so does demand. There will be considerable surpluses in segments where workers do not have any formal training. In the future, the influx in this segment will significantly exceed demand. This potential should be realised.

It can therefore be concluded that it is particularly important to have sufficient flexibility in the labour market. Admittedly, in view of the specialised fields of vocational training, certain shortages and surpluses can be seen in parts of the labour market. These are reduced if the vocational integration of workers is taken into account. This

shows that the labour market possesses a high ability to adapt, which is what we expect for the future.

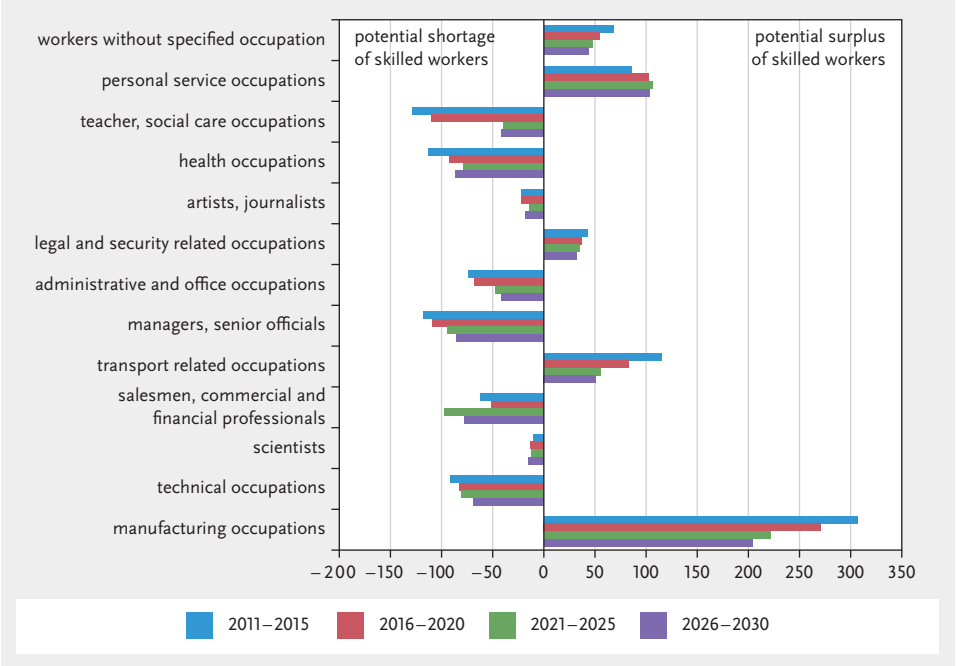

Figure 5 Skills shortages with a steady state supply structure
Annual balance between potential and actual workers by occupation (in 1000s)

Source: Economix

Conclusions and recommendations

In view of the demographic challenge, Germany faces important political and social reforms. These include the need for:

- A labour market policy which fully exploits the existing potential to expand labour supply. This includes taking measures to find a better balance between career and family life, as well as a sustainable personnel policy. The main focus of labour market policy will shift from activating the workforce to the integration capacity of the labour market. This involves considering areas of life outside of working life, further flexibility involving working hours, maintaining and raising performance among ageing employees and improving the transparency of the labour market. We also urge organisations to pursue a sustainable personnel policy in which the ability to learn and adapt is increased among ageing employees. Our suggestion is to set up assessment centres where the occupa-

tional competencies of native and foreign employees without completed formal training are validated.

- An education policy which supplies the required competencies, even with the shrinking population. The crucial step is to transform the initial vocational training system into a lifelong learning system which provides general and widely recognized certificates. This includes having clear validation rules for the majority of courses and a modular training system which takes the training participants' needs for flexibility into account. We suggest updating older university degrees as well as supplementing the now highly specialised courses of study with related fields. We believe that it is predominantly the state's responsibility to set the structure and rules of such a training system and that it is up to the universities, technical colleges and private training institutions to suitably prepare people for the labour market. In view of the variety of competencies in the education and training system, we suggest using an open method of coordination, whereby regional governments set mandatory targets. Another core aspect is to improve school and vocational integration for people who are socio-economically disadvantaged and who are from educationally deprived backgrounds in order to reduce the danger of a surplus of people with low qualifications.
- A structural policy which is able to use the – by international comparison – good human capital endowment in Germany in the context of changing global trends. This does not only include research and innovation but also increases sustainability and further develops the German social model. The orientation of business models towards long-term targets and social balancing were factors which protected Germany during the economic and financial crisis and which will also contribute to growth in the future.

Blueprint of the forecasting model

Come writers and critics
Who prophesize with your pen
And keep your eyes wide
The chance won't come again
And don't speak too soon
For the wheel's still in spin
And there's no tellin' who
That it's namin'
For the loser now
Will be later to win
For the times they are a-changin'

(Bob Dylan, 1964)

It was not only the financial and economic crisis which created great uncertainty in future developments. In addition to the insecure outcome of the euro crisis, further risks arise from the conflicts in the Middle East, political and economic effects of climate change and the unresolved issues regarding demographic change. Despite – or maybe even because of – the wide range of future pathways which arise in these areas, long-term orientation is important. It is worth further developing the debate on the possible developments of a long-term forecast and to align political action.

With this in mind, the German Ministry for Labour and Social Affairs commissioned Economix the project of "Analysing the future labour demand and supply based on a calculation model". The purpose was "...to be able to submit regular and transparent, detailed and scientifically founded expectations regarding the future development of the labour market's demand and supply in Germany" (German Ministry for Labour and Social Affairs 2011). This meant developing a forecasting model which could be used as an early warning system so that possible bottlenecks could be assessed and suitable measures could be put in place in order to safeguard workforces.

In view of the strong turbulence caused by the financial and economic crisis, it was clear that the simple use of models based on the past would not give accurate or reliable estimations of future trends. There was the danger that the econometric esti-

mates would be fundamentally influenced by the early phases of the crisis, but that the reaction phase would not be sufficiently included, particularly because this stage is currently in full swing. It was therefore necessary to first reflect on the future structural breaks following the crisis rather than focussing on the statistical significance of equations based on the past.

Our methodical answer to this problem was to develop long-term scenarios for the German economy and the German labour market, in which possible changes in the economic environment and policy responses were discussed and combined to produce an overall picture of different trends. In this project, the scenarios developed describe the possible behaviour of labour market actors and political institutions in their mutual dependence and in the setting of an international economy. They rely more on logical interaction in an interdependent system than on empirical data from the past. These scenarios were put together by specialists to form a separate report (Düll 2013a) and were the reference points used to operate the econometric models. The models themselves are vital in order to transform the scenario hypotheses into statistical figures and to achieve a consistent overall result. It was therefore the combination of qualitative and quantitative procedures which enabled us to develop the forecasting models and the results which are presented in this report.

However, an answer also had to be found for a second challenge, which became very evident as a result of the crisis. The crisis showed that the future is something that cannot be predicted, at least not in the sense, as far as we know, of precisely how the world will look in the year 2030. It is quite possible that the efforts to save the euro will fail and that the European economy will crash into a long recession. The possibility that conflicts in the Middle East will escalate also cannot be excluded, and that the world will, once again, be divided into two. It is also not unlikely that climate change will advance more rapidly than the government currently is willing to believe. We are aware that all of these are possible but are nevertheless convinced that these problems will successfully be kept under control. The reason for our optimism is not only attributed to societies' existential interests, but also to the awareness of global dependence. We rate the pressure of making multilateral compromises much higher than the advantages of single action, by whatever means. We therefore expect that nations around the globe for their own interests will not stop seeking mutual solutions together with other countries.

This is the starting point of our forecast model, which we have intentionally made a strategic forecast rather than a prediction. That is to say, the importance does not lie in describing all possible developments and aberrations as realistically as possible. Rather, we have asked the question of where we want the German economy and the German labour market to be in the year 2030. This includes the question of what we can achieve with our resources and what kind of developmental opportunities other countries will give us. The question of what is possible and what is likely has been amended by considering the appropriate strategy. We believe that the future is both

accessible and mouldable. Therefore, our priority was to provide strategic answers for the challenges instead of posing fateful questions in a deterministic system.

The project has been arranged in three methodical phases:

- *Phase 1 – Forming hypotheses:* This served to recognise the important trends of global competitiveness, trends in technology and work organisation, demographic change, immigration and the training system and to discuss possible pathways for the future. Specialists were appointed to focus on seven topics and their findings were used to form long-term scenarios for the German labour market.
- *Phase 2 – Model-based forecast:* Based on the scenarios, quantitative forecasts were generated regarding supply and demand in the German labour market. This was based on quantitative models which were developed by Cambridge Econometrics (CE), the Warwick Institute for Employment Research (IER) and the Research Centre for Education and the Labour Market (ROA). They considered the changes which are deemed likely by adjusting the models and they calculated the amount of supply and demand in a detailed sectoral, occupational and skills-based structure.
- *Phase 3 – Qualitative Analysis of the demand for skilled workers:* Using the model-assisted estimations and the relationships identified in the scenarios, the expected changes for the future are shown here with regard to the demand for and supply of skilled workers. The strategic answers thereto are discussed.

In this report, we have presented the results of our model calculations and analysed the demand for skilled labour. They depend on a differentiated model system, which was initially developed for forecasting the demand of skilled labour in EU countries (Cedefop 2008) and has been adapted to the features of the German labour market. Furthermore, a flow model has been developed to show labour inflows and labour outflows and to identify the demand for skilled labour and any potential bottlenecks in the labour market. The process is illustrated in Figure 0-1. All models have been annotated in a separate method description (Kriechel, Vogler-Ludwig 2013).

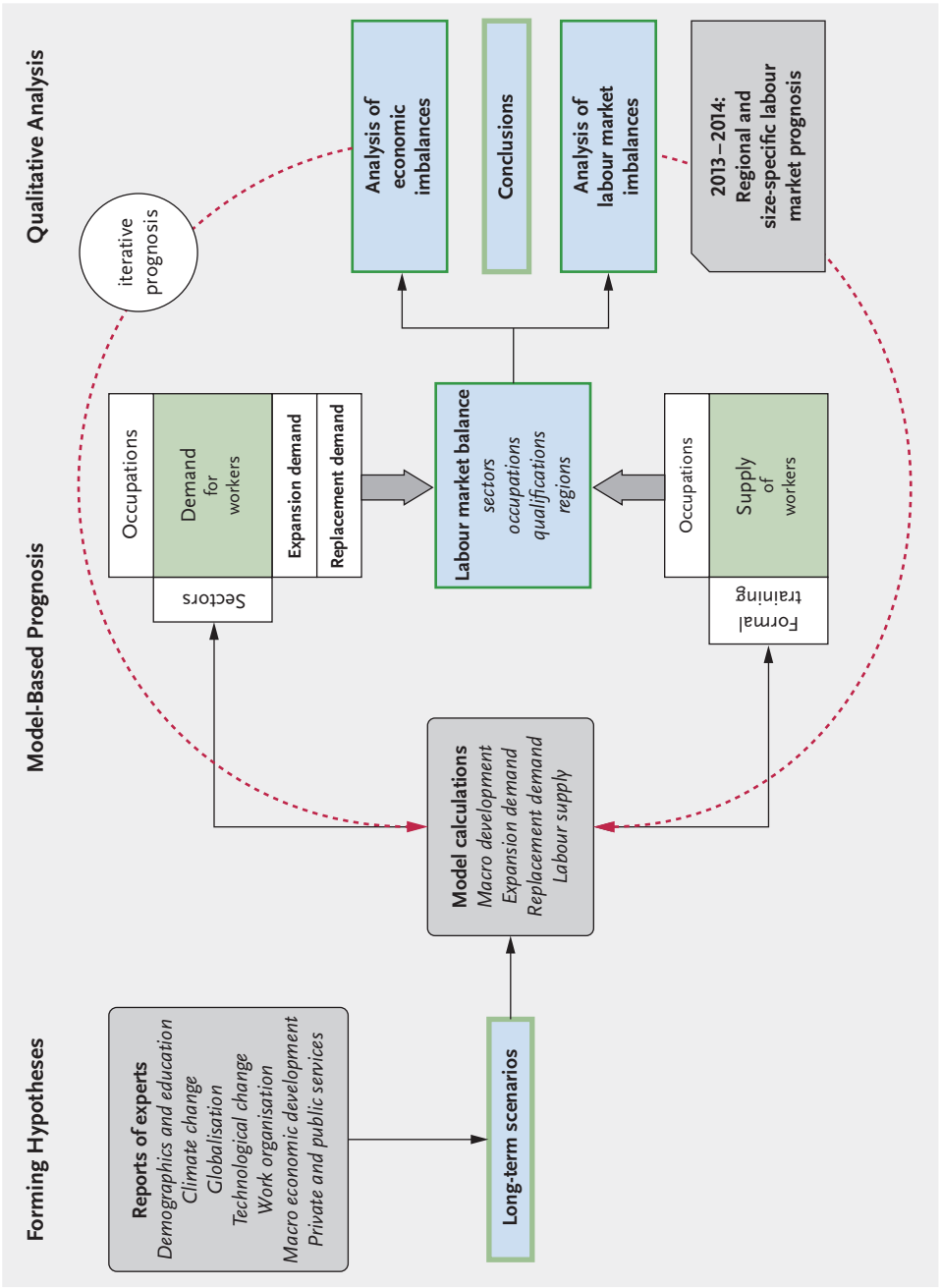

Figure 0-1 Model structure

Source: Economix

The quantitative forecasting model consists of four modules:

- *G3M:* A structured sectoral model which simultaneously estimates supply and demand in the German labour market. On the demand side of the labour market, it distinguishes 44 sectors of the economy[3] which are entwined together in an input-output matrix. Foreign trade, consumer demand and government demand are assessed in detailed segments. Labour supply relies on the 12th coordinated population forecast from the Federal Statistical Office (Variant 1-W2) and the separate forecast of male and female employment behaviour.
- *EMod:* The model for occupational-specific and qualification-specific demand for workers. It estimates the changes in the occupational composition of employees in 44 sectors of the economy and in 88 occupations.[4] The expected changes in work organisation are relevant, but so is shifting employment due to intra-sectoral structural change. Where appropriate, the forecast relies on time series analyses of the vocational structural change. Furthermore, changes in technology and work organisation were also included from our specialists' results. In addition to the occupations, 27 skill groups from vocational training[5] are distinguished. The vocational integration of workers is depicted in the matrix of occupations and qualifications, thereby building an important bridge between labour demand and labour supply.
- *RMod:* The model for replacement demand, which forecasts the long-term replacement of workers by occupation and qualification, and which is primarily determined by demographics. Together with the results from EMod – the so-called expansion demand – RMod generates the long-term overall demand for workers. The model relies on data from occupational structures, gender and age structures in employment. It estimates the replacement demand on the basis of a cohort model, which refers to the typical occupational progression of an age cohort.
- *SMod:* The flow model of the labour market which, in addition to the long-term demand for replacement and expansion, forecasts the short-term labour inflow and labour outflow over the course of a year and thus measures bottlenecks and labour surpluses according to occupations and qualifications. The model relies on a transition matrix of people who are employed, unemployed and non-employed. It is derived from the inflows from the training system and takes into account the effect of external migration. The estimations distinguish between occupations and qualifications and are consistent with the estimations of the preceding modules.

The data for the model calculation comes from the national accounts, the *"Mikrozensus"* (Labour Force Survey for Germany), the employment statistics from the German Federal Employment Agency and the Job Vacancy Survey. We would like to

3 See Annex, Table 3.3

4 See Annex, Table 3.1

5 See Annex, Table 3.5

thank the Federal Statistical Office and the German Federal Employment Agency for their cooperation and constructive input in retrieving this data for us.

This project was created by a team consisting of 12 researchers:

Kurt Vogler-Ludwig (Economix, project coordinator)
Nicola Düll (Economix, expert report coordinator)
Tim Vetter (Economix)
Rob Wilson (IER, model coordinator)
Peter Millar (IER, EMod)
Luke Bosworth (IER, EMod)
Hector Pollitt (CE, coordinator)
Katy Long (CE, G3M)
Ben Kriechel (ROA, RMod)
Pamela Meil (ISF, specialist)
Bernd Dworschak (IAO, specialist)
Helmut Zaiser (IAO, specialist)

The team had four separate meetings together. A workshop was held on 23rd and 24th April 2012 so that the specialists could discuss the scenarios with the client. The authors of this project would like to thank the whole team for their dedicated work and for completing their allocated sections in a timely manner.

The plan for this project in 2013 was to prepare a regional forecast for the labour market in the 16 federal states of Germany and to anticipate the labour market in large, small and medium-sized enterprises. 2014 will see an update of the forecast, whereby also the results of the census and the re-classification of occupations from 2010 will be available. A further, optional update of the forecast is planned for 2016.

In addition to this, we see the need for further methodological developments, especially regarding an in-depth analysis of the sectoral transitions in employment. Sector-specific analyses regarding technological development, international competitiveness and organisations' training policy requirements would be useful to help identify fundamental structural changes at an early stage. On the supply side, studies in the change of educational behaviour and employment behaviour may further support the model calculation. Finally, better statistical support of the transition matrices would be useful. Expanding the research programme to cover these topics would be greatly appreciated.

For a better understanding, it may be useful to explain certain fundamental terms which have been used in this report:

- The number of *persons employed* includes all workers in a job as measured in the national accounts. Thus, it also encompasses self-employed workers and part-time employees, neither of which is fully included in the *"Mikrozensus"* figures. With corresponding estimates, we have broadened the *"Mikrozensus"* statistics. The number of persons employed is identical to labour demand (stocks definition).

- *Labour supply (stocks definition):* This is identical to the labour force, which consists of all persons employed and unemployed. *Unemployment* does not only cover people who are registered as unemployed according to the German Federal Employment Agency's statistics, but also includes the unemployed population according to the ILO concept and the definition of the national accounts. We do not have any hidden reserves in our estimations, as it is practically zero in the long-term. We have used the terms *supply on the labour market* and *demand on the labour market* as synonyms for labour supply and labour demand.
- *Labour supply (flow calculations):* This means the dynamic labour inflows and outflows. It includes the annual change in occupations over the course of a year, as well as the change of a persons' status between being unemployed, non-employed and employed. This also includes people from the vocational training system and immigrants. The net labour inflow and net labour outflow is equivalent to the change in status of the labour force.
- *Overall demand and replacement demand:* Overall labour demand consists of *expansion demand* – the change in the number of persons employed – and *replacement demand*. Replacement demand measures the long-term, predominantly age-related labour outflows among employed persons. Labour outflows over the course of the year have not been taken into consideration. It is possible for overall demand to be negative if positive replacement demand is offset by a sufficiently large negative employment trend.
- The term *economic sector* has been used instead of branch in order to avoid any misunderstandings. It describes the subdivisions of industrial classifications of the economy without any reference to a specific aggregation level.
- *Salary* or *wage* is the average real gross annual income per employee.
- *Vocational training* consists of all levels of training including tertiary institutions. *Dual (vocational) training,* however, is the training according to the German Vocational Training Act and the Trade and Crafts Code. This is carried out in both an organisation and in a vocational school. We have also used the term *apprenticeship* for this.
- *Technical colleges* refer to master schools for crafts professions and other professions at a high intermediate level. Administrative schools and other school-based vocational training are included.

1 The labour market in the year 2030 – demographics and labour supply determine development

1.1 Turnaround in employment

After more than a decade of strong employment growth, the German labour market is at a turning point again: Over the next 20 years, the growth potential of the German labour market will increasingly be determined by labour shortages. The lack of skilled workers will set limitations to employers' expansion plans – limitations which will be difficult to overcome. The ageing population will cause labour supply to fall significantly more than the population itself and the shrinking labour force will finally force a decline in the number of employed persons. We estimate that the employment figure will be 39.2 million in the year 2030, which is 1.4 million lower than in 2010 (Table 1-1, Figure 1-1).

Table 1-1 German labour market development

	1995–2010	2010–2030	2010–2015	2015–2020	2020–2025	2025–2030
	change in 1000					
Population	-60	-2731	-712	-612	-561	-846
Labour force	2152	-2866	-424	-727	-775	-940
Persons employed	2801	-1434	477	-452	-652	-806
Unemployed	-649	-1432	-901	-275	-123	-134
Unemployment rate (%)	9.0	4.8	5.6	5.0	4.4	4.2
	Average annual change (%)					
Real gross domestic product	1.2	1.5	2.0	1.6	1.3	1.3
Real annual gross income per employee	1.4	1.7	2.1	2.0	1.5	1.3
Productivity per person employed	1.5	1.9	2.1	2.0	1.7	1.7

Sources: Economix, CE, IER

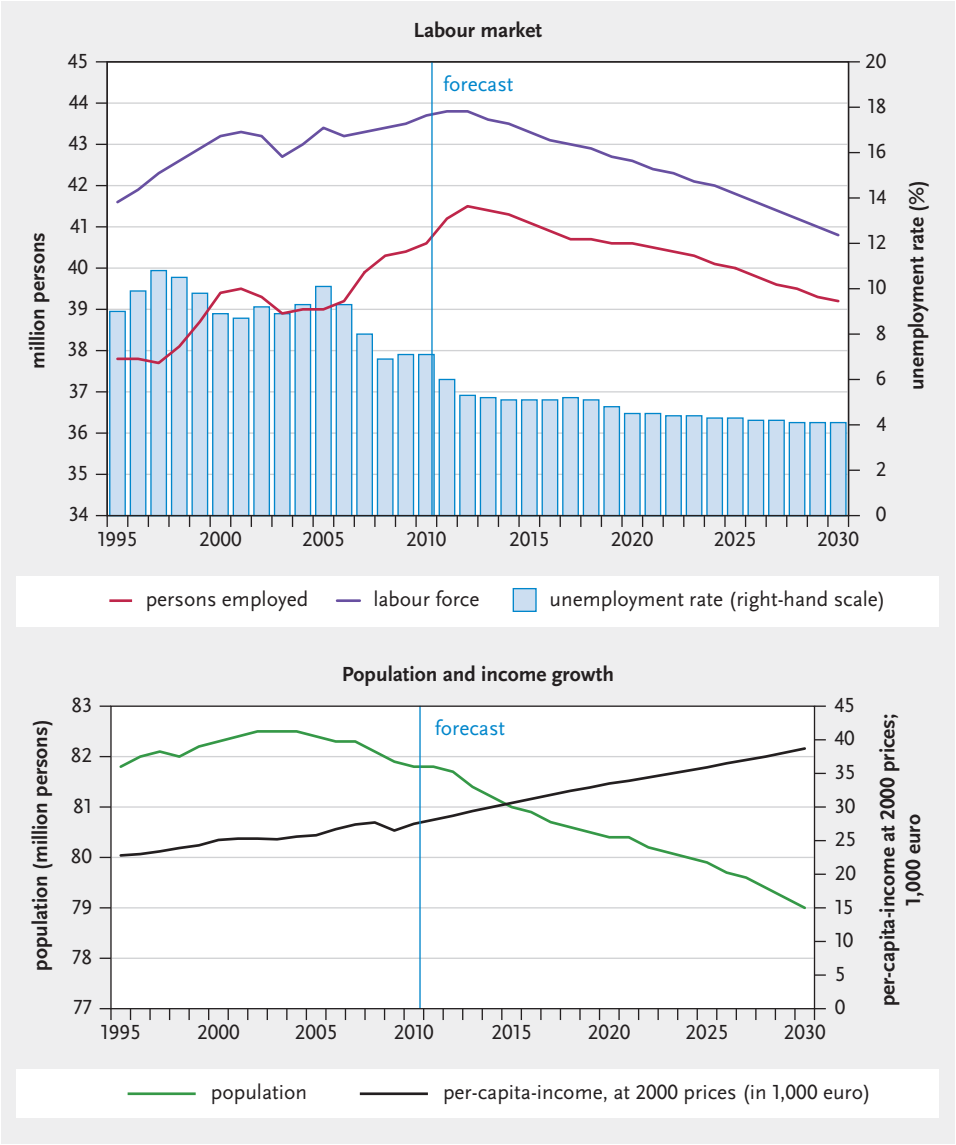

Figure 1-1 German labour market development

Sources: Federal Statistical Office (National Accounts, Population Forecast), Economix

However, the times of high unemployment are also gone. Our calculations show that, on average, there will not be more than 1.7 million unemployed persons from 2025 to 2030 and that the unemployment rate will fall to 4.2 %. Nevertheless, we will never again achieve the low unemployment rate of the 1960s. This is because the qualification profiles of labour supply and labour demand are too diverse, the ob-

stacles to raise the qualification level of those who are educationally disadvantaged are too high, and organisations are too demanding when it comes to labour requirements. Therefore structural unemployment will not be completely eliminated.

This does not mean that the German economy will not grow. On the contrary, there will be relatively high growth of 1.5 % per year on average between 2010 and 2030 and there will be particularly strong growth in the current phase between 2010 and 2015. As time passes, however, negative demographic effects will prevail and growth will slow down.

With declining employment, this growth will predominantly be driven by a rise in productivity. This means that demands on employees regarding performance, ability and motivation will increase further, and labour intensity will grow. Many future applicants will intensify their efforts in training programmes so that they can meet these growing requirements.

At the same time, organisations will be in strong competition with each other to attract the best. This will be the result of a quantitatively insufficient labour supply as well as organisations' increasing dependency on a skilled workforce. Business strategies will be geared more than ever towards technological and scientific competitiveness, where they will only be able to survive if they have a highly qualified and skilled workforce. It is out of the question that German businesses will lower their performance expectations, as the market segments which offer simpler products and services are occupied by competitors with significantly lower costs. The response to labour shortages will therefore most likely be to outsource production and services to countries which have lower labour costs.

The labour deficit will be linked to a rise in the annual real gross income, which, at 1.7 %, will be slightly higher than the average growth of real production. However, income growth will not be fully reflected in wage increases given real world conditions. On one hand, this is attributed to the internationalisation of labour markets. The global supply of labour is too large for workers to be able to fundamentally improve their position in the wage bargaining process. On the other hand, it is a result of the structural change towards the service sector with an increasing proportion of self-employed persons. The wage share will thus decline in the long-term. The average income per capita will rise by 1.9 % per year and in 2030 it will be 40 % above the level of 2010 (Figure 1-1).

Our forecast is based on a variety of measures, which politics may use to tackle the shortage of workers. The employment rate of women and older people will significantly increase. By the year 2030, working hours of full time employees will rise by 0.2 % per year to give an average of 40 hours per week. Furthermore, we anticipate that the Federal Government and the federal states will make considerable efforts to increase training participation among young people, especially among young people with an immigration background. Finally, based on Variant 1-W2 of the 12th coordinated population forecast, we anticipate a net immigration into labour force of 126 000

people per year during the 2010–2030 period. This figure is considerably above the average from previous years, yet it is not unrealistic for the medium to long-term and is actually relatively moderate considering the latest developments regarding the expanded free movement of workers and the effects of the financial crisis. Nevertheless, not even these measures will be enough to prevent the decline in employment and the slowdown in growth. Low birth rates and the ageing population have too much of an effect on labour market activities.

1.2 Slight loss in labour market dynamics

Due to a decline of labour demand and labour supply, the labour market will experience a slight loss in dynamic movement. We expect labour inflow to decrease from 16.5 % to 15.6 % of total labour force. Starting from the same initial value of 16.5 %, labour outflow, however, will only decrease to 16 %. This means that – as shown above – the labour market will progressively lose more workers rather than gain them.

Between 2010 and 2030, annually 6.7 million workers will join the workforce, either by changing from being unemployed to being employed, or by changing jobs (Table 1-2). The source of this influx will particularly be people who were non-employed until now, the equivalent of 2.4 million per year. A further 0.8 million will come from formal vocational training. The number of migrant workers from abroad will also remain quantitatively low at 0.4 million. The figures will be significantly higher among unemployed persons who enter gainful employment (1.1 million) and those who change jobs (1.9 million).

Table 1-2 Labour inflows and labour outflows
Annual average from 2010–2030; million persons

	Inflows	Outflows
Job changer	1.9	1.9
Unemployment	1.1	1.2
Non-employment	2.4	3.2
Vocational training	0.8	
Immigration	0.4	0.3
Death		0.2
Total	**6.7**	**6.9**

Source: Economix

Our definition of people who change jobs is people who change their vocational activities within a year. This also includes changing jobs within an organisation, for example due to restructuring or career advancement. The essential fact for counting a movement as a job change is that the employer decides on filling a vacancy. We

therefore count movements in the labour market which deal with the relationship between demand from organisations and supply from employees – a movement which is relevant for the magnitude of the supply of and demand for skilled workers.

Labour outflows are measured in the same way as labour inflows. In the phase between 2010 and 2030, 6.9 million employed persons will leave their job annually, or more specifically change their working status. This includes becoming non-employed, emigration or death, a change from being employed to being unemployed or a change in job. Primarily, these outflows will be into non-employment (3.2 million), into unemployment (1.2 million) and the large group of people who change jobs. They therefore appear on both sides of the gross flows and will later play an important role in explaining the employment structure changes. There is little difference in the volume of labour inflow and labour outflow, even in individual positions. However, it is important to take the gross flows into account, as they lead to changes in the structural composition of labour supply (chapter 3).

Estimating labour market flows

In the framework of our labour market forecast, a model has been developed to estimate labour inflows and labour outflows. In the form of a transition matrix, this model illustrates the inflows into the labour force, such as non-employed persons (including those in formal training) and immigrants, and takes the shifting of employees into account: On one hand, this includes changes in status of being employed and being unemployed, and on the other hand it includes occupational change.

The estimations are based on data from the "Mikrozensus", the Job Vacancy Survey and from other statistics. Details of the concept and the approach adopted in this model can be found in the method description.

Likewise, calculated replacement demand measures the long-term required replacement rate of employment. It is much lower than the labour inflows and labour outflows because the shifts in occupations are largely excluded. Again, more details can be found in the method description.

Up until the year 2030, the reduction of labour market dynamics will predominantly be caused by the lower exchange between employment and unemployment. This is directly related to lower unemployment. Instead, changing organisations or changing jobs – at least in relation to employment – will gain importance. The number of people who change jobs relative to employment will increase due to the fierce competition for employees.

The number of people who enter employment after completing vocational training will drop from 930 000 to 780 000 per year. This means that the various systems for formal vocational training (tertiary education, dual training and technical colleges) will contribute to the decline of labour supply due to demographic trends. We expect, however, that significant efforts will be made to include more people from educationally deprived backgrounds into the vocational training system. This will not be easy because the labour market will also provide them with the opportunity of getting a job without investing high amounts in training. Nevertheless, the proportion of workers without vocational training will fall, and among those with vocational training there will be a clear shift to tertiary training.

According to the official population forecast and our calculations, the number of immigrant workers will increase from 334 000 to 406 000 per year. However, there will also be a high and rising emigration rate of around 306 000 employees per year, meaning that the net effect of immigrants will remain low. The globalisation of labour markets will cause stronger dynamics in the international division of labour. This quite positive trend will contribute to a better supply of workers who have the required skills and qualifications, yet at the same time, will also tear gaps in Germany's labour supply. The international migration of workers will thus improve employment allocation quantitatively but it will still remain insufficient in a quantitative sense.

Labour inflows and labour outflows will predominantly be determined by the non-employed. This reallocation of labour involves 3.2 million people per year. The labour inflows and labour outflows will consist predominantly of women, as well as young and older employees. In relation to the total number of employed persons, these flows will largely remain constant.

1.3 Economic development

1.3.1 Overall economic output

The real economic production of the German economy, which comes close to the real turnover, will grow by 1.7 % per year up to the year 2030.[6] In the current phase until 2015, the annual growth rate will be 2.2 %, but will then gradually fall to 1.3 % per year (Table 1-3). This will be determined by a series of sectoral trends:

- The strongest growth will be in the business service sector where there will be annual growth of 2.7 % over the entire forecast period. This includes subsectors such as temporary employment agencies, research and development, legal, tax and business consultancy, information services, architecture and engineering offices. Their expansion is related to the restructuring of the German economy into a service economy, which together with the specialised scientific and technical services will allow great growth potential.
- In contrast, the manufacturing sector will grow at a slightly slower pace, with an average annual growth rate of 1.6 %. The restructuring of industrial organisations into technical service providers will positively influence growth. Nevertheless, the growth rate of all sectors of the manufacturing industry will remain below average – except in the electronics/electrical engineering sector. There will be declining production levels in the textiles, clothing and leather sector. Other sectors, such as the building sector, machine and vehicle construction or chemistry will also only grow below average. The electronics/electrical engineer-

6 The difference of 0.2 percentage points in comparison to GDP growth is due to the rising share of inputs.

ing sector will benefit from the energy restructuring as well as from the advancing digital integration of industrial goods.

- While globalisation is generally working against German industry, the trade and transport sector will benefit from it. With the increasing volume of trade and transport, the turnover in this sector will increase by 2.0 % per year. Wholesale and transportation will gain especially, while growth in retail will remain significantly below average.
- Because of the declining population, personnel service providers will only experience low growth. The building industry will shrink towards the end of the forecast period. Also, agriculture will only be able to achieve low production growth.
- Over time, energy, water and recycling management will achieve higher growth rates again. However, due to successful energy saving in private and industrial areas, it will not be possible to achieve the same values that arose in the period from 1995 to 2010.

Table 1-3 Output by economic sector
Average annual change of gross output (%)

Sector	1995–2010	2010–2015	2015–2020	2020–2025	2025–2030	2010–30
Agriculture, forestry, fishing and aquaculture	2.1	1.1	1.1	0.4	0.5	0.8
energy, water and recycling	1.5	0.2	0.1	0.3	0.6	0.3
manufacturing	1.5	2.2	1.8	1.2	1.2	1.6
construction	-1.6	1.4	0.8	-0.4	-1.0	0.2
trade and transport	3.0	2.5	2.2	1.7	1.6	2.0
personal services	1.6	1.3	1.1	0.4	0.1	0.7
business services	2.8	3.1	2.8	2.5	2.3	2.7
public and social services	2.7	2.2	1.7	1.3	1.2	1.6
Total	**2.0**	**2.2**	**1.9**	**1.4**	**1.3**	**1.7**

Source: Economix, CE

1.3.2 Demand components

Overall economic growth will be accompanied by significant shifts in meeting the demand of the German economy (Table 1-4):

- With the declining population, private consumption will become less important. Shrinking employment and the ageing population will also be contributing factors.
- The volume of foreign trade will expand further as part of globalisation. Exports and imports will continue to increase, and their shares will amount to approximately 60 % of GDP in the year 2030. Imports will rise more sharply than

exports, meaning that the foreign trade balance will drop towards zero. The services balance will be increasingly positive and will thus partly compensate for the weakening trade surpluses.

- Investment in construction and capital goods will increase. This will primarily be a result of the financial crisis due to the "escape into real assets", and will be related to a fear of inflationary trends. At later stages in the forecast time period, investment will be put into renewable energy, environmental and climate protection.
- Public consumption will more or less maintain a constant share of GDP, although the declining population will cause expenditure to be cut here, too. Nevertheless, government benefits will be increased, especially in the areas of healthcare and social security. Training expenditure will remain approximately the same, despite the falling number of students.

Table 1-4 Demand components
% share of real GDP

	1995	2010	2015	2020	2025	2030
Investments	29.1	25.4	25.7	26.4	27.7	29.2
Private consumption	56.6	52.1	49.9	47.9	46.2	44.1
State consumption	9.5	10.5	10.3	10.3	10.3	10.4
Exports	23.5	47.1	52.1	56.1	58.1	59.1
Imports	21.3	41.9	48.9	53.9	56.9	58.9

Source: CE

Consumers' preferences for social and private services

With regard to private consumption, expenditure for social services, healthcare and training has increased substantially over the past decade (Vogler-Ludwig 2013b). This will continue to be the case. The ageing population as well as consumers' clear preferences for healthcare services and residential care services organised by the society will also contribute to this. The transfer of childcare and residential care services to governmental or private service providers gives leeway for a higher proportion of women to be employed, but also provides individual freedom beyond work life. Personal services are very highly rated, such as travelling, free time, health, but consumers will also be prepared to spend more money on the maintenance of their dwellings. However, the consumption of goods will remain a lower priority. Energy expenditure will decline due to increasing investments in energy saving construction and consumer goods.

Business service sector and social service sector will be responsible for investment activities

Investment activities will continue to shift from the industrial goods sectors (agriculture, manufacturing, construction) towards the service sectors. Two areas are at the forefront: business services and social services. There are various reasons for this:

- Investments in the business services sector will be borne by strong growth and a high rate of innovation in information and communication technology. Information and communication services, and also financial services, will boast the highest levels of investment.
- In the social services sector, it will predominantly be the growing need for healthcare and nursing which raises the level of investment.

Investments in the energy and water sector will also increase. However, it remains unclear who exactly will be responsible for these investments, as the energy sector is facing a drop in demand. The question of how the costs of reorganising the energy sector will be divided among energy producers, consumers and the government is still unresolved. A higher cost burden for consumers could therefore mean that the savings which we have estimated for household energy costs may be lower.

1.3.3 Competitiveness and foreign trade

Germany belongs to the group of countries which traditionally have a strong export orientation. Considerable surpluses in the current accounts have been recorded for decades, which are essentially achieved by industry. We do not expect this to persist because:

- Industry will change from being a manufacturer to a service provider (chapter 2.1). Manufacturing of goods will increasingly be outsourced abroad, while technological developments and management of the global value chain will tend to remain within Germany. This will cause a drop in exports. Regarding imports, there are two factors to take into account: while there will be an increase in importing consumer goods and investment goods, the import of intermediate goods will fall. Overall, we expect that the trade balance in the year 2030 will have a small surplus of approximately one percent of GDP. However, this surplus will only be a fifth of what was achieved in 2010.
- The competitiveness of Asian countries – especially China – will increase and they will make advances in sectors which were previously occupied by developed industrial countries: high-quality products, complex and technical production processes, innovative and modern products. This will reduce the cost advantages of these countries, although they will not disappear. A significant proportion of Germany's industrial production will be lost in the long-term. This will limit the German industry's export opportunities and will raise imports.
- The sustained current account surpluses were and still are an explosive charge for the balance of the global economy. They are the real economy's contribution to the euro crisis, and they need to be reduced in order to find a sustainable solution. In the long-term, solving the economic difficulties in the currently problem-struck countries of the eurozone will lead to higher imports from these countries and will thus reduce Germany's current account surpluses.

As a result, we see a fundamental change in export-oriented Germany: Germany's economic strategies, which still are characterized by elements of mercantilism, will

give way to an investment oriented strategy where it will be increasingly important to be positioned at the control centres of the global value chains instead of serving the material flow of the chains. In other words, the German economy will retreat further from manufacturing industrial goods, yet at the same time, it will play an even larger role in research and development, marketing and global management. Germany's income will increasingly be invested in global shares. Thus, Germany will be anything but a "bazaar economy" because it will not be trade but rather a dominant role in the production chain which will be at the fore.

With this reorientation, the German economy's income sources will shift. If export surpluses do not make a considerable contribution to the total income, capital income (fed by the investment income of international shares and by selling German manufacturing companies to foreign investors) will play an increasingly important role in the future. Owners of industrial companies will become the international investors who will accelerate this process. This means that manufacturing knowledge will be lost in favour of organisational and financial knowledge.

This strategy is based on the principle that the German economy will use its comparative advantages which will increasingly involve scientific, innovative and creative skills, while the skills for craft and industrial trades will diminish. However, defending leading technological positions and internationalising business processes will only succeed if the reorientation into knowledge-based competitiveness covers all medium and low-skilled qualification levels. Thus, it depicts a reform programme on all training levels.

1.3.4 The euro crisis and growth of the German economy

The forecast of long-term economic growth of 1.5 % per year is certainly not without controversy. The overall economic risks of the euro crisis are presently so high that much less favourable developments appear to be possible. The dangers particularly lie in the instability of some overly indebted EU countries and the still insecure financial system.

Based on the World Bank's model calculations, the risks are not only contained in Europe but rather in the whole global economy (World Bank 2012: 16): if two larger EU countries with a share of approximately 30 % of GDP were to be hit by the crisis, the economic performance of the entire eurozone would shrink by 6 % and would pull the remaining industrialized countries into recession. International trade would decline by 3 %. A new global recession, as laid down by the World Bank's scenario, would mean that even the well prepared countries in the eurozone would be overwhelmed and this would force a lower rate of growth in the long-term. It would probably be even worse if the eurozone broke down completely, as this would lead to a strong appreciation in countries which were economically better off. Growth would only be possible with a lengthy adjustment process.

In our opinion, these catastrophic scenarios are unlikely. All political and economic actors will attempt to avoid such developments from happening. Even though Europe's and Germany's future is hanging by a thread, we do not believe that the game is already over. Step by step, we will get over the crisis and growth will once again recover.

However, the illusion of limitless growth, which occurred during the first decade at the turn of the century, came to an end and with it, the overly optimistic asset valuations in the balance sheets. Therefore, we are not at the beginning of a new expansion phase, as we were in the middle of the past decade. Our forecast of 1.5 % growth takes the growth limits into account, as they are imposed by the Euro crisis, climate change, or the competitive strength of Asian industrialized countries. On the other hand, it does not underestimate the strength of the German economy which developed so vigorously in the past decade. Germany can build on this for a number of years.

1.3.5 Inflation and raw material prices

We do not expect the global financial system to come apart at the seams again. We assume that it will be possible to counter the existing risks in certain countries and with certain financial actors by means of loans and credit guarantees. The European Stability Mechanism and the broadened activities of the European Central Bank offer the possibility of equating the almost eruptive rise in individual risks and to gradually steer the entire financial system to calmer waters. This could happen even without a substantial increase in the inflation rate if the credit limits which were raised for the short-term are reduced again. We therefore do not expect a long-term rise in the inflation rate. In our opinion, consumer prices will increase by an average of 1.5 % per year during the period 2010 to 2030 (Table 1-5).

However, it will be a different story for energy and raw material prices. Energy prices will more than double, with an annual increase of 5.1 % up until the year 2030. Raw material prices will only just be below this figure, with an increase of 4.2 %. Nevertheless, these price increases will not be borne to their full extent. The price increase of primary energy sources will at least partly be absorbed by a rise in energy efficiency of 2.3 % per year, and fossil fuels will lose their importance as they are replaced by renewable energy sources.

The price increase in raw materials will be more difficult to bypass, especially as recycling involves higher costs. Costly lines of production will inevitably be outsourced to regions with lower costs as a reaction not only to the price increases but also to the limited availability of materials.

Table 1-5 Price developments
2010 = 100

	2010	2015	2020	2025	2030	2010–30 Average annual change (%)
Private consumption	100.0	106.1	113.9	122.9	134.1	1.5
Comestible goods	100.0	109.4	119.5	130.7	142.9	1.8
Beverages	100.0	110.4	121.9	134.6	148.6	2.0
Agricultural products	100.0	112.6	126.7	142.7	160.7	2.4
Metals and minerals	100.0	122.8	150.9	185.4	227.7	4.2
Energy, crude oil	100.0	152.5	189.8	229.4	271.3	5.1
Energy efficiency	100.0	112.6	126.3	139.9	156.3	2.3

Source: CE

1.4 Two long-term scenarios as development alternatives

The future of the German labour market depends on the answers to fundamental questions regarding the development of the economy and the development of society:

- How does society deal with the reality of demographic decline? Will targeting economic growth still be the focus or will society be happy with what it has achieved?
- How will the economy defy with regard to the new industrial countries? Will Germany be the industrial country of the past or will it stand its ground in the world economy with its knowledge, innovation and efficiency?
- How will society develop with regard to equal opportunities, income and wealth? Will society accept the outcome of two decades of market deregulation or will it strive to create a better social balance and greater social mobility?
- Finally, how will Germany's economic and political environment be shaped? Will the financial and economic crisis become uncontrollable? Will Europe and the rest of the world disintegrate, resulting in great difficulties for growth and world trade?

These are all largely open-ended questions which do not have a clear and concise answer. Not much can be taken from the current trends and too much can happen in the future. The question is therefore not so much what the situation will look like in 20 years time but rather where do we want to be in 20 years time and what do we have to do in order to achieve it?

In order to weigh up these objectives, we have developed two scenarios which attempt to describe the basic trends of future developments and to establish the consequences thereof (Vogler-Ludwig 2013a).

1.4.1 Scenario 1: Growth and Work

The success of German industry in world markets, its hold on principles of the social market economy and its restructuring toward ecological paragons have all made the German model a worldwide benchmark which more and more countries are aspiring to. The country has found an institutional and social framework which creates a link between continuity and stability with the flexibility to adapt, to increase economic growth, and to curb unemployment. It is a Germany which is unrecognisable from the perspective of the 1980s and 1990s.

The general belief is that it is not important to simply safeguard it, but rather to successfully overcome the economic crisis and demographic threat. People know about their strengths and want to develop, adapt and apply them in the changing environment. There is a growing recognition that economic success is largely based on employees' qualifications. Not only academic professions are significant, but also the level of competence and performance within the workforce at all qualification levels and hierarchy.

The era of human capital is dawning. On one hand it is based on a high level of work orientation and motivation and on the other hand it is based on fair remuneration. More and more women are pursuing careers and by 2030 the figures for employed women will be very similar to that of men. This will be made possible with the expansion of childcare facilities which are far beyond the objectives outlined for 2013. High incentives are offered because companies are in need of skilled workers. Career prospects for women will improve and the task of balancing work and family life will become easier. Work opportunities for older workers will increase so that older workers can be employed for longer.

It is obvious that technological leading positions can only be attained by continuously updating the know-how of the workforce. Continuous vocational training will therefore be a decisive strategic measure taken on by both the economy and the government. More and more universities are open for further training and they offer certified courses for those who are already in employment. Further training and retraining at the secondary level are gaining more and more support. Now more than ever, promotion and salary are dependent on professional vocational training.

However, the German economy is unable to escape demographic decline. Even with the rising employment rate, the size of the workforce will decrease after the year 2020. The immigration of workers will thus rise, but even this will not be able to fill the gap in labour supply. The answer to the demographic challenge will therefore lie with jobs which try to increase their productivity with technical modernisation and improved work organisation. The annual rise in productivity will double to approximately 2 %. Nonetheless, potential economic growth will slow down from an average of 2 % per year until 2020 to 1.3 % up to 2030. This alone can be attributed to the shrinking labour force.

As in the past, successful economic development is based on industrial service providers, which the manufacturing industry and the knowledge-based service providers increasingly specialise in. They defend the technological edge in industrial market segments not only by investing in research and development but also with strategic investments in foreign companies. This is how the value chain can, at least partly, be controlled.

Among growth industries, energy technology and environmental technology will be given top priority (Vogler-Ludwig 2013c). Thanks to an early start in specialisation, energy and environmental technology can participate in growth in environmental markets, which will also be supported in other countries due to rising oil prices and growing environmental awareness. Mechanical and plant engineering, the chemical manufacturing industry and various technical, legal and economic consultancy firms are also part of this growth industry.

The manufacturing sector will receive impulses from biotechnology and nanotechnology, both of which are reaching market maturity on a growing scale. Service companies will grow with the increasing need for economic, technical and strategic consultancy, which arises from globalisation of the value chains. However, automotive industries and other energy intensive production areas, such as metal production, are not likely to be growth industries. They have difficulty switching to environmentally friendly and energy efficient technology and can therefore participate less and less in the strong growth in demand in the new industrialised countries.

The leading position in technology is also related to weaknesses in the new industrialised countries. In particular, China is not able to raise its industrial production to this level. Firstly, this is due to high wage increases which end up reducing cost advantages and secondly, it is due to the highly flexible labour markets which counteract the accumulation of know-how on the highest level. China remains in the lower and middle quality segments of industrial production and therefore remains reliant on the transfer of know-how.

As economic success is based on the work orientation and motivation of employees, more and more participatory organisational models are coming into force. Fields of activity are becoming broader, communication and cooperation are becoming major areas in business competence, and preferred characteristics include customer orientation and identifying with business objectives. Joint events and retention awards bind employees together. Research and development is carried out in networks with high economic and technical specialisation as well as interdisciplinary cooperation.

Social partnership is thus strengthened under these conditions. It ensures stable working relations and fair income distribution in exchange for high motivation, performance and flexibility in the workplace. However, this only applies to core employees. Until now, non-core employees run the risk of unstable work relations and a modest income. Nevertheless, as labour shortages increase there are likely to be fewer and fewer non-core workers.

First and foremost, the main risk for this scenario is in macroeconomic developments. If the financial and economic crisis, together with the euro crisis, should strike the financial system again, a sustained fall in growth is to be expected. Companies' development opportunities and economic policy are not the only things which will be restricted. The biggest threat is that it will not be possible to stabilize the global economy a second time and the global trade system will crumble.

1.4.2 Scenario 2: Welfare and Happiness

Despite the risks at hand in the global financial system, this scenario is not devoted to the catastrophic case of a collapsing global economy. It is focused on a development which has manageable relations in financial markets as a prerequisite, even though it is difficult to predict the dynamics of the crises. This scenario is about the development of the labour market and the qualification structure and not about the stability of the financial system.

The alternative to a work-oriented and performance-oriented society as described in the previous scenario is a sustainable society which is lifestyle-oriented. Here, the focus is not on maximal growth and a high income but rather the ideal of an ecological economy and a way of life where personal goals are realised, which goes far beyond maximizing materialistic elements. This society is significantly less work-orientated and has a hedonistic lifestyle where personal happiness is the main goal.

The old questions of "to have" or "to be" are at the core of this debate. If we presently bury ourselves deep in the "to have" world, there are visible forces which work towards the alternative. Firstly, the value of material improvements decreases with a rising level of welfare. Secondly, climate change has forced society and the economy to change their mentality, resulting in an increasingly large proportion of the population questioning economic growth and the advantages of a global economy. Germany is trying to go it alone – despite warnings that ecological improvements would only be possible on a global scale. Germany embraced environmental protection very early on, has put a stop to atomic energy and is managing to attain economic success from the changeover into a sustainable economy. It could be expected that in 20 years time Germany will be more sustainable and less of a workaholic than today.

Triggers for low motivation at work and the focus on the "genuine joy of life" could be reasons why, in the end, Germany's growth model, which is centred on the manufacturing industry, is not successful. It is also quite conceivable that the new industrial countries in Asia and Latin America will succeed in becoming the new technological pioneers in many areas of production. Research and development would then increasingly be concentrated in these countries. The complexity of the products manufactured in these countries is growing steadily. This does not only apply to mass production, but also to the technology-oriented investment industry and consumer goods industry as well as the consulting industry which are all steadily flowing out of Germany. At the same time, China is using its high volume of currency

reserves in order to control the global value chains. Important large companies in Germany are transferring ownership to China.

The limited options to compensate job losses in the manufacturing industry, which are due to curbed growth in service industries, result in lower employment figures. Due to the superior position held by USA, Canada and Great Britain in the financial and business services sector, the potential for growth in these areas remains modest. Germany has to recognize that it is gradually sliding into an intermediate position among its competitors.

However, Germany has sizable assets which have been accumulated within the country and a large proportion thereof is invested in holdings abroad. The yields from these assets amount to an increasingly large proportion of the total income which continues to increase thanks to clever investment strategies. The former manufacturing virtues have lost their value for Germany. Selling manufacturing companies to Chinese competitors leads to the release of financial resources which can be invested profitably worldwide. Germany is transforming itself from an industrialised country into a country of financial investors and asset managers.

Thus, labour shortages in light of demographic decline are no longer a threat. More of a worry is that unemployment due to a loss of jobs in the manufacturing industry will rise again. However, with the help of rising investment income, the average income can be maintained at a high level. In this way, welfare is secured even if happiness is not.

The unbalanced distribution of wealth and rising unemployment figures are factors which may make social problems worse. This will lead to even larger gaps in income and wealth. Again, we will see a polarisation between rich and poor, between those at the top and those at the bottom.

With a high return on investment, the workplace loses its central purpose in life. On one hand, investment income is a considerable source of income also for the middle classes. On the other hand, social welfare programmes are necessary in order to improve the living situation of those who are unemployed. This makes it possible for a larger proportion of the population to live, even without work. For many, it is a modest form of happiness – or an acceptable form of unhappiness – which at least reduces the toil of daily work. Work orientation weakens. The employment rate falls – especially among men.

The economy of this new welfare society needs less skilled industrial workers, engineers and scientists. It needs finance experts, asset managers, accountants as well as social workers and nursing staff for the elderly. Young people with manufacturing oriented professions are likely to leave the country and nursing staff will be brought in from abroad. Immigration levels will be kept within bounds as unemployment will be high.

On one hand, research and development concentrates on basic research, and on the other hand it concentrates on financial and economic sciences. There are immense

changes in the financial system as this sector is changing more than ever from credit intermediaries to asset managers. There is a strong growth in employment despite rationalisation. The focus is on international investment strategies and personal consultation.

While the educational sector takes on a central strategic role in the industry-centred model, education policy remains rather conservative in this scenario. Neither the restructuring of the dual education system nor continuing vocational training plays an important role. The focus is primarily on budding employees who are involved in financial and economic services. The number of people involved in educational training does not increase. Governmental expenditure on education and training is minimized while the population decreases.

In this scenario, growth decreases due to a decline in the working pool and low productivity. By the year 2020, an annual growth of ½ % could be possible. Thereafter, however, a fall in domestic product of ¼ % per year is to be expected. Happiness is beyond accurate measurement at the moment. One can only hope that it will rise steadily.

1.4.3 Our choice

Although there are strong tendencies towards sustainability and less of a demanding attitude in the German population, we do not believe that the scenario "Welfare and Happiness" is capable of winning a majority. In particular, weak growth, ongoing unemployment, and with income and wealth drifting further apart, it does not seem plausible that this is really sustainable. It will also fail due to escalating conflicts.

Therefore, if we take the strategy of "Growth and Work" in the following, then it will definitely not be one-dimensional. The reason for this is that Germany's society is too diverse in its views and intentions. There will therefore always be elements from both scenarios which crop up when it comes to assessing future developments.

2 Labour demand – from a service-based economy into a knowledge-based economy

At the beginning of the forecast period 2010–2015, the German economy finds itself in a phase of strong growth and rising employment. This is due to the structural reforms of the past decade, wherein the economy, politics and the workforce faced up to the challenges of structural change and adjusted to it in various ways. Now, however, the question is how to proceed with a shrinking population and declining employment. We can expect that not everything will remain as it is and that changes in economic, training and employment strategies will be necessary. Furthermore, we can also expect that Germany will choose strategies based on its strengths and comparative advantages in the global economy. This means that not everything will change, as many of these strengths will remain.

This chapter focuses on changes in sectoral employment structures, the shift in occupational and qualification employment structures as well as replacement demand due to the retirement of workers. It does not just illustrate the scale of changes, but also highlights the various causes and relationships between these structural changes in the labour market.

2.1 Sectoral change in employment

Germany will continue to find its way in the service economy with determination. In the business services sector alone, our forecast projects the creation of 750 000 jobs by the year 2030 (Figure 2-1).[7] Furthermore, jobs will be created in the financial services sector and in the social services sector (education, health and social affairs). However, there will be significant job losses in the manufacturing sector, the trade and transport sector and in the public administration sector. The manufacturing sector alone will cut back on 768 000 jobs, the trade and transport sector will cut 613 000 jobs and the public administration sector will cut 461 000 jobs. Expected

7 See also Annex, Table 2.2.1

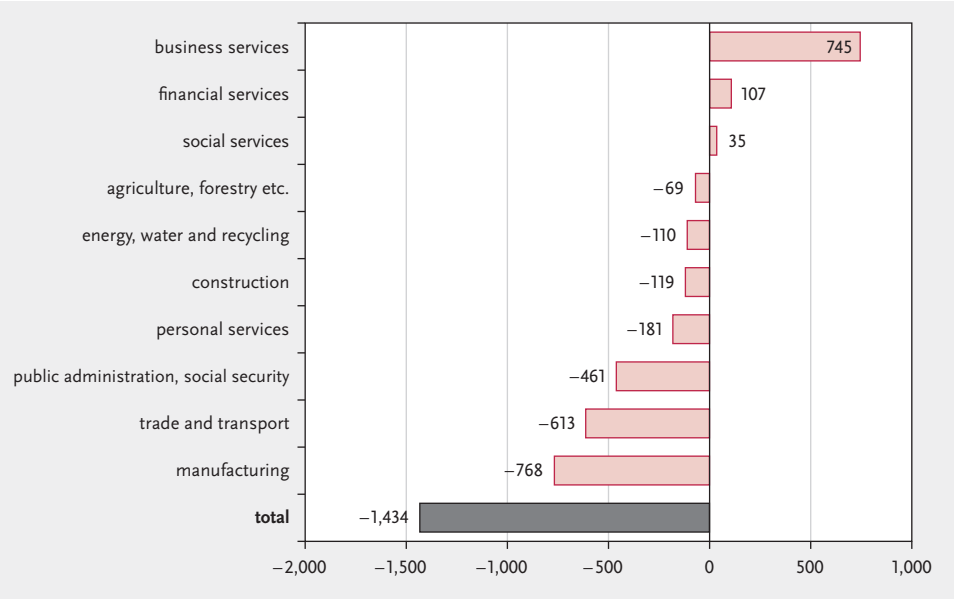

Figure 2-1 Sectoral employment 2010–2030
Absolute change in persons employed; in 1000s

Source: Economix, CE

changes in the construction industry, energy, water and recycling and agriculture will also limit the number of jobs available.

However, the difference in absolute terms loses its dramatic appearance when the relative changes are looked at more closely. Overall, compared to the period 1995–2010, we expect a decelerated structural change in employment. The share of the business service sector in total employment will increase by roughly 2.5 percentage points by the year 2030 and the manufacturing sector will lose 1.3 percentage points. Compared to the period 1995–2010, these changes are smaller: back then, the business service sector won 5.3 percentage points and the manufacturing sector lost 3.7 percentage points. The reason for this is the continuing shortage of workers. Under the conditions of declining labour supply, organisations will react to short-term demand growth by setting higher productivity requirements for their workforces. In the long-term, they will look for further ways to economise with efficient production plants and organisational improvements and in the end, production will be outsourced abroad. In return, a reduction in demand will set workers free, however, competitor organisations that are experiencing bottlenecks will snap up these employees much quicker than they have done until now. Therefore, the structural changes in demand and production will only have a subdued effect on employment.

Table 2-1 Sectoral structure of employment
% share of total employment

sector	1995	2010	2015	2020	2025	2030
Agriculture, forestry, fishing and aquaculture	2.3	1.7	1.7	1.6	1.6	1.5
energy, water and recycling	2.1	1.4	1.3	1.3	1.2	1.2
manufacturing	21.3	17.6	17.2	16.6	16.6	16.3
construction	8.9	5.9	5.7	5.9	5.8	5.8
trade and transport	20.6	19.6	18.5	17.8	18.4	18.7
financial services	3.6	3.4	3.5	3.7	3.9	3.8
business services	9.6	14.9	15.5	16.4	16.8	17.4
personal services	9.9	12.2	13.0	12.9	12.5	12.2
public administration; social security	8.0	6.8	6.4	6.2	6.0	5.9
social services	13.6	16.5	17.1	17.7	17.3	17.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Economix, CE

There are a number of causes for these structural changes in employment:

- The growing success of China and India in high technology industries will force German industry to further reduce domestic production capacities and, at the same time, expedite specialisation in technical services (Meil 2013b). This will substantially contribute to stronger employment growth in the business services sector.
- At the same time, industrial companies will secure their leading role in the global value chain with financial investments abroad. The German economy will therefore change from being a producer to an investor and will follow USA and Great Britain down the same route of de-industrialising its national economy. In turn, growing personal assets will call for competent financial services and both of these are likely to lead to a rebound in the financial business.
- We expect that information technology will boost its rationalization effects. There will be advancements in digitalising information, networking will grow and the automation of processing information will increase. This will have an impact on sectors which have a heavy administrative burden, especially commerce, publishing and the media sector. The effects of rising employment brought on by manufacturing goods for information technology will, however, arise in other parts of the world.
- Energy and the growing importance for environmental protection will limit jobs in the energy sector and in particular, rising energy prices will set further incentives to improve energy efficiency. Positive employment effects will be visible in construction, agriculture and electrical engineering.
- The shrinking population will have a negative impact on a range of economic activities, for example the building and housing sector, education and other public sectors. On the other hand, the ageing population and the development

of childcare facilities will contribute to the expansion of welfare and healthcare services. We believe that the population will politically assert their strong interest for state financed personal services and thus, the declining employment rate caused by depopulation will be partly compensated for in these areas.

Table 2-2 shows the development of employment in 44 economic sectors. The trends are analysed and explained in the following sections.

2.1.1 Goods producing sectors

This core sector of the German economy, which comprises not only the manufacturing sector but agriculture, energy and the construction sector, will lose one million jobs or 10 % of their total workforce by the year 2030. Therefore, deindustrialisation in employment will continue, although maybe not as extreme as in the past. In the year 2030, the manufacturing sector will have a 25 % share of total employment. In 2010 this figure was 27 % and in 1995 it was 35 %. The slowdown of restructuring is due to structural change within the industries as it will be enforced in the future (chapter 2.2).

From the 16 economic sectors which manufacture goods, there is only one sector in the forecast which is expected to increase its employment. This is the industrial field of electronics/electrical engineering, which will particularly benefit from the energy turnaround. Not only the expansion of renewable energies but also the various uses of energy-saving technology will cause employment growth in this sector.

Table 2-2 Employment development by sectors

Sector	Count 2010 (1000s of persons)	Change 2010–30 (1000s of persons)	Average annual change 2010–30 (%)		
			Persons employed	Production	Productivity per person employed
agriculture, forestry, fishing and aquaculture	672	-69	-0.5	0.8	1.3
mining, extraction of rock and ores	86	-35	-2.6	-1.5	1.0
food and beverages	857	-124	-0.8	1.4	2.2
textiles, wearing apparel, leather products	167	-70	-2.7	-2.5	0.1
wood, cork, straw	135	-7	-0.3	0.3	0.6
paper products and printing	353	-37	-0.6	0.6	1.2
refined petroleum, chemical, pharmaceutical products	485	-104	-1.2	0.4	1.6
rubber, plastic, glass, ceramic products	604	-68	-0.6	0.8	1.4

(Table 2-2 continued)

Sector	Count 2010 (1000s of persons)	Change 2010–30 (1000s of persons)	Average annual change 2010–30 (%)		
			Persons employed	Production	Productivity per person employed
metal production and metal working	1144	-190	-0.9	1.0	1.9
electrical equipment, electronic and optical products	863	108	0.6	3.8	3.2
mechanical engineering	1044	-131	-0.7	1.7	2.4
vehicle manufacturing	950	-110	-0.6	0.4	1.0
furniture, other manufacturing, repair	561	-36	-0.3	1.3	1.6
energy supply	250	-34	-0.7	-0.5	0.3
water supply, waste management services	235	-41	-1.0	1.5	2.5
construction	2379	-119	-0.3	0.2	0.4
wholesale trade	1724	-44	-0.1	1.8	1.9
retail trade	4068	-266	-0.3	0.6	0.9
transport, warehousing	1580	-242	-0.8	1.7	2.5
postal and courier activities	414	-35	-0.4	1.4	1.8
accommodation, hotels and restaurants	1670	-61	-0.2	0.7	0.9
publishing, motion picture, broadcasting	413	-39	-0.5	1.4	1.9
telecommunications	169	-25	-0.8	4.0	4.8
IT, information services	658	-28	-0.2	3.3	3.6
financial services, insurance, financial intermediaries	1237	80	0.3	1.8	1.5
real estate	431	-28	-0.3	-0.7	-0.4
accounting, management consulting	1161	255	1.0	3.8	2.8
architecture, engineering; technical testing and analysis	560	109	0.9	2.4	1.5
research and development	170	55	1.4	4.1	2.6
other scientific and technical services	483	24	0.2	2.2	2.0
renting and leasing of goods	139	28	0.9	2.0	1.0
employment agencies	647	218	1.5	4.2	2.7
travel agencies, tour operators, reservation services	105	-11	-0.6	-0.4	0.1
other business service providers	1677	195	0.6	1.5	0.9
public administration; social security	2758	-461	-0.9	0.7	1.7

(Table 2-2 continued)

Sector	Count 2010 (1000s of persons)	Change 2010–30 (1000s of persons)	Average annual change 2010–30 (%)		
			Persons employed	Production	Productivity per person employed
education	2488	-100	-0.2	0.4	0.6
healthcare	2480	93	0.2	2.4	2.2
social work, nursing homes	1749	42	0.1	2.6	2.5
arts, culture, gambling and betting	392	23	0.3	1.6	1.3
sports, entertainment, recreation	249	-28	-0.6	2.1	2.7
interest groups	704	-83	-0.6	0.7	1.3
repair of consumer goods	77	-7	-0.5	-1.6	-1.1
other personal services	738	-12	-0.1	2.2	2.3
personal domestic services	876	-18	-0.1	1.6	1.7
Total	**40603**	**-1434**	**-0.2**	**1.7**	**1.9**

Sources: Economix, CE

The economic sectors which will experience heavy job losses are key industries in the German economy: metal production and metal working, mechanical engineering and chemistry, to name but a few of the larger ones. They are projected to lay off between 11% and 21% of their employees by the year 2030. Furthermore, the consumer industry will also cut back on employees. This includes – other than the textile and wearing apparel industry, which has been struggling with great employment losses for a long time – the foods and beverages sector, the furniture and woodwork sector, and the paper products and printing sector. They will be faced with an increasing number of imports, their production capacity will either be limited or outsourced abroad, or they will be otherwise negatively affected by technological change. This process will not be confined to the high technology industries as competitive countries in Asia will not only rapidly advance in this segment, but they are also about to take over the technological leadership in an increasing number of fields (Meil 2013a).

However, this process will not occur as a devastating turn of events because large Asian enterprises are still geared towards supplying the global market with bulk commodities, while the German manufacturing businesses are responsible for providing high quality "custom built" goods in small batches. This will also continue to be a steady basis for the medium-sized industrial enterprises in Germany. Large enterprises in vehicle manufacturing, chemistry or the metal industry, however, will not survive as the producers that they are today. They will mostly change into technological corporations where innovation, knowledge management and the global value chain will be the main focus. The transformation into industrial service providers

will secure many jobs and thus, will slow down the statistically observed structural changes in different sectors.

In the mining sector, we expect a cut back on employment by 41 % between 2010 and 2030, meaning that it will only have about 50 000 employed persons in the year 2030. In 1995 this figure used to be almost 200 000. However, even energy production will restrict employment. The energy sector is currently enduring a strong restructuring process which is reducing past profits. With an annual decline of -0.5 % in production, as well as high capital expenditure in the reorganisation of energy production, it will remain this way for a long time. This means that redundancies will become an economic necessity.

The agricultural sector will continue to reduce employment, albeit at a decelerated pace because of its increasing importance for the environment and renewable energy.

2.1.2 Trade and transport

Declining employment in this sector will primarily relate to the retail trade and the transport/warehousing sector. In wholesale trade, we expect only small losses as this will gain importance over the course of the next few years due to the growth in foreign trade.

Retail will lose a quarter of a million of its employees. This will be due to a smaller population as well as the increasing importance of e-commerce. While wholesale will engage in e-commerce, retail (especially small businesses) will be pushed out of the market. Small retail businesses will continue to die out and, at the same time, large internet providers will become even larger. The enormous economies of scale, which also emanate from the use of information technology in the trading sector, will boost the concentration of enterprises and further reduce employment.

Similarly, the transport sector will also lose approximately a quarter of a million of its workers. While the increase in e-commerce requires additional staff to deliver goods, restructuring from production to services will mean that transport volumes will fall overall. Furthermore, the declining population will also reduce demand.

2.1.3 Business service sector

This is the sector where we expect the strongest employment growth of 750 000 jobs (+12 %). Its expansion will predominantly be from accounting, management consulting, temporary employment agencies and other business service providers. By the year 2030, each of these sectors will have created between 200 000 and 260 000 new jobs. Moreover, architecture and engineering offices, research and development as well as the scientific and technical services will create 190 000 jobs in total. Information services and other sectors will, however, cut approximately 100 000 jobs.

The growth of the business services sector is a phenomenon which has been observed not only in Germany but also in other highly developed countries. The use of technical, sales, legal and other consultancy services has long been part of corporate governance practices. However, as industrial companies are turning into technical service providers themselves, the line between service specialists and manufacturers is blurred. Consultants will be integrated to a much higher extent in companies, specialised departments for consultancy services will be created and then they will enter the market as separate companies. It is a rolling process which increasingly blurs the distinction between producers and service providers.

We believe that the importance of knowledge intensive business service providers will go from strength to strength because this is where the German economy's decisive competitive advantage lies: in technical know-how, in organisational talent, in science and research, in design and creation, and in corporate management with long-term perspectives, etc. Those who demand such services, as well as the service providers themselves, all benefit from these competitive advantages. Furthermore, the business services sector will develop their own international sales strategies and will profit from global expansion in these markets. Growth of the business services sector will therefore not only affect the restructuring of the German economy, but also the international competitiveness of service providers.

In accounting, management consulting, we expect employment to increase by 22 % by the year 2030. That is the equivalent of 255 000 additional jobs which will primarily be created because the sector will be in the middle of the restructuring process. They will develop concepts for the new organisational structure of companies; they will consult on economic and legal questions; and last but not least, this is where the rising number of business holdings will be located. Without this sector, reorganisation into a knowledge economy will not be possible. Not only does this sector generate valuable knowledge, but it is also this sector which implements the strategies.

Furthermore, other sectors will be responsible for knowledge advancement, especially research and development, architecture and engineering as well as the scientific and technical services. Employment in research and development will rise by a third by the year 2030 and in architecture and engineering it will rise by a fifth. Growth will remain lower in scientific and technical services, as there will be significant savings due to automated analytical techniques.

In the information and communication technology sector, the production of software and other IT services will see growth. However, there are also subsectors which will be negatively affected, especially publishing, motion picture, broadcasting. Print media will increasingly be replaced by digital media, book production will significantly decline, and radio and television will partly be replaced by the internet. Total demand for information will rise, but new technologies will be able to cover this demand much more easily and with cheaper costs. Overall, we expect a decline in employment in this sector of approximately 39 000 workers (-9 %).

Employment agencies will continue to grow because of persistent labour market shortages. We expect a 33 % growth, giving a total of 865 000 people. In the year 2030, it will have a 2.2 % share of the total number of persons employed – only just above the peak of 2008. The strong demand for agency work will be faced with a limited supply of agency workers. This will prevent agency work from becoming a mass phenomenon. Generally, we expect that the number of marginal workers will be lower overall. However, agency work will become increasingly important as it will cover organisations' short-term demand for workers.

2.1.4 Financial services

The financial economy is still in shock from the global financial crisis of 2008, which, in turn, has caused employment in this sector to stagnate. We expect that these rigidities will subside and that by 2030, 107 000 jobs will be created (+8%). The financial services, insurance, financial intermediaries sector will contribute to this rise with 80 000 additional jobs. The renting and leasing of goods sector will create +28 000 additional jobs.

The expectation of new growth in the financial services sector may be surprising in view of customers' loss of trust and the increasingly restrictive governmental regulations in this sector. Also, the large labour-saving potentials of information technology and internet banking point towards falling employment figures. According to our forecast, the decisive stimuli for demand and employment come from two directions: from the increasing number of international investors and from growing private investments. This will allow demand for financial services to grow, especially in advisory and brokerage services. High deposits in banks and insurance companies will help to provide investment banking with a new boom, even though there will be more stringent conditions and lower profit margins than was the case in the past. Also, a possible separation of investment and commercial banks would not jeopardize these developments, as these conditions would make growth in investment banking even stronger.

As the analyses of assets in Germany have shown, private assets in Germany have continuously grown by 2.3 % per year since 1995 (Vogler-Ludwig 2013a). Despite lower economic growth, little will change in this respect in the future. There are two causes for this:

- Growth of private assets will resume, with an increase in the average income, the ageing population and the increasing value of inheritance.
- An increasing share of Germany's income will come from foreign investments. While, in our opinion, export surpluses will become smaller, foreign investments will continue to grow. It can be expected that German companies will invest more and more abroad, while in the same way parts of the German industry will be sold to foreign investors, especially to Chinese competitors.

As can be seen from the example of solar energy, China wants to orientate their high technology with the newest generation of technology from the start, instead of repro-

ducing the last generation of technology. In addition, China has large currency reserves which are used for hedging its economic strategy. The acquisition of Volvo by the Chinese Geely International Corporation and the acquisition of the construction machinery manufacturer Putzmeister by Sany are examples which show that China has a technology-driven acquisition policy. The transfer of technology is at the fore, not the short-term financial gain. China's enormous financial power leads us to expect that further strategic acquisitions will take place in the next few years, whereby Chinese companies will penetrate high-tech markets.[8]

If this trend materialises, German industry will not have any other option than to secure their position with financial investments in the new industrial countries. This would mean that German companies would have to take leave from being a manufacturer and increasingly become a financial investor instead, just like we have been seeing other large companies doing for a long time. With this strategy, Germany will follow USA and Great Britain down the same route of extensively eliminating their own industrial production.

The German financial economy will remain an important player in this development, as the link to non-financial companies provides it with a significant market advantage. Nevertheless, Germany will be involved in global economic developments and thus, will more than compensate labour losses from rationalisations.[9]

2.1.5 Private and public services

The employment trend in this sector will be affected by the declining population and the increasing number of opportunities to rationalise personal services, as well as a growing demand for personal and social services (Dworschak, Zaiser 2013b). Overall, in the personal services sector, we expect that employment will fall by 181 000 (-4 %). This will cover all sectors – with the exception of the arts, culture, gambling and betting sector. In the public sector, employment will fall by 426 000 (-4 %). There will be job cuts in public administration (-462 000) and in education (-100 000), however there will be job gains in the healthcare and social care system (+135 000).

Depopulation will predominantly affect the hotel and catering industry, real estate, domestic services as well as other personal services. Similarly, public administration will be restricted insofar as it provides personal services. Yet these sectors will also be able to profit from the growing number of older people in the population, as they are the ones who will largely take advantage of increased demand for personal serv-

8 The worst case scenario for industrial policy may happen when – perhaps in the year 2022 – the Quandt family sells its BMW shares to a Chinese automobile producer after it becomes evident that there will be no catch up with Chinese electrical cars – neither in technological quality nor in price. This may be understood as a capitulation in front of the Chinese predominance and may accelerate the abandoning of industrial capacities.

9 Here, we need to point out again that our forecast depends on the successful management of the financial and economic crisis. A further crash of the financial system would deteriorate growth conditions, but not only for this sector, and would thus lead to a scenario with significantly lower growth.

ices, especially health and care services. Consumer spending in private households has significantly shifted in this direction in the past and we expect that this trend will continue (Vogler-Ludwig 2013b).

Demand for public and private services are dependent on each other to a large extent. As long as the government does not intervene, demand for personal services will remain limited because of income distribution. Under such conditions, it is always only the higher income groups that can afford the services of the lower income groups. The larger the income differences, the higher the demand for personal services because the richer classes can buy services from the lower classes cheaply. However, we do not expect income distribution to grow further apart, and we therefore also do not expect additional stimuli from this direction. It is rather the expansion of state funded or partly state funded personal services which uses redistribution to break through the barriers of income distribution. Public services are generally funded by duties or taxes and are then privately consumed. Thus, depending on the rationing of services, large sections of the population have access to these services, independent of their income.

The government is already implementing this solution by expanding childcare and residential care facilities and will definitely continue to do so. Additionally, the declining population will ensure that the government can proceed with this by freeing up resources in the social sector and using it for structural improvements in these services. It is a relieving factor that the population of people under 65 will drop by 8.2 million. However, it is a concern that the population aged over 65 will increase by 5.5 million by the year 2030. Overall, we expect increased expenditure on health and care services due to medical advancements and the population's rising demands for quality service. By 2030, the share of GDP which will be spent on health and care services in the private and public sectors will rise from 14 % to 15 % or possibly up to 16 %.[10]

In the education sector, we expect that the supply of educational services will not follow suit with the declining number of children and youths. However state and private training institutions will significantly invest in the quality of training offered. Despite the population declining by a total of 4 million (-16 %), we expect that the number of employed workers in education and training will only fall by 4 %. Firstly, this will be attributable to quality improvements, predominantly in relationships between students and teachers, supervisors and workers. Secondly, training institutions will be increasingly involved in training adults, especially in vocational continuing training. The proportion of GDP which will be spent on training will remain steady at 4.5 % as a result of the declining population. However, the expenditure per capita aged 29 or under will rise by approximately 45 %.

10 Internal calculations; we do not expect that the growing population over 65 will lead to the same growing demand for health and care services. The final stages in a person's life which end up being costly will be postponed due to improved health and increased life expectancy.

Depopulation is not solely to blame for the significant fall in employment of 17 % in public administration. We expect that the consistent use of information technology will significantly rationalise administrative procedures, leading to redundancies. Administrative procedures will increasingly be automated and citizens will predominantly conduct these activities via the internet. Technical support of administrative activities will increasingly be outsourced.

2.2 Employment and productivity

Employment trends in different sectors primarily depend on changes in the volume of production. This explains 73 % of the changes in employment, while 18 % is due to changes in productivity. The remainder is affected by changes in working hours and by other factors.

Technical improvements in production processes and time saving organisational changes are not the sole factors which result in improved productivity. Productivity is noticeably increased by higher intrinsic values of performance. This restructuring into high value-added products and services considerably helped the German economy to advance in the last decade and is the foundation of the competitiveness which she possesses today. We expect that specialisation in technical services will be developed further in the future and that Germany will become stronger by being one of the world's leading technology centres.

Looking at it more closely, among the sectors with the highest productivity growth there are also sectors of the manufacturing sector that appear such as electrical equipment/electric and optical products and mechanical engineering (Table 2-2). Other sectors, such as the food and beverages industry, metal production and metal working or the chemical industry are at least in the middle bracket of productivity growth up until the year 2030.

At the top of the sector with high productivity growth are sectors which have high technological rationalisation potential – such as telecommunications and information services – as well as sectors with significant scope for rationalisation, such as accounting, management consulting, research and development or transport/warehousing. The use of information technology will make significant progress here, not only with regard to improving hardware but also with regard to the wider use of software. This will become the so-called "internet of things", which means linking devices via information technology to achieve independently controlled and regulated networks. This will create significant saving potentials in areas which, until now, were subject to human supervision (Dworschak, Zaiser 2013a). Also in the social work, nursing homes and other personal services, there will be a high rationalising potential caused by intelligent care and monitoring technologies.

In public administration and the financial services, productivity growth will remain in the middle of the range across sectors, however, productivity growth in the build-

ing sector, in the energy supply and the other business services providers sector will remain weak.

Productivity growth will increasingly be driven by a shortage of workers. Compared to the trends to date, in which labour productivity was significantly increased in value-added product segments by outsourcing, the search for labour saving, technical and organisational solutions is at the fore. This means that information technology will play an important role.

2.3 Structural change in occupations

2.3.1 Method

The way in which employment by occupation is structured largely depends on organisational adjustments in the company, the labour saving effects of new technologies, and last but not least the division of labour in the product specific value chains. Furthermore, it is related to the sectoral transitions, as set out in the section above. Occupational and qualification-specific changes thus reflect many of the factors which drive the developments within sectors and in the overall economy. However, there is also a new factor: considerably clearer than can be determined from watching the economic sectors, the occupational and skills-specific changes show in which qualitative direction labour demand will move. These are important considerations for training and labour market policies over the next few years.

The 88 occupational groups used in this forecast provide a summary of occupations, just like the 27 subjects of formal vocational training describe a variety of different training possibilities (Annex, Tables 3.2 and 3.4). When interpreting the results, it should therefore be taken into consideration that this structure could change. It is even more important to be aware of the fact that the content of individual occupations

Classification of occupations:

The portrayal of occupational change in employment comes from the occupational classifications of 1992. The disadvantage of this is that it is an outdated classification scheme, yet it provides the forecast with indispensable long-term comparisons which date back to 1995.

The new occupational classifications of 2010 have also only partly been used in the official statistics. For this forecasting work, we do not plan to use these classifications before 2014. The old classifications are used here.

To analyse the structural change in occupations, we took 88 occupational groups into consideration (Annex, Table 3.1) and to analyse the skills-specific structural change we took 27 fields of vocational training into account (Annex, Table 3.5). The occupational groups were crossed not only with the 44 economic sectors but also with the fields of vocational training. This gave two matrixes with 3872 cells in the first instance and 2376 cells in the second instance. So that the sampling error with this differentiation grade was not too large, five-year averages were generated for the periods 1995–1999 and 2006–2010. These patterns were applied to the "Mikrozensus" data – where a considerable amount of the data came from – as well as to the data provided by the German Federal Labour Agency.

and training paths can change, without this being reflected in the language labels attached to them. The occupational and skills-specific structural change, as set out here, only shows the tip of the iceberg. It can be expected that changes to the content of occupational activities will predominantly take place in job descriptions and the qualification descriptions that we have observed. Examples of this include increased use of computer technology or considering environmental aspects in various jobs and training programmes. In order to have a complete picture of the qualitative changes in labour demand, a third dimension would also be necessary, which would be the consideration of changes in skills profiles. For the current project, this remains a vision for the future.

2.3.2 Overall development

We expect that manufacturing jobs and administrative and office jobs will bear the brunt of the decline in employment until the year 2030 (Figure 2-2).[11] In manufacturing jobs, employment will fall by approximately 1.1 million and in administrative and

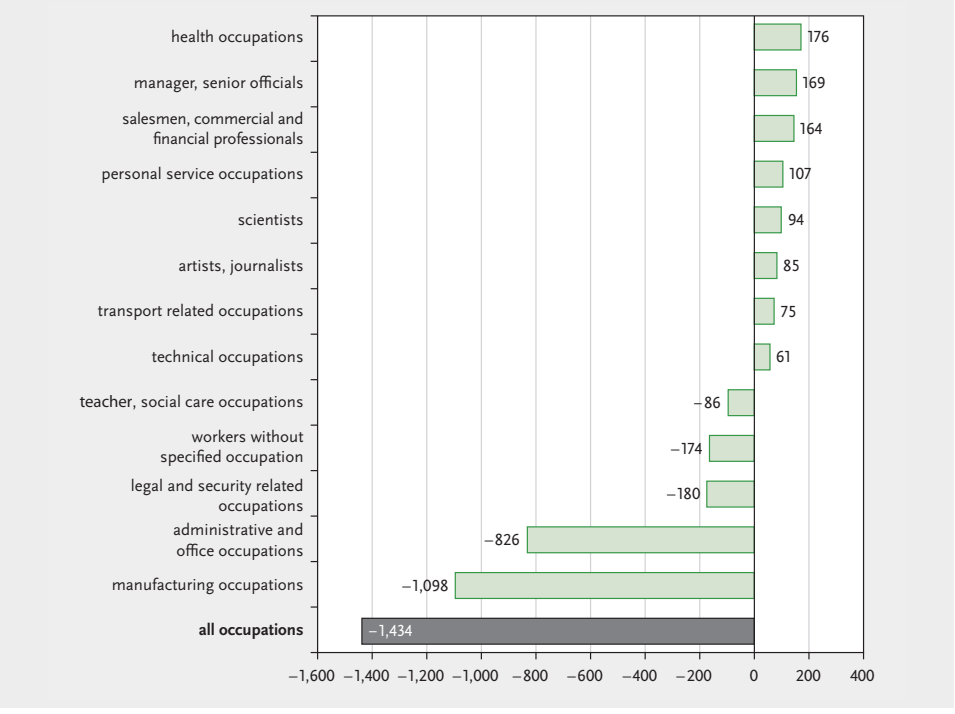

Figure 2-2 Employment development by occupation 2010–2030
Absolute change of persons employed, in 1000s

Sources: Economix, IER

11 The details of changes in employment by occupations are presented in the Annex, Table 2.2.2.

office jobs it will be 0.8 million. With the general labour shortage, this means that companies in these segments will see this as the greatest opportunity to save on workers. Further automation of industrial production and the increased use of information and communication technology will lay the foundations for this. Also, outsourcing production and services abroad will increasingly be used. Administrative and office jobs will not escape. Furthermore, an increasing number of imports of high-quality goods and services will reinforce this process.

Employment in technical occupations, however, will rise. The link to globalisation is also visible here, wherein technical services will become the most important product of industry. In this context, we expect that employment among scientists will increase by 94 000.

The trend towards becoming more scientific and professional can be seen in areas of management and administration. We expect a significant increase in the number of managers and senior officials (+169 000), while the number of routine administrative and office jobs will significantly fall. This seems to be typical for technical and organisational progress, which tends to save on low-skilled labour while favouring more complex tasks. In this case, management functions will particularly be expanded due to the composition of the global value chain, where a higher number of project managers are needed for numerous product segments.

The movement of goods will increase because of globalisation, but also as a result of increasing e-commerce, meaning that more people will be needed in transport professions. Finally, the number of traders in various sectors (trade, transport, finance) will increase.

In the occupational group of teachers, social care, we expect a decline in employment of 86 000. This will only negatively affect teachers (-180 000), whereas the number of employed workers in social care and welfare occupations will increase (+122 000) due to a high demand for nursing and care services. For the same reasons, we estimate that there will be a significant increase of 176 000 in health occupations and 107 000 in personal service jobs. There will be a decrease of 180 000 in the number of safety and security occupations due to the abolishment of national service, which is still included in the figures from 2010. The number of persons employed in creative jobs (artists, journalists) will, in our opinion, increase by 90 000 because art and culture have an ever-increasing importance in growing prosperity.

Upgrading the overall economic employment profile is only possible in this way if the number of workers without a specific occupation (i. e. those who have not participated in vocational training) declines. With increased efforts in so-called transition systems for vocational training and increased professional acknowledgement, we assume that it will be possible to successfully decrease the number of workers without a specific occupation by 174 000.

In relative terms, the changes are apparently not as strong (Table 2-3). By the year 2030, the number of manufacturing jobs will have decreased from 24 % to 22 % and

the number of administrative and office jobs will have decreased from 14.8 % to 13.2 %. Sales people selling goods and services will increase their share from 12.5 % to 13.3 %. Changes in other occupations will not exceed a tenth of a percent. This moderate structural change in the occupational structure hides more important changes that will occur within occupational groups and professions.

Table 2-3 Persons employed by occupation
% share of total employment

Occupation	1995	2010	2015	2020	2025	2030
manufacturing occupations	29.9	24.0	23.2	22.6	22.3	22.1
technical occupations	6.0	5.8	6.0	6.1	6.2	6.2
scientists	0.8	1.3	1.4	1.5	1.5	1.6
salesmen, commercial and financial professionals	11.4	12.5	12.4	12.4	13.0	13.3
transport related occupations	6.0	6.2	6.1	6.2	6.4	6.6
managers, senior officials	4.4	5.8	6.0	6.2	6.4	6.4
administrative and office occupations	15.7	14.8	14.4	14.1	13.7	13.3
legal and security related occupations	3.7	3.7	3.7	3.6	3.5	3.4
artists, journalists	1.3	1.9	2.0	2.1	2.1	2.2
health occupations	5.2	6.5	6.7	6.9	7.0	7.2
teacher, social care occupations	6.6	8.1	8.5	8.8	8.4	8.1
personal service occupations	5.5	7.6	8.1	8.2	8.2	8.1
workers without specified occupation	3.4	1.7	1.5	1.4	1.4	1.3
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Sources: Economix, IER

For changes in the employment structures to occur, it is crucial that working practices are restructured within economic sectors. Technological and organisational progress takes effect here, as do changes in the product spectrum within the sectors. Occupational activities are usually closely linked to sectors. Especially so-called hybrid jobs, such as managers, salesmen, accountants, etc. are expected to carry out very varied tasks in certain sectors. We therefore consider the forecast for employment to be directly related to sectoral restructuring.

2.3.3 Occupational profile for the agricultural sector: ecological reorganisation

The occupational profile for the agriculture, forestry, fishing and aquaculture sector is particularly focused on agricultural occupations (Figure 2-3). In 2010, 60 % of workers in this economic sector were employed in this occupational segment. Other professions involving manual work, such as horticultural occupations and livestock keepers. Forestry and hunting professions also employ a large number of people. In

2010, 82 % of persons employed in this economic sector were involved in agricultural and forestry production.

According to our calculations, the number of professions involving manual work in the agricultural, forestry and fishing sector will hardly change. In the year 2030, the figure will still be 78 %. This minimal change will be the result of ecological restructuring in this sector. The expansion of ecological farming will restrict the present rationalisation. Above all, ecological experts will play an important part in environmental policies. Their advice will be required in many other economic sectors, for example in the food industry, in the energy sector and in the construction industry.

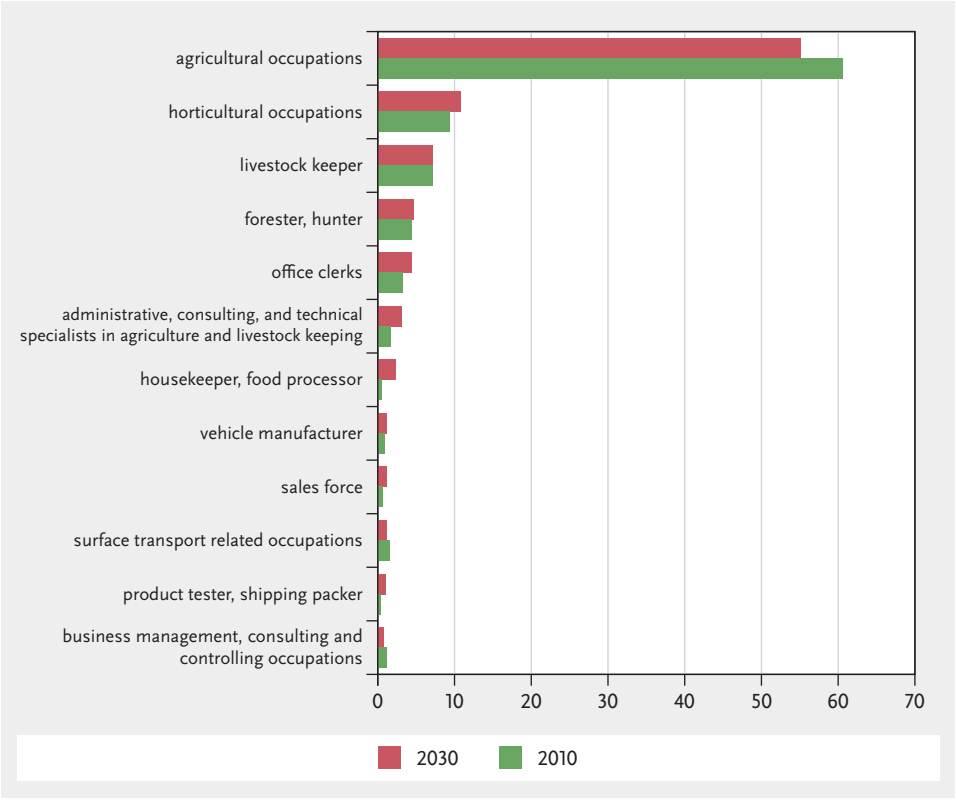

Figure 2-3 Restructuring of employment in the agricultural sector
% share of total employment of this sector
Ranking of occupations with the highest share in 2030

Sources: Economix, IER

2.3.4 Occupational profile for the manufacturing sector: from a manufacturer to a technical service provider

In the manufacturing sector, we expect that there will be a proportional decrease in many manufacturing jobs (Figure 2-4). This includes metal and plant manufactur-

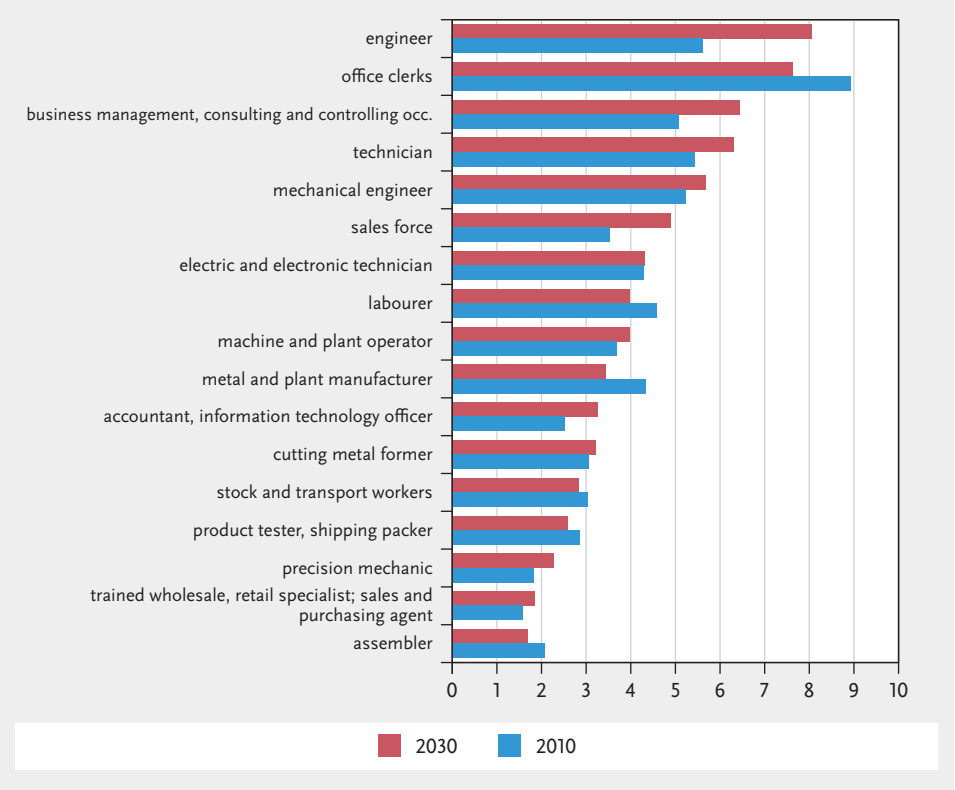

Figure 2-4 Restructuring of employment in the manufacturing sector
% share of total employment of this sector
Ranking of occupations with the highest share in 2030

Sources: Economix, IER

ers, assemblers and people in metal-working occupations, stock and transport workers. Even if, for example, mechanical engineering or machine and plant operators record a relative increase, this does not change the expectation that almost 800 000 jobs will be cut in production by the year 2030. This is the reason why in many manufacturing jobs, the indicators show a steady decline in employment.

On the other hand, the winners will be:

- Engineers, who will increase their share in total employment by 2.5 percentage points to 8 % in the manufacturing sector.
- Managers, whose share will rise by 1.5 percentage points.
- Sales force, who will also grow at a similar rate.

Hence, trends which have been present for a long time will continue (Vogler-Ludwig 1983): the decline in employment will focus on manufacturing occupations which are typical for the industry, e. g. occupations in the food industry which deal with food. In these segments, the respective industries have the best opportunities for

rationalisation and employ the majority of workers. This warrants high levels of successful rationalisation, compared to peripheral jobs, in the whole scope of an organisation's activities. The downsizing of manufacturing professions can therefore count as being one of the most reliable findings in industrial research.

The shift into knowledge-based occupations in engineering, management and sales signifies the process of service orientation which is closely linked to it. Large parts of the German industry are, and will become, technical service providers, for whom the service of technical solution developments is a major part of the business model. Manufacturing occupations will play an important role in the year 2030 with an overall employment share of 49 % in the manufacturing sector, but they will be increasingly bound by the strategy of technical service providers. It will not be mass production which determines the activities in these occupations, but rather individual developments of special technical solutions. This will mean that there will be a significant reorientation of skills profiles in these occupations. Manual crafts business will then be an important employer for manufacturing jobs. Skills requirements will also increase in this segment.

The field of activity for engineers will develop in two directions. On one hand, they will be even stronger than before in product development. On the other hand, they will move into product management, meaning that they will be involved in the organisation and management of the global value chains. The tasks that they performed in the past within Germany as production managers will be less and less needed. With these changes, the activities which engineers and managers will be required to carry out will overlap more than ever. For international project management, technical specialisation will be more of an advantage than a specialisation in sales. However, project management is about having the right combination of both fields of specialisation.

During globalisation, managers and leaders will have other tasks to carry out which do not include technical specialisation. Their focus will be on retaining an individual organisation's economic significance in the changing value chains, if not increasing it. This involves questions of international marketing, strategies for technological developments, optimal division of labour, legal and financial protection, and thus it is also about an organisations' strategic orientation in view of the growing competitiveness of Asian countries. A lot can be squandered here, as can be seen in the solar industry. It is up to the associations and chambers to raise awareness of these challenges. In our forecast we assume that it will succeed, even though it will involve a considerable amount of effort.

2.3.5 Occupational profile for the trade and transport sector: global trading with e-commerce

This sector will lose 8 % of its workers from 2010, although it will strengthen its core activities (Figure 2-5). The proportion of sales force, of wholesale, retail salesmen and

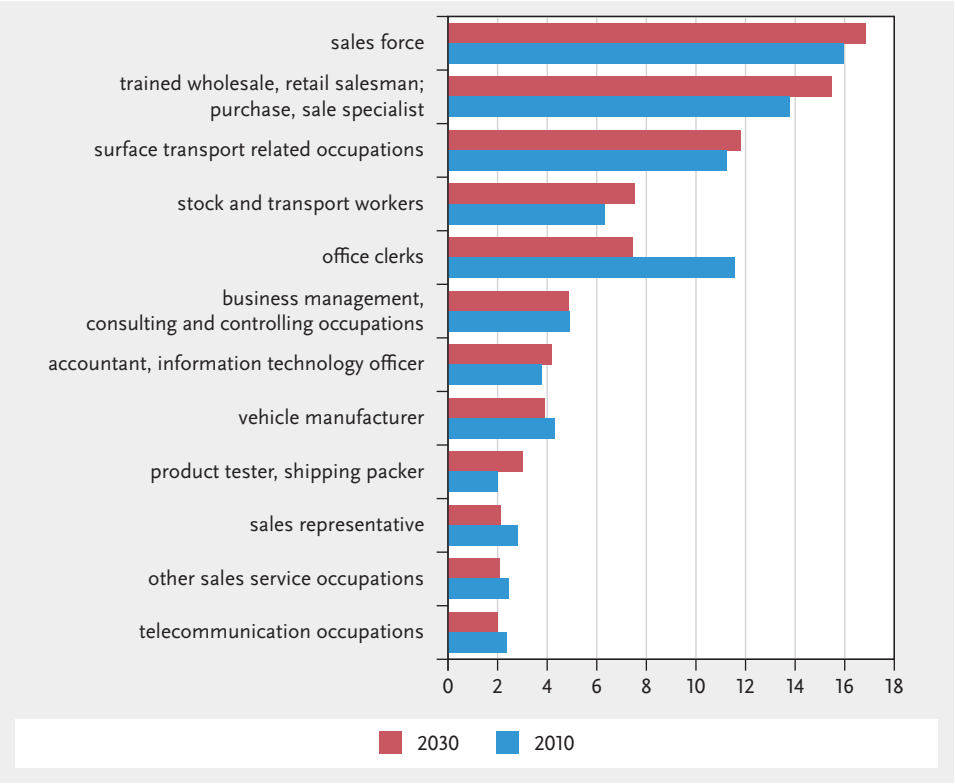

Figure 2-5 Restructuring of employment in the logistics and transport sector
% share of total employment of this sector
Ranking of occupations with the highest share in 2030

Sources: Economix, IER

in surface transport related occupations will rise by the year 2030. This reflects the increased importance of domestic and international trade, which will ensue in the process of globalisation. E-commerce will predominantly reduce administration and office jobs. Even a higher share of stock and transport workers or accountants and IT officers will not be able to compensate for this.

In the trade and transport sector, this will give rise to a considerable redirection of occupational profiles. Trading activity will be conveyed via new media to an even larger extent than before. Fields of action will be expanded from regional into nation-wide markets and from national into international markets. Retail will function with even fewer staff, yet because of this, the technical expertise of sales personnel will advance in technically complex and sophisticated areas. Specialised retailers will resort to high quality consumer goods and capital goods.

Downsizing in simple trade professions is one of the conditions for employment growth in other occupational areas. Viewed in this light, it is almost a pre-requisite

for rising employment, for example in healthcare and nursing or in other business service sectors. Without this restructuring, it could become difficult to cover the need for manpower requirements in the areas which are growing. Therefore, education and labour market policies should establish a mobile labour market, on one hand by emphasizing basic skills in vocational training and on the other hand by promoting occupational changes in continuing training.

2.3.6 Occupational profile for the business services sector: rationalising clerical work

Strong employment growth in this sector will more or less include all occupations (Figure 2-6). The occupational structure will therefore only change slightly. Office clerks and accountants, IT officers will be an exception to this rule, as these fields of work will be reduced in many economic sectors due to the use of information and

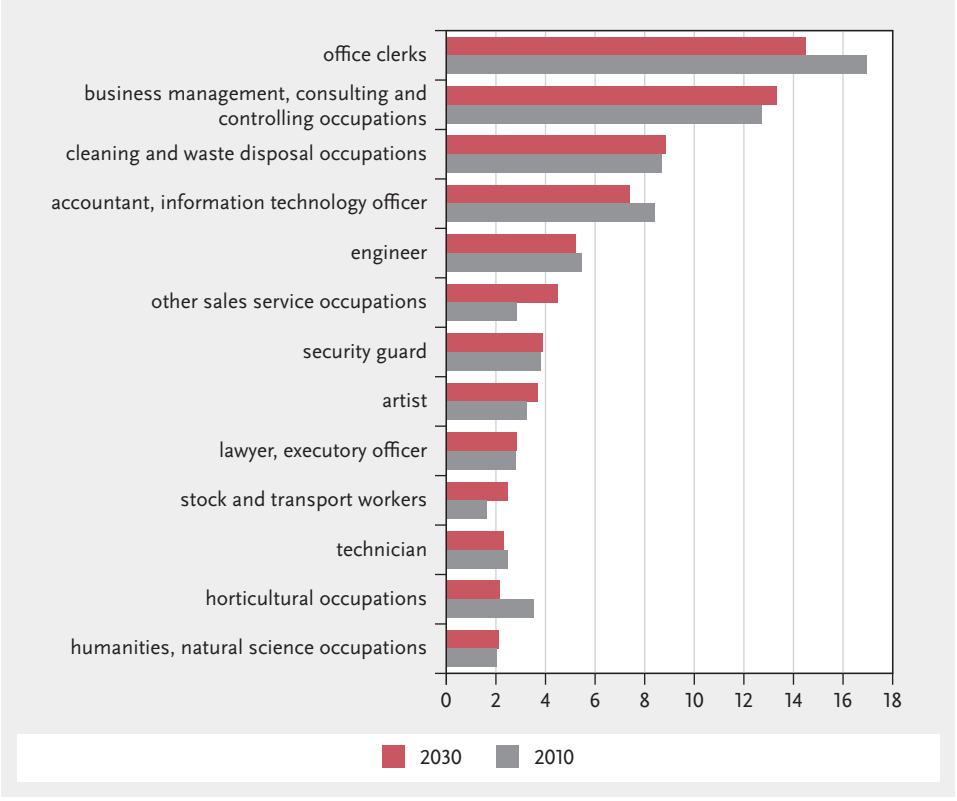

Figure 2-6 Restructuring of employment in the business services sector
% share of total employment of this sector
Ranking of occupations with the highest share in 2030

Sources: Economix, IER

communication technology. However, the number of occupations in corporate management will increase disproportionally. Even the so-called other sales service occupations – predominantly occupations in transport, advertising specialists, trade brokers – will increase proportionally, just as it will for artists and journalists. The business services sector will increasingly look for workers who can take on creative tasks in design and communication.

The segment of IT specialists, which is not listed separately in the occupational classification of 1992, is likely to expand in relation to the employment figures in the business services sector. There is an increasing need for IT specialists in many fields of application in information and communication technology, although it still remains limited due to IT companies' weak competitive position in Germany. The IT development centres are situated in other parts of the world – especially in the USA and in Asia. This lag, which Germany has not made up for in decades, will remain this way in the future, meaning that the demand for IT specialists will remain behind that of other industrialized countries.

In addition to enhancing expert knowledge in the business services sector, the sector will also profit from outsourcing simple services from other economic sectors. This will lead to an increase of jobs in cleaning and waste management or for workers in warehouses and in transport.

2.3.7 Occupational profile for the public administration sector: cutting jobs in almost all occupations

Abolishing compulsory military service, which is still included in the data from 2010, will significantly influence the changes in the occupational profile of the public administration sector (Figure 2-7). The share of other security related occupations will decrease from 20 % to 16 %. However, the number of office clerks, political representatives and senior officials, as well as the number of social care and welfare occupations will increase.

However, this should not hide the fact that almost all areas of employment will decrease between 2010 and 2030 in absolute numbers. In clerical occupations, 133 000 jobs will be cut and in security occupations it will be 178 000. These two figures together already amount to three quarters of total employment decline in the public administration sector. However, the fall in the employment rate will affect practically every occupational group. It is assumed that the only increase will be in the group of political representatives, senior officials; a total increase of 17 000.

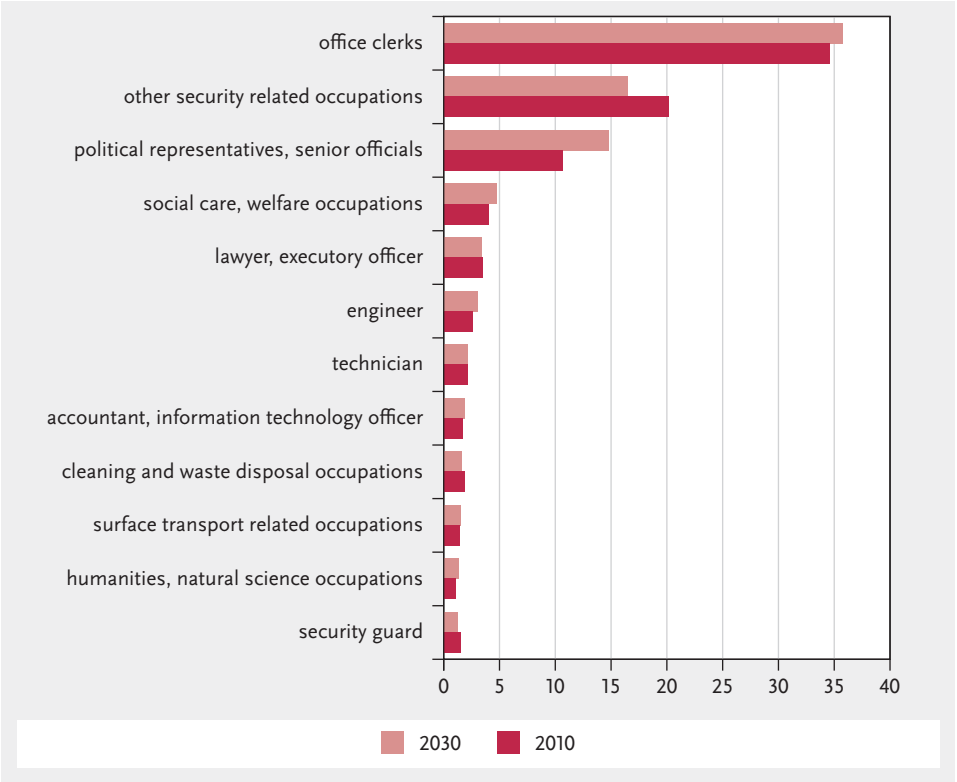

Figure 2-7 Restructuring of employment in the public administration sector
% share of total employment of this sector
Ranking of occupations with the highest share in 2030

Sources: Economix, IER

2.3.8 Occupation profile for the social services sector: adapting to the ageing population

With the decreasing number of children, the demand for occupations in education will fall significantly (Figure 2-8). In total, 180 000 fewer teachers will be employed in 2030 compared to 2010. The expansion of technical colleges and adult training programmes will, however, lead to an increase in employment of 64 000 in humanities and natural science occupations.

The rising number of older people will noticeably increase the demand for occupations in healthcare and social services. Employment in health occupations will rise by 124 000, and in social service occupations an increase of 122 000 is expected. As a result of high expenditure in care, employment figures will rise in domestic work and in the food industry as well as in the hotel and catering sector.

Overall, the social services sector is characterised by a significant amount of restructuring. This is apparent from the fact that the fluctuations of growing and shrinking

occupations keep the scales in balance, as can be seen from the changes in Figure 2-8. During restructuring, as in many other economic sectors, management positions will increase but office and sales jobs will be restricted.

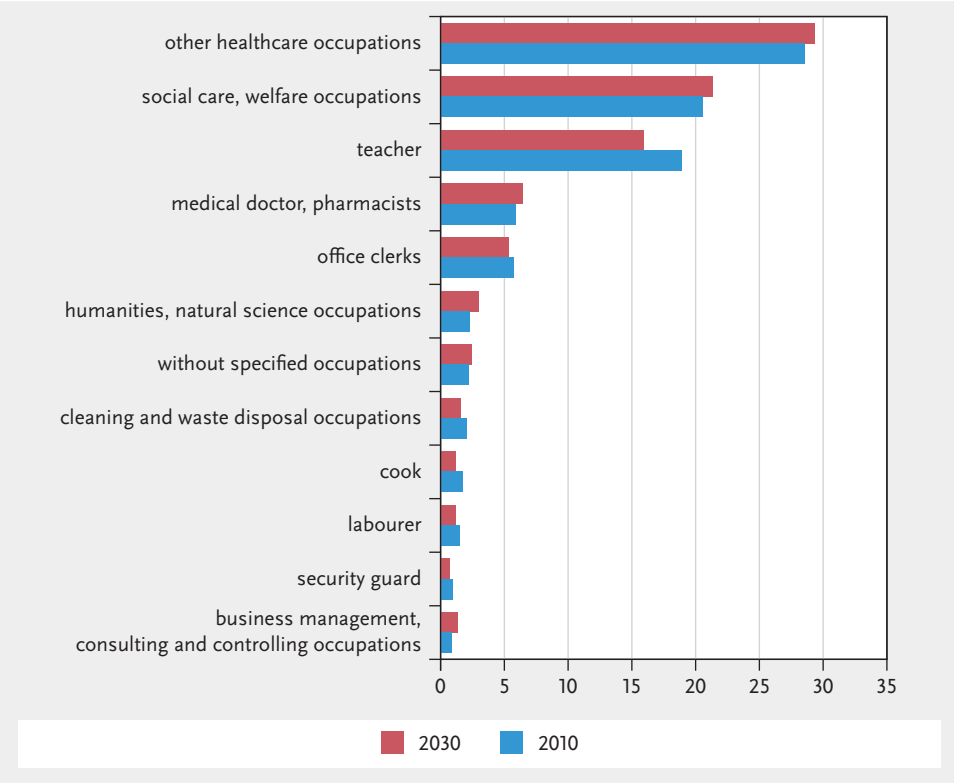

Figure 2-8 Restructuring of employment in the social services sector
% share of total employment of this sector
Ranking of occupations with the highest share in 2030

Sources: Economix, IER

2.4 Skills-based and qualification-based structural change

2.4.1 Overall development

Employed persons' qualifications will gain considerable recognition by 2030. The number of employed persons who have a higher education degree will rise by approximately 3 million, giving a total of 10.4 million (Figure 2-9, Table 2-4), which is the equivalent of a 40 % increase. The number of employed persons with dual vocational training will remain substantial and will only drop moderately by 211 000, giv-

ing a total of 20.5 million (-1 %). On one hand, the restructuring process will be achieved by reducing the number of employed persons who have a qualification from a technical college. In this segment, we expect a drop of 781 000 employed persons (-19 %). On the other hand, the number of employed persons without any vocational training will fall by 3.4 million, giving a total of 4.9 million (-41 %).

With this trend, strong growth in labour supply will continue for people with a tertiary education. Between 1995 and 2020, the group of people with these qualifications is projected to grow by 39 %. Therefore, it is not the high growth rate which we have estimated for 2030 that is so surprising, but rather the almost continuous expansion in this labour market segment. This contradicts the constant concerns for a surplus of academics. Restructuring the economy requires a constant qualitative revaluation of human capital at this fast pace in order to make use of the competitive advantages in knowledge-based service markets.

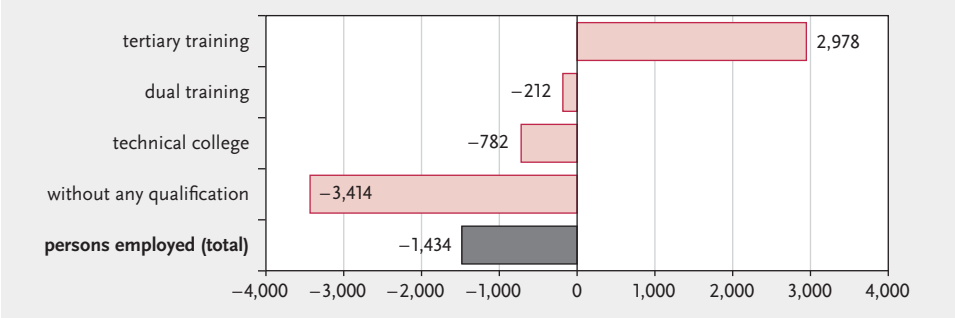

Figure 2-9 Main groups of formal training 2010–2030
Absolute change of employment in 1000s

Source: Economix

Unlike the past, employment in the segment of dual vocation training will not expand any further. The growth of 1.8 million, which was measured between 1995 and 2010, will not continue due to the diminished importance of manufacturing occupations and occupations in trade. Yet the dual training system will remain an essential segment of vocational training, and more than half of the number of people employed in 2030 will have completed the dual system (52 %).

The shift towards tertiary education had already begun to evolve in the past due to the low number of people who graduated from technical colleges. We expect a significant acceleration here. More and more technical college graduates will be replaced by university graduates with bachelor degrees. The increasing number of graduates at this level will make this possible.

This will not only result in substituting master craftsmen with bachelor graduates, but also specialised jobs will be adapted to fit the skills profiles of these graduates. More than ever, organisations will take advantage of graduates' theoretical knowl-

edge and the broad range of training opportunities offered to graduates from tertiary education. This reorientation will affect a number of workers from dual vocational training in that they will need to carry out more complex and demanding tasks.

This crucial restructuring will come into force as a result of fewer workers not having any vocational qualifications. We expect that the shortage of skilled workers will prompt not only governments but also organisations to invest in training their employees. At the lower end of the qualification spectrum, this will include increased effort in integrating youths from educationally deprived backgrounds as well as developing life-long training schemes. These are the prerequisites that are needed for the economy to be able to transform its qualification needs into effective demand.

Table 2-4 Persons employed by formal training

Formal training	Count (1000)		Change 2010–30	
	2010	2030	1000 persons	%
humanities and cultural studies, sports	1589.0	1985.4	396.4	24.9
law, economics and social sciences	2439.5	3718.2	1278.7	52.4
mathematics, natural sciences	702.1	1132.6	430.5	61.3
human medicine, veterinary medicine	578.9	947.3	368.4	63.6
agricultural science, forestry and nutrition science	166.6	183.3	16.7	10.0
engineering sciences	1575.9	1912.0	336.1	21.3
arts, art sciences	338.1	488.6	150.5	44.5
other	7.1	7.3	0.2	3.2
tertiary training	**7397.1**	**10374.7**	**2977.6**	**40.3**
farming, animal breeding, fishing	555.7	505.6	-50.1	-9.0
industrial and craft manufacturing occ.	380.6	332.9	-47.7	-12.5
metal working occ.	2015.7	1862.9	-152.8	-7.6
other manufacturing occ.	1735.3	1712.0	-23.3	-1.3
construction occ.	1114.7	1093.3	-21.5	-1.9
technical occ.	733.9	639.0	-94.9	-12.9
salesmen and service occ., shipping and transport related occ.	4974.3	5084.4	110.1	2.2
organisation, administration and office occ.	4460.2	3761.7	-698.5	-15.7
private service occ.	974.4	907.2	-67.2	-6.9
healthcare and social occ.	2092.5	2681.2	588.7	28.1
body care, guest relation, domestic and cleaning occ.	1504.9	1895.3	390.4	25.9
other occ.	185.7	40.8	-144.9	-78.0
dual training	**20728.0**	**20516.3**	**-211.7**	**-1.0**
engineering occ.	1964.0	1214.6	-749.3	-38.2
commercial occ.	593.4	401.6	-191.7	-32.3

(Table 2-4 continued)

Formal training	Count (1000)		Change 2010–30	
	2010	2030	1000 persons	%
IT specialists, mathematicians, natural scientific occ.	60.7	41.0	-19.8	-32.6
creative-artistic occ.	88.0	95.2	7.2	8.2
education related and nursing occ.	1284.8	1453.0	168.1	13.1
other occ.	120.6	124.1	3.5	2.9
technical college	**4111.5**	**3329.5**	**-781.9**	**-19.0**
without any qualification	**8273.7**	**4859.5**	**-3414.2**	**-41.3**
not stated	**92.7**	**89.4**	**-3.3**	**-3.5**
Total	**40603.0**	**39169.5**	**-1433.5**	**-3.5**
Of these				
MINT tertiary training	2278.0	3044.6	766.6	33.7
MINT dual training	733.9	639.0	-94.9	-12.9
MINT technical college	2024.7	1255.6	-769.1	-38.0
MINT (total)	**5036.6**	**4939.2**	**-97.4**	**-1.9**

Source: Economix

The entire qualification structure will be determined by a chimney effect, wherein at the upper end there is a strong demand for graduates from tertiary education which then pulls all the lower levels upwards. This will create significant career prospects for employees, whereby they will be able to take advantage of a higher level of general and vocational training. Above all, displacing vocational training with the so-called transition system will come to an end and it will open up new opportunities for those who are educationally disadvantaged.

2.4.2 Tertiary education graduates: strong demand for lawyers, economists and social scientists

The majority of additional jobs in tertiary education will be taken by lawyers, economists and social scientists (Figure 2-10). These will represent 1.3 million of the 3 million newly created jobs allotted to tertiary education graduates. Strong demand for these fields predominantly depends on the growing importance of legal, economic and social aspects in many professions. As has been seen in the past, the number of graduates from tertiary education has increased in occupations such as finance, management or legal professions. This illustrates an increase in professionalisation, which has led to a decrease in the share of graduates from technical colleges.

We not only expect this trend to continue in the future, but we also believe that lawyers, economists and social scientists will spread out further into non-specialised

occupations. This includes technical occupations with engineers and master craftsmen as well as personal service providers and teachers. This will be due to the increasing importance of management tasks, as well as the necessity to consider the economic, social and legal aspects in other occupations.

There will also be a significant increase in employment in the fields of mathematics and natural sciences, while the number of engineers will also increase, but in comparison it will only increase slightly. This is because of the growing importance of research and development compared to the production of goods. Furthermore, the demand for linguists and cultural scientists will increase, as will the number of physicians.

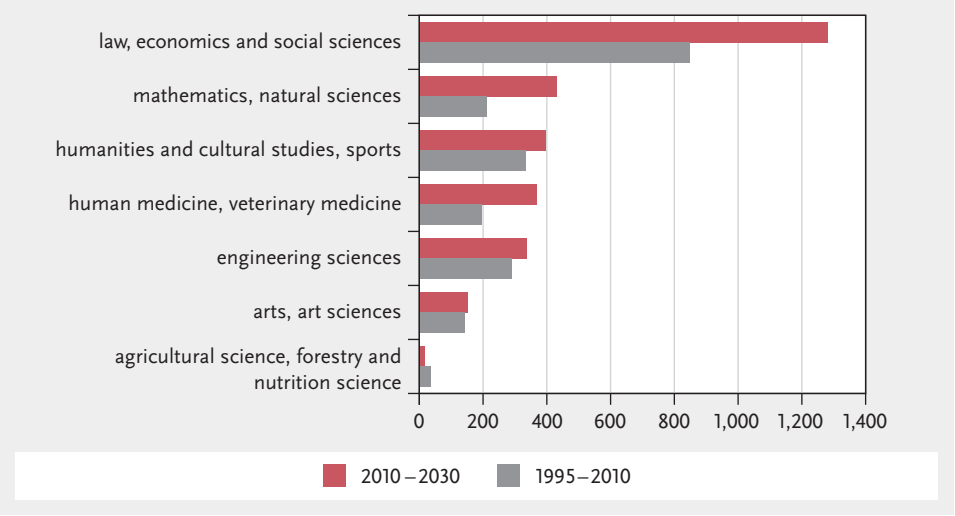

Figure 2-10 Persons employed with tertiary training
Change of persons employed, 1000s
Ranking of subjects by increase 2010–2030

Source: Economix

2.4.3 Dual vocational training

Within the dual training system, there will be a significant increase in demand for workers who have completed dual vocational training in healthcare and social occupations (Figure 2-11). Furthermore, we expect demand for trained staff to increase in the fields of body care, guest relation and cleaning occupations.

However, there will be a sharp decline in demand for workers who have completed dual vocational training in organisational, administration and office professions. This will be the result of the structural change in occupations. In contrast, the number of workers who were trained up in a manufacturing occupation will, by comparison, only change a little. However, we do expect a considerable increase in the range

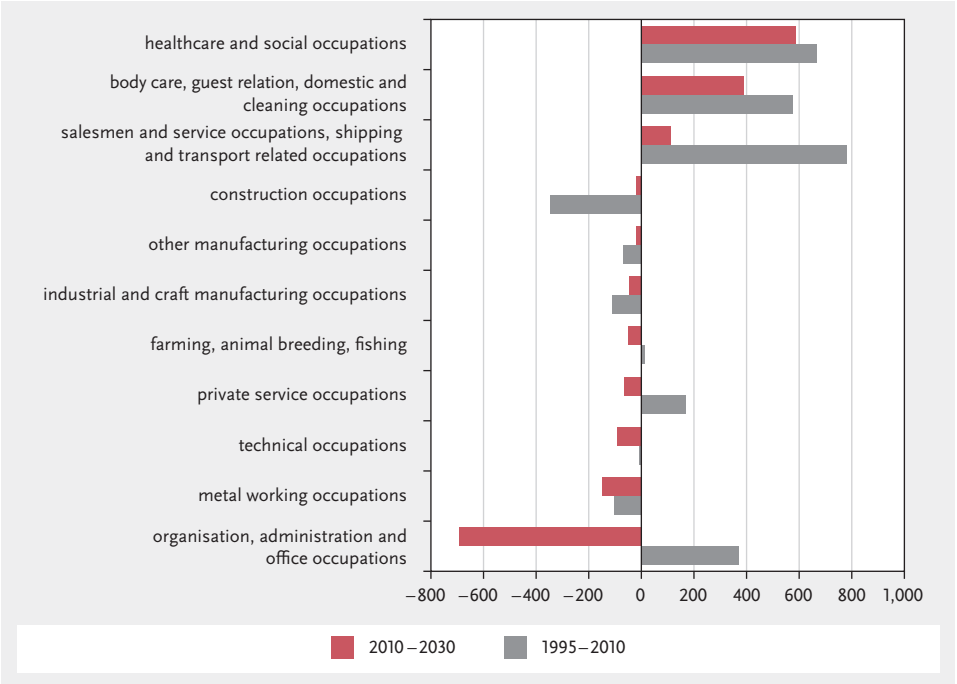

Figure 2-11 Persons employed with dual training
Change of persons employed, 1000s
Ranking of subjects by increase 2010–2030

Source: Economix

of competences offered in training and applied in the tasks of these occupations. Workers who adapt to the structural change will be the ones who are able to keep their worth as skilled employees. As explained above, a decline in mass production will shift the range of working tasks towards high-quality manufacturing processes, skilled craftsmanship and cooperation in research and development. Thus, workers in manufacturing occupations will continue to be indispensable.

It is also vital to develop further the dual vocational training system in three directions:

- To cover the demand for skilled workers, it will be necessary to open up the dual vocational training system more actively to youths from migration backgrounds. For this to happen, the dual vocational training programme needs to be adapted to better suit the educational qualifications of this group of people.
- Vocational training has to be made more accessible in order to achieve the chimney effect described above. Until now, for the majority of people who completed the dual vocational training programme, it is a catch-22 that only a few people manage to find their way out of. A comprehensive classification system for all training regulations could be created which would allow different career

paths to be compared to each other and would ensure that training units can be transferred to other occupations and to higher training levels.
- The lower inflow of young people has to be compensated by adults participating in vocational training. In particular, people without any vocational training need to be won over and the dual training programme is ideal for that. Therefore, a dual training programme for adults needs to be created which is in line with their current working activities, or a special training area needs to be set up where they are trained up and supported. A classification system would also be necessary here so that the combination of training units results in a job profile.

This means that the dual training programme has to stop focusing on being an initial training scheme and needs to be developed into a modular system, whereby adults can develop their skills further. Successful examples of this can be found in the Netherlands and in Australia (Vogler-Ludwig 2012). In particular the Netherlands have managed to create a transparent training system in the intermediate qualification band, which allow occupational transitions in many directions. Moreover, it is a system where school education and vocational training can be compared equally. The first point which appears to be important is the flexibility requirements from the structural change, the second point being the increase in theoretical requirements in many occupations.

2.4.4 Graduates from technical colleges

There will be a sharp reduction in the number of workers in engineering occupations who graduated from a technical college. The number of graduates who completed training for commercial jobs at a technical college will also decline. In the future, the training system in technical colleges will have even more of a presence in the fields of education and nursing (Figure 2-12).

The decline in engineering occupations will be the result of strong expansion in tertiary education. The master craftsman, who until now, more often than not, held a technical college certificate, will not be as important anymore, and in the future this person will be a graduate of tertiary education instead. Other technical college graduates will also be substituted by tertiary education graduates, especially those in commercial occupations. The rising demands in commercial occupations will require high investments in vocational training.

With regard to vocational training for occupations in art and design, a strong demand for workers with creative and artistic talents will compensate the substitution effect. Similar developments will also be apparent in the fields of IT and computer science.

In total, the number of so-called MINT occupations will remain constant.[12] In the year 2030 there will be 4.9 million workers in these specialised fields, which will only slightly be under the level of 2010 (5 million).

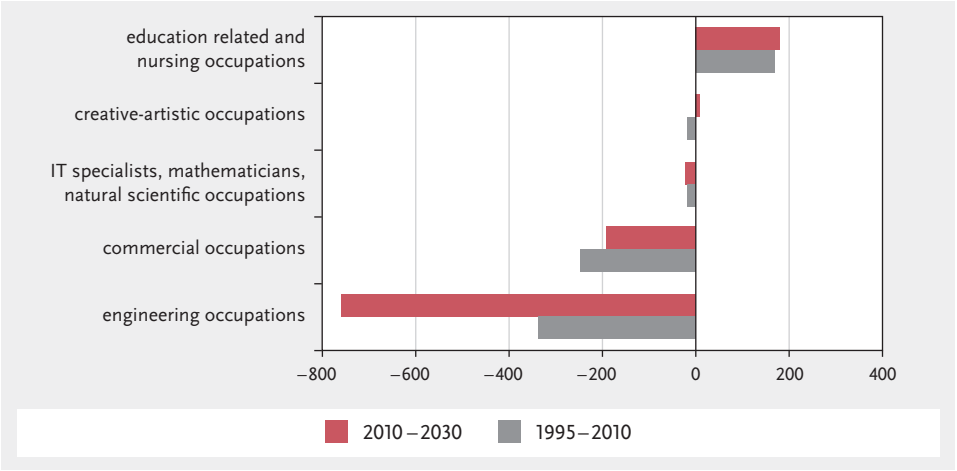

Figure 2-12 Persons employed with technical college training
Change of persons employed, 1000s

Sources: Economix, IER

2.5 Replacement demand

2.5.1 Overall results

In this forecast, we have used two different concepts to measure the so-called replacement demand, i. e. measuring the number of workers who leave employment, independent of whether they will be replaced:

- The replacement demand concept developed by ROA essentially measures replacement demand based on demographic composition (Kriechel, Vogler-Ludwig 2013, chapter 3.2). Cohort changes by occupation, sex and age in different age cohorts are used. This concept reflects the long-term changes in the employment rate. Together with the need for expansion demand, i. e. fluctuations in the total number of employed persons, it generates the overall demand, i. e. the number of workers that will be needed given the demand trend over the period concerned.
- The flow model which was developed for this forecast measures the short-term and long-term labour inflows and labour outflows (Kriechel, Vogler-Ludwig 2013, chapter 4). Labour inflows and outflows from employment are part of this

12 MINT – Formal qualification in mathematics, natural science, informatics and technical science.

concept. In particular, this model measures short-term changes in employment due to workers changing jobs or changing their status from being employed to unemployed or non-employed. Migration flows and demographic flows are also included. The net inflows and outflows correspond to changes in the workforce or the number of persons employed, respectively.

The results of both concepts are illustrated in Figure 2-13. Until the year 2025, the long-term replacement demand will remain at approximately 1.2 million workers per year and will fall to 1.1 million thereafter. Total employment which initially rises and then falls implies that the total demand of 1.5 million in 2010 will fall to 0.9 million in 2030.

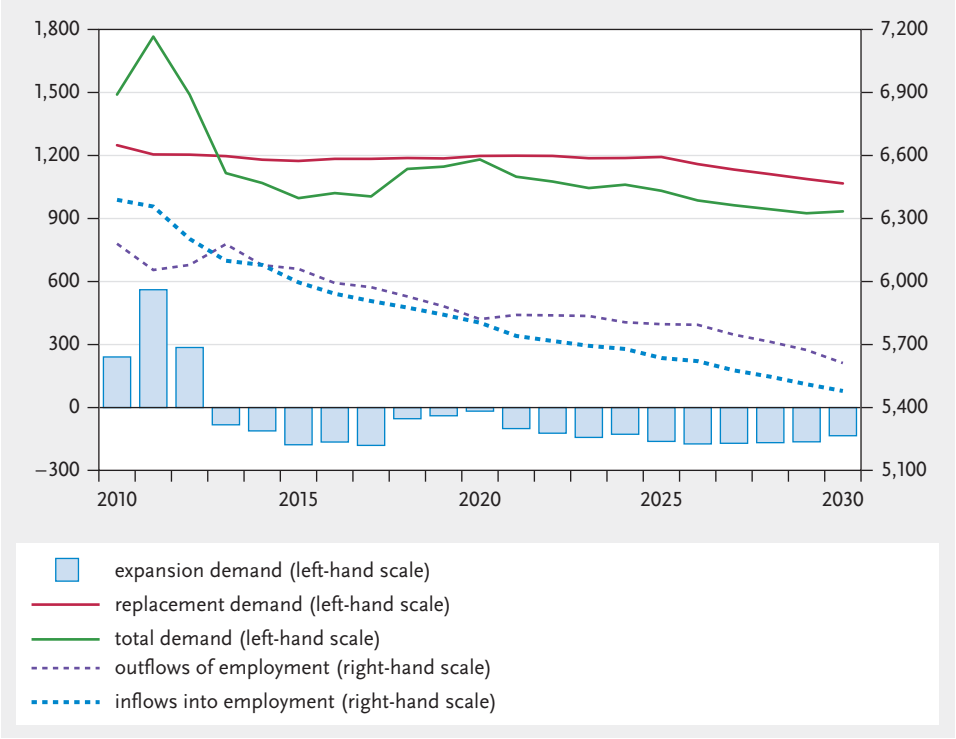

Figure 2-13 Replacement demand and employment related labour market flows
1000 Persons

Sources: Economix, ROA, IER

Replacement demand estimates the structural labour outflows. Based on the total level of employment, these outflows are mainly caused by retirement and by women taking family leave. The effect of retirement is particularly important in the model because, according to our calculations, increasing the retirement age to 67 until the year 2029 will lead to a longer working life and thus to fewer labour outflows. This

effect is so strong that after 2020 the overall economic replacement demand will fall. In the same way, rising female labour participation will reduce replacement demand due to family leave. Finally, the structural transition of occupations into service providers will result in a longer working life and a lower replacement demand. We therefore do not only ascertain that there will be an absolute decline in the number of workers to be replaced by the year 2030, but we also believe that there will be a structural decline in the replacement demand rate of 3.2 % of workers in 2010 to 2.7 % in the year 2030.

The concept of labour market flows generates much higher rates. Taking into account the demand throughout the year, annually 6.2 million workers will be needed in order to fill the positions which become vacant. This demand will drop to 5.6 million by the year 2030. In this estimation labour demand will be reduced by -0.6 million persons over the forecasting period.

2.5.2 Long-term replacement demand and overall demand for occupations

The total, annual labour demand will be an average of 1.1 million between 2010 and 2030, which is 2.8 % of the labour force. Based on the 34 occupational groups, there is a positive demand which – for most part – will be the result of the long-term replacement demand (Table 2-5).[13] Most workers will be needed in purchasing and sales. The annual demand of 105 000 people comes from the 98 000 people who leave their job each year and who are needed to replace this turnover and the on average 7 000 additional people who are needed each year. It is a completely different story for clerical professions: here, the long-term replacement demand will be 133 000 people per year. However, the number of workers will fall by 45 000 per year, meaning that total demand will be 88 000.

Table 2-5 Long-term replacement demand and total demand by occupation
Annual averages 2010–30

34 occupational groups Ranking by total demand	Total demand	Replacement demand	Expansion demand	Total demand rate	Share of 50–75 year olds*
	1000 persons			% of persons employed	
salesmen	104.9	98.2	6.6	2.6	25.1
teacher, social care occupations	88.4	86.8	1.6	2.6	33.1
office clerks	87.6	132.9	-45.3	2.0	29.4
personal service occupations	81.0	76.9	4.1	2.5	29.2
managers, senior officials	76.7	61.4	15.2	3.1	30.3
transport related occupations	76.6	73.0	3.6	3.0	29.6
* average 2006–2010					

13 More detailed results for 88 occupations can be found in the Annex, Table 2.3.2.

(Table 2-5 continued)

34 occupational groups Ranking by total demand	Total demand	Replacement demand	Expansion demand	Total demand rate	Share of 50–75 year olds*
	1000 persons			% of persons employed	
health occupations	76.2	68.1	8.1	2.7	23.4
building	56.7	62.1	-5.5	4.4	21.4
engineers, natural scientists	39.8	31.7	8.1	3.1	30.0
mechanical engineers and precision mechanics	39.3	46.7	-7.5	3.2	22.0
workers without specified occupation	34.6	43.1	-8.5	5.9	16.2
accountant, information technology officer	34.2	31.0	3.2	2.5	23.1
technicians	30.7	34.2	-3.5	2.7	27.8
banking, insurance specialist	29.1	24.3	4.8	2.8	25.6
security occupations	28.0	37.7	-9.7	2.4	30.7
electric and electronic technician	26.6	28.4	-1.8	3.4	22.9
plant operators, installer	25.4	34.3	-8.9	3.0	24.6
agricultural occupations	23.6	29.8	-6.3	2.4	33.2
artists, journalists	22.4	17.0	5.4	2.7	24.0
food related occupations	20.9	26.6	-5.7	2.4	23.5
product tester, shipping packer	17.3	13.4	3.9	3.6	28.0
labourer	15.4	20.1	-4.7	2.6	25.7
metal extractors and manufacturers	14.6	16.4	-1.7	3.0	25.9
wood occupations	14.4	15.5	-1.1	4.1	19.4
machine operators	13.6	15.1	-1.5	3.0	27.2
humanities, natural science occupations	11.0	7.6	3.4	2.4	18.7
lawyer, executory officer	7.7	7.3	0.5	2.5	28.0
assembler	6.6	6.5	0.1	3.2	27.2
chemistry and plastics related occ.	5.7	6.8	-1.0	2.8	25.7
miner, building materials manufacturer	4.8	5.6	-0.8	6.0	25.2
textile and leather occupations	4.3	6.4	-2.1	3.0	36.8
master craftsmen	3.8	5.5	-1.7	2.6	33.3
paper and print related occupations	3.5	5.8	-2.3	2.4	28.3
ceramists and glass manufacturers	0.7	1.3	-0.6	2.6	29.3
Total	**1115.1**	**1175.0**	**-59.9**	**2.8**	**27.1**

* average 2006–2010

Sources: Economix, ROA

Total demand in relation to the labour force is between 2 % and 6 % per year for the 34 occupational groups. In the more detailed 88 occupational groups, it may be even higher. Three types of occupations can be distinguished:

- *Mobile occupations:* the highest total demand is for miners, building materials manufacturers (6.0 %), workers without specified occupations (5.9 %), building occupations (4.4 %), wood occupations (4.1 %) and product testers, shipping packers (3.6 %). These are all professions with high labour inflows and outflows, meaning that occupational mobility can be named as being one of the causes for the high rate of total demand.
- *Old occupations:* demographically, we can observe that occupations with the highest proportion of the labour force (1/3 or more) between 50 and 75 years old can be found in teacher, social care occupations, master craftsmen, textile and leather occupations as well as in agriculture. This leads to high replacement demand in these occupations. However, total demand is below average at between 2.4 % and 3.0 %. Here, high labour outflows are reduced by declining employment.
- *Growing occupations:* this includes occupations in humanities, natural science occupations, artists and journalists, engineers, managers, banking and insurance specialists and health occupations. Total demand is slightly above average at 3 %. These occupations are all comparatively young. The proportion of the labour force over 50 is between 19 % and 30 %.

The relationship between the three explanations is recognisable but it will remain weak overall. Human resource management in the different sectors, which can vary greatly, not only because of the recruitment process but also with regard to older workers, has a noticeable effect on the figures. The strongest influence on total demand is the age structure of an occupation.

The considerable differences in total labour demand are illustrated in Figure 2-14 for selected occupations. This shows that total demand – despite the relatively continuous development of replacement demand – can exhibit strong cyclical fluctuations. Typically, this is the case for mechanical engineers/precision mechanics, but is also visible in engineering and in sales. In clerical professions, however, the decline in employment, significantly and continuously, reduces the level of replacement demand. There are no economic fluctuations here. The demographic decline among students will have a massive impact on teachers from the year 2020, meaning that total demand will barely be positive. It will be different for health occupations; total demand will predominantly be borne by replacement demand in addition to rising employment.

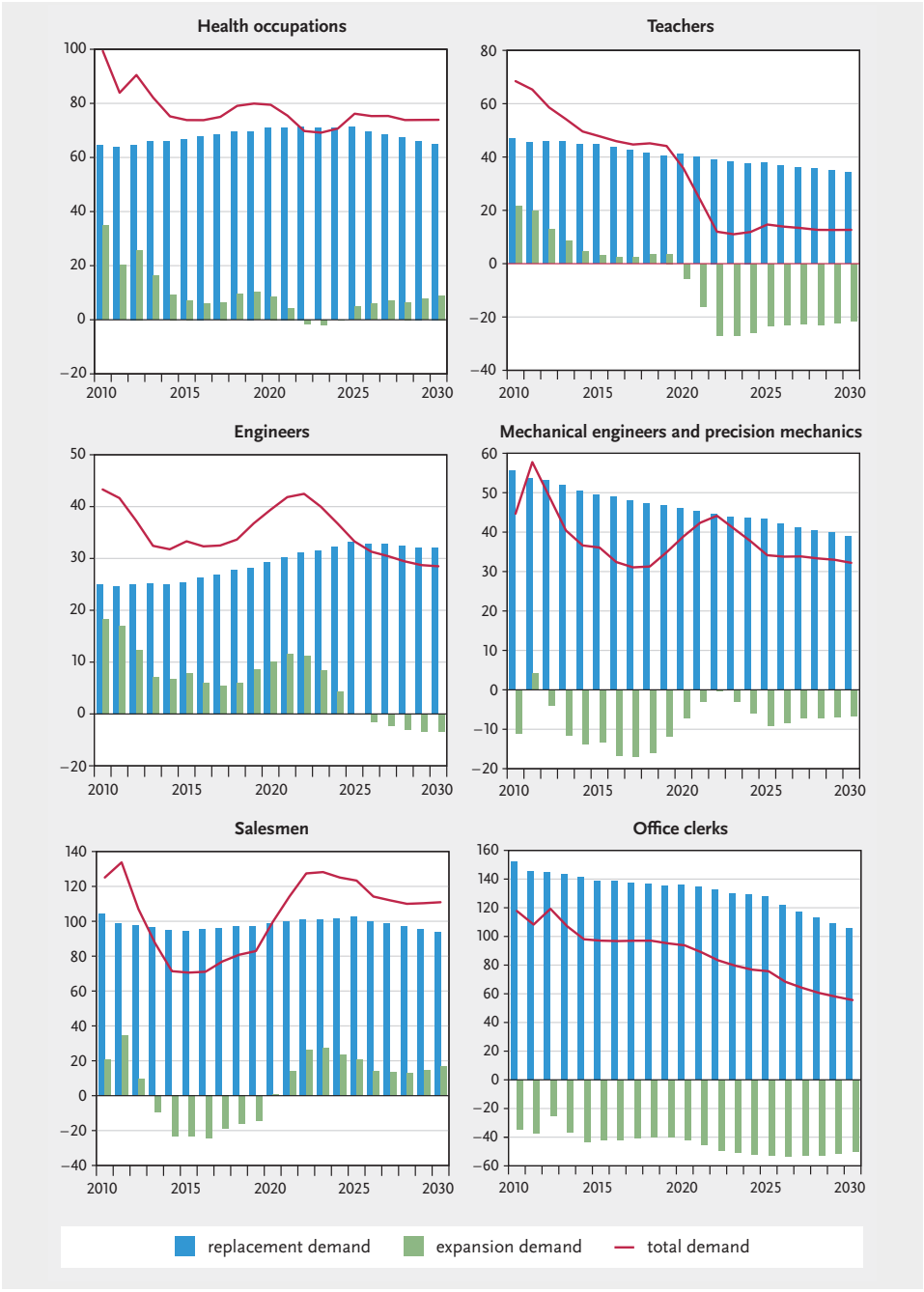

Figure 2-14 Employment demand in selected occupations
1000 persons

Source: Economix

2.5.3 Long-term total demand for formal vocational training

The structural change in sectors and occupations will increase demand for highly skilled and highly qualified workers. According to our calculations, by the year 2030, 413 000 workers with tertiary education will be needed per year, 614 000 with dual vocational training, 70 000 with a technical college degree and only 18 000 without vocational training (Table 2-6). The strong demand for academics is also visible in the relationship between total demand and employment in the respective qualification bands: every year, tertiary education graduates will be needed to replace 4.3 % of the labour force to fill vacant positions (to replace departing employees and to fill additional positions). In the segments of dual vocational training and technical colleges the figures will be 2.9 % and 2.0 %, respectively. For workers without any vocational training, replacement demand and the negative expansion demand will almost cancel each other out, meaning that only 0.3 % of workers will be required. For people with MINT[14] qualifications, total demand will be 145 000 workers per year. That is 2.9 % of employed workers with MINT qualifications.

The highest total demand identified is for lawyers, economists and social scientists. On average, 159 000 workers trained in these professions will be needed per year by the year 2030, whereby every year 68 000 additional workers will also be recruited. Furthermore, 74 000 humanities and cultural studies graduates as well as 66 000 engineering scientists will be required.

Total demand will exclusively result from replacement demand for workers with dual vocational training, as the stock of employees declines. The highest total demand will be for salesmen and service, shipping and transport related occupations (136 000). For dual vocational training in healthcare and social service professions, 89 000 employees per year will be needed, and a similar number will be needed in organisation, administration and office professions (84 000).

Falling labour demand for technical college graduates will reduce replacement demand by a third. Only occupations in education and nursing will have higher demand. Overall, there will be a demand for 43 000 workers per year who have completed training in these fields, 9 000 of which will be additional workers. For workers with artistic and creative training, demand in relation to employees will remain comparatively high (3.1 %). However, demand for workers who completed training in engineering occupations or commercial occupations will remain weak (1.1 % and 0.8 % of employees, respectively). The same goes for occupations in IT specialists, mathematicians and natural scientific occupations.

In fields with MINT qualifications, 145 000 people per year will be required, especially to cover replacement demand. The employment rate among these qualifications will not change. Expansion in the segment of tertiary education will probably lead to a reduction in the segment of technical colleges.

14 MINT – Formal qualification in mathematics, natural science, informatics and technical science.

Table 2-6 Long-term total demand by formal training
Annual average 2010–2030

Formal training	Total demand	Replacement demand	Expansion demand	Total demand rate
	1000 persons			% of persons employed
humanities and cultural studies, sports	74.1	53.4	20.7	3.9
law, economics and social sciences	158.9	91.3	67.7	4.6
mathematics, natural sciences	47.0	25.4	21.6	4.8
human medicine, veterinary medicine	40.4	21.6	18.7	5.0
agricultural science, forestry and nutrition science	6.2	5.2	1.0	3.2
engineering sciences	66.1	49.0	17.1	3.7
arts, art sciences	19.6	11.4	8.2	4.2
other	0.3	0.2	0.1	3.5
tertiary training	**412.5**	**257.5**	**155.0**	**4.3**
farming, animal breeding, fishing	13.8	16.4	-2.6	2.5
industrial and craft manufacturing occ.	12.7	15.2	-2.5	3.5
metal working occ.	66.4	74.5	-8.1	3.3
other manufacturing occ.	59.4	60.5	-1.1	3.3
construction occ.	52.0	53.1	-1.1	4.6
technical occ.	14.8	20.6	-5.8	2.1
salesmen and service occ., shipping and transport related occ.	136.0	130.3	5.7	2.7
organisation, administration and office occ.	84.2	118.0	-33.9	2.0
private service occ.	24.7	27.5	-2.8	2.6
healthcare and social occ.	89.2	59.5	29.6	3.6
body care, guest relation, domestic and cleaning occ.	62.4	42.5	19.9	3.5
other occ.	-1.3	5.6	-7.0	-1.5
dual training	**614.0**	**623.8**	**-9.7**	**2.9**
engineering occ.	17.1	50.1	-33.0	1.1
commercial occ.	3.3	13.2	-9.9	0.8
IT specialists, mathematicians, natural scientific occ.	0.4	1.3	-0.9	0.9
creative-artistic occ.	2.7	2.7	0.0	3.1
education related and nursing occ.	43.0	33.6	9.4	3.2
other occ.	3.5	2.7	0.8	2.6
technical college	**70.0**	**103.6**	**-33.6**	**2.0**
without any qualification	**18.3**	**190.2**	**-171.9**	**0.3**
Total	**1114.6**	**1175.0**	**-60.3**	**2.8**
Of these				
MINT tertiary training	113.0	74.4	38.7	4.0
MINT dual training	14.8	20.6	-5.8	2.1
MINT technical college	17.5	51.4	-33.9	1.1
MINT (total)	**145.3**	**146.4**	**-1.1**	**2.9**

Sources: Economix, ROA, IER

2.5.4 Long-term replacement demand by age

We expect that with a rising retirement age, employment will increasingly shift into the over 60 age group. This will result in stronger replacement demand in this age group. Hence, the calculations illustrate an increase in the share of older people in replacement demand (Table 2-7). The proportion of the age group 60–64 years old and the group 65+ years old will increase between 2010 and 2030 by 4.7 and 5.5 percentage points, respectively. Together, they will account for 53 % of replacement demand in the year 2030. In 2010 the figure was 43 %. However, the 50–59 year old age group will lose 12 percentage points. The effects of extending employees' working lives come into play here. For the youngest workers aged 15–29 years old, replacement demand will only increase slightly because of the high participation rate in vocational training. The proportion of 30–49 year olds will decrease by two percentage points by the year 2020 and will then rise back to the same level by 2030. Educational choices as well as employment participation among women both play a role here.

Table 2-7 Replacement demand by age
% share of total replacement demand

Age group	2010	2015	2020	2025	2030
15–29	2.9	4.4	4.3	3.9	4.0
30–49	9.7	8.2	7.8	8.6	9.8
50–59	44.3	43.0	43.5	40.4	32.7
60–64	30.6	30.4	28.7	31.7	35.3
65+	12.6	14.1	15.6	15.3	18.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Sources: Economix, ROA

3 Labour supply – the challenge of an ageing population

3.1 Population development

The labour market of the future is marked by two trends: a shrinking population and a rising share of older people. According to Variant 1-W2 of the 12th coordinated population projection of the German Federal Statistical Office, the German population will decrease by 2.7 million to 79 million persons by 2030. The working-age population (15–74 year olds) will decline even further by 4.7 million to 58.6 million. Thus, 0.5 % of the working-age population will disappear annually up to 2030.

This population decrease is linked to a notable ageing of the population (Figure 3-1). The number of those at least 60 years old will rise by 7.1 million by 2030, whereas

12th coordinated population projection of the German Federal Statistical Office:
Out of nine variants, we chose Variant 1-W2. It assumes that:

- The birth rate will rise from the current 1.36 children per woman to 1.4 children per woman. This is in accordance with our assumption that governments and business will implement policies to promote a better compatibility of family and career. Therefore, a further decline of the birth rate seems to be unrealistic. Under the assumption of rising labour participation rates for women, an increase in the birth rate to 1.6 children per woman is plausible, though this would require a fundamental change in the population's perception of the role of the family and of family work. However, moral values and modes of behaviour change at a slow pace. Furthermore, the trend towards a more highly qualified female workforce is expected to have a rather dampening effect on the birth rate.
- Life expectancy at birth will rise by 7.8 years for men and by 6.8 years for women until 2060 compared to the year 2006/2008. This is due to medical advances and a healthier lifestyle of large sections of the population. Even further progress in medicine is conceivable. In a different variant of the population projection, the Federal Statistical Office calculates with a life expectancy increase of 10.6 years for men and 8.8 years for women. Under the pressure of rising health expenses in the context of the ageing population and an increase in old-age poverty, this potential may not be realised.
- The net migration balance will increase from next to zero to 200 000 per year from 2020 onwards. Net migration has grown in the recent past. This is related to the expansion of free movement of workers in the European Union; to the large EU-internal differences in unemployment rates due to the financial crisis; but also to the large labour demand in Germany. It is assumed that the German labour market will still be highly attractive and that the government will at least facilitate immigration of highly skilled workers from outside the EU.

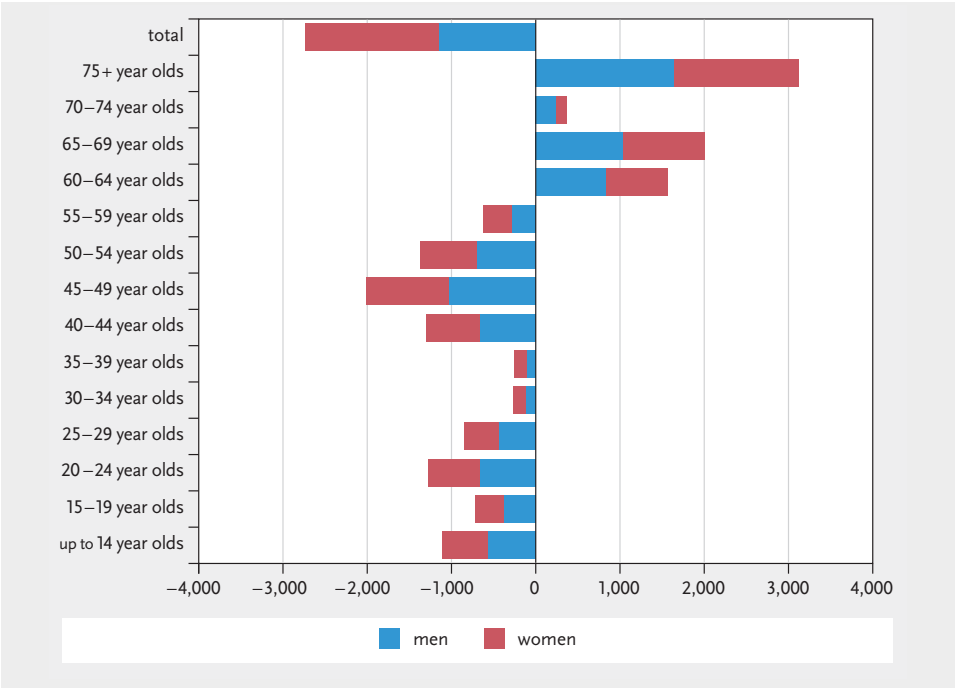

Figure 3-1 Population by age
Change 2010–30 (1000 persons)

Sources: Federal Statistical Office (12th coordinated population projection, variant 1-W2), Economix

the number of persons under 60 years old will be 9.8 million fewer. After 2020, the baby boom generation of the 1960s will reach retirement age and the currently high number of 40 to 55 year olds will therefore significantly decline. However, the younger generation under 30 years old will also decrease substantially. There will be 4.0 million fewer people under 30 in the year 2030 compared to 2010.

This is Germany's demographic challenge; a challenge that will not only be linked to significant changes in the population's political preferences. It will cause a shift in the age structure of the labour force, it will impact on productivity and economic growth, it will lead to different consumer and investment behaviour, and eventually it will cause great financial challenges for social systems. This will happen if the population's behaviour does not fundamentally change.

We assume that adaptations will happen in many areas. Employment behaviour will, according to our expectations, adapt to the shortage of skilled workers. Governments and the economy will set incentives to attract new workers. Markets will adjust to suit their ageing customers by progressively offering personal services. Personal services will increase and there will be new sources of income. A higher share of overall income will come from investment and asset income and will therefore compensate productivity and growth losses within the country, at least partially. There-

fore, it does not appear that the population decline will spread to the labour market one-on-one. On the contrary, many political and economic measures will lead to a sustainable change in behaviour. This is shown in detail in the following section.

3.2 Increasing labour market participation among women and older people

The projection of labour market participation needs to concentrate on three labour supply aspects: labour market participation of women, labour market participation of older people, and the overlapping effect of labour market participation and educational participation. There are various factors which determine behaviour, e. g. different participation rates in training and in the labour market among migrants and their descendants, the general employment behaviour of the population according to social class and vocational training, and last but not least the incentive effects of the labour market and the social system. In the following, our assumptions for those aspects are outlined, reasoned, and calculated regarding their effects on labour supply.

3.2.1 Labour market participation of women

As can be seen in Figure 3-2, an increase in female participation is expected in all age groups.

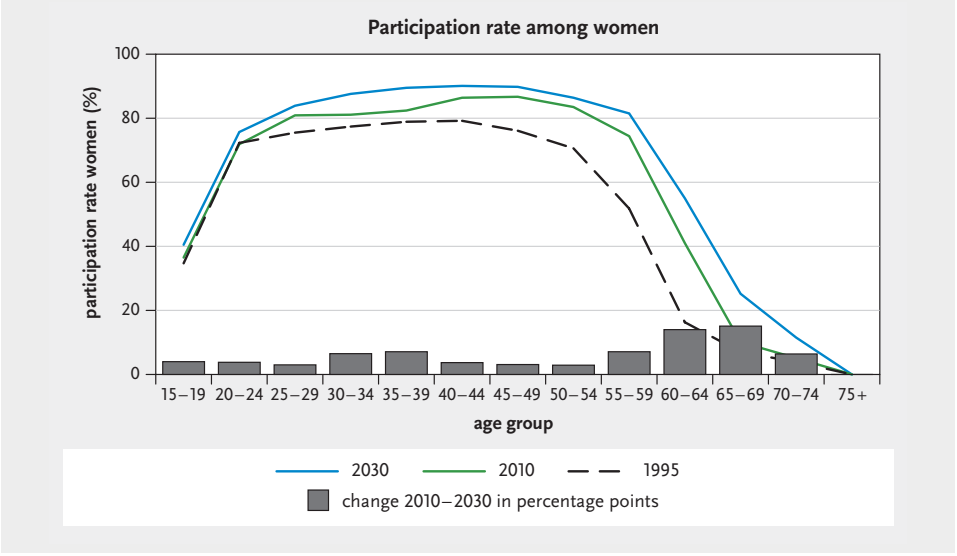

Figure 3-2 Participation rate among women
Female labour force in % of female population by age groups

Sources: Economix, CE

There are two opposing effects that affect participation rates of young women aged between 15 and 19 years old: on one hand, a shorter high school education *(Gymnasium*[15]*)* and women's changing roles lead to a rise in participation rates; on the other hand, an increasing proportion of female high school graduates and female university students reduces participation rates. This only has a limited negative impact on participation rates because a proportion of female pupils and students take up employment (usually only on a small scale) while studying. It is therefore expected that the participation rates of these youths will rise, however this rise will be relatively modest up to 2020 and will accelerate after 2020. Similar developments will be observed with the group of 20 to 24 year olds.

In the past, women were giving birth to their first child at an increasingly older age. This contributed to a rise of 5.4 percent in participation rates among women aged 25 to 29 years between 1995 and 2010. We expect there to be a further increase of three percentage points in the next 20 years. However, among 30 to 39 year olds, improved childcare services and increased efforts to ensure a better balance between family and work lead us to assume that there will be a more significant increase in participation rates than has been the case in the past. We expect an increase of 7 percentage points by the year 2030.

The participation rate of women aged between 40 and 64, and in particular women aged between 55 and 64, has risen strongly since 1995. Starting with a low level of participation, the participation rate has doubled in the last two decades, and among those aged between 60 and 64 years old it has more than tripled (Düll 2013b). We assume that this trend will continue, albeit with different dynamics depending on the age group. It is assumed that the participation rate of 55 to 59 year olds, which rose from 52 % to 74 % between 1995 and 2010, will continue to rise slowly. We expect that it will be 78 % in 2020 and 82 % in 2030. As a result, the employment behaviour of 55 to 59 year olds will be similar to the participation rate of 50 to 55 year olds (86 %). However, it will remain well below that of 40 to 44 year olds (90 %). A further rise in the participation rate can be seen as being a result of women entering the labour market at a later stage, studying longer, increasing their level of education, taking the necessary career breaks to raise children, as well as the threat of old-age poverty.

The participation rate of 60 to 64 year old women rose from 16 % to 41 % between 1995 and 2010, and is expected to rise to 55 % by 2030. This will still be significantly less than the participation rate of 55 to 59 year old women, although the gap between these two age groups will be smaller. Raising the retirement age to 67 and the increased labour market participation of pensioners will, in our estimation, lead to an increased participation rate of 25 % among 65 to 69 year olds and will therefore be two and a half times higher than it was in 2010. Finally, we believe that more than one in ten women aged between 70 and 74 years old will be employed, compared to

15 Gymnasium: High school which leads to advanced tertiary education (university entrance qualification)

one in twenty women in 2010.[16] However, this does not reveal any information regarding the quality of work or the number of hours that older people work. Peripheral employment is particularly common among older people.

3.2.2 Labour market participation among men

The most notable changes in labour market participation among men will occur in the group of over 55 year olds, whose participation rate will continue to increase (Figure 3-3). As among women, the participation rate will continue to rise, albeit to a lesser extent than in the past 15 years. The intensity of change varies substantially depending on the age group. Therefore, we believe that the participation rate of 55 to 59 year old men will increase from 86 % in 2010 to 90 %. The labour market participation of this age cohort will almost remain the same, and will only start to change from the age of 60.

According to our estimations, labour market participation among those who are 60 and older will rise substantially. Among 60 to 64 year olds it will rise from 57 % in

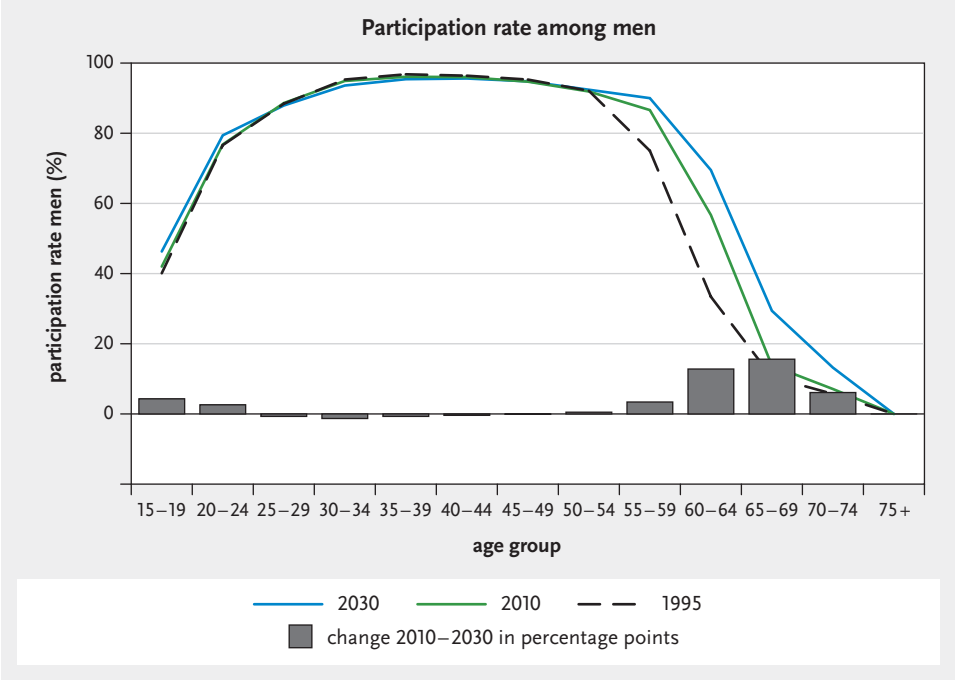

Figure 3-3 Participation rate among men
Male labour force in % of male population by age groups

Sources: Economix, CE

16 See Annex, Table 2.1.4

2010 to almost 70 % in 2030. Among persons aged between 65 and 69 it will rise even more sharply from 14 % to 29 %, and among 70 year olds the rate will rise from 7 % to 13 %. This means that the participation rate will almost double compared to former participation rates among persons aged 65 and older.

Looking at other countries, it is visible that a number of countries have a high labour market participation rate among older persons. This could be because pensions need to be enhanced to prevent poverty, or because there is still a professional interest in high labour market participation in old age. This is currently the case in Sweden, Ireland, Estonia, Israel, and New Zealand. In 2010, between 22 % and 24 % of 70 to 74 year olds were employed in the USA and in Iceland, and in Japan the figure was 30 %. However, there are countries where the participation rate among older people is substantially lower, for example in Italy, Spain, and other southern European countries.[17]

We assume that the participation rate among young men will rise slightly. The effects of shortening secondary school (*Gymnasium*) education and the trend towards a highly skilled workforce generally cancel each other out. We believe that the male participation rate will fall slightly during the 'family phase' because men are becoming more involved at home (i. e. an increasing number of men will take advantage of paternity leave for a short period of time). However, this is likely to be of minor effect, as gender-specific behavioural patterns change very slowly. According to our assumptions, the formation of a very wealthy social class that can make a living out of their returns on capital, and which is characterised by a low propensity of work, will also reduce the participation rate of men to a lesser extent.

3.2.3 Conditions for an increased participation rate

The estimations presented in this forecast regarding the participation rate are based on assumptions that allow for employment behaviour to change and assumes measures to support them politically. Generally, our understanding is that an increased participation rate is associated with falling unemployment, as the chances of finding a job will increase. Companies will set incentives to attract workers, not only with financial means, but also with qualitative improvements in the workplace, regarding childcare services, the working environment etc. Furthermore, we believe that the labour market reforms of 2005 with respect to benefit regulations will not be revoked. This means that unemployment will still be a considerable financial risk for the workforce and should be avoided. Hence, there will also be workers available for low-wage positions.

Assumptions regarding how labour market participation will develop have been based on the following considerations:

- There has already been a certain degree of catch-up in the female participation rate in the past. However, higher female labour participation rates in a number

17 Labour Force Survey OECD Statistics, see http://stats.oecd.org

of European countries suggest that this catch-up effect is not over yet. The forecast is based on the assumption that, under certain conditions, labour participation rates similar to those in Denmark, Norway or Sweden can be achieved. For this to happen, the government and company policies need to pave the way so that the reconciliation between work and family life is significantly improved. We believe that the states will react to the shortage of skilled workers in the long-term and will take the necessary measures in the following areas: expanding and improving childcare provisions for all ages, lengthening school classes and the school day, offering incentives to take shorter parental leave.

- We expect that companies will collaborate with social partners and, in view of the shortage of skilled workers, will intensify their efforts to make better use of the female workforce potential. Subsequently, an increasing number of flexible working time models for men and women will be established, working hours of part-time jobs will be extended or "shorter" full-time jobs will be created, and a range of further measures to enhance the reconciliation between work and family life will be adopted. Companies and social partners within companies will increasingly develop and implement career management systems for part-time employees and for employees that have to take time off to look after their family.
- An increase in female qualification levels will lead to an increased participation rate as non-employment would lead to higher opportunity costs.
- Improved conditions increase societal acceptance of working mothers, which is likely to have a positive effect on the propensity of (young) mothers to work, thus helping to change the perception of women's role in society.
- As a result of the pension reform, the participation rate among older persons, including those who have already reached the statutory retirement age, will rise. Higher participation rates for older persons – especially those over 60 – can be achieved if: companies and social partners at company-level develop flexible working-time models for older workers, companies implement demographically oriented human resource management policies, companies, employees and the government invest in lifelong learning for the whole duration of an employee's working life and for all skill levels, companies adapt their work organisation to fit in with the change in age structure, and companies organise the transfer of knowledge between their older and younger employees. Under these circumstances, older workers will be more highly valued and will thus be more motivated to work for longer. The threat of old-age poverty will also increase their willingness to work for as long as possible. It is even more important for women to extend their employment life as they usually receive a relatively low pension due to breaks over the course of their working life. At the same time, they more often depend on their own income and thus have to save for their own retirement.
- We expect that the participation rate among immigrants will increase as a result of their professional qualifications being recognised and the expansion of life-

long learning and subsequent training. This will also make it easier for immigrating family members to get their foot in the door of the German labour market. Furthermore, a more strongly governed migration policy will help to attract workers from abroad that have a chance on the German labour market.

3.3 Development of labour supply

Increased participation rates cannot prevent labour supply from shrinking, but they will help to dampen the demographic effect. Instead of declining by 6.1 million, as it would be the case at constant participation rates, the decline of labour supply can be more than halved and limited to 2.87 million persons as a result of rising participation rates. As the male labour force will decline by 1.9 million persons between 2010 and 2030, the decline of the female labour force will only be half that (approximately 960 000, see Figure 3-4[18]). On average, the labour force will decrease by 143 000 persons per annum between 2010 and 2030 (95 000 men and 48 000 women). In relation to the labour force, this means that labour supply will shrink by 0.3 % annually, 0.4 % among men and 0.2 % among women.

Figure 3-4 Labour force by gender

Sources: Economix, CE

However, it will not be possible to prevent the labour force from ageing. First of all, the baby boom of the sixties will visibly flow through the age profile of the labour force over time, thus increasing the proportion of the labour force that is over 55

18 For detailed results see Annex, Table 2.1.1

years old (Figure 3-5). However, this will no longer be the case from the year 2020. Extending employees' working life on one hand and the decline in the size of the young labour force on the other hand will contribute to the ageing process. The share of the labour force aged between 55 and 75 years old will rise from 17 % to 26 % for both men and women alike, while the proportion of young workers under 30 will fall from 22 % to 19 %.

However, it should be noted that increased labour market participation of older workers will not lead to a proportional increase in the volume of work because the number of part-time employees and those in peripheral employment is especially high in this group. We believe that working hours will be extended for part-time workers in order to meet labour demand. Nevertheless, longer working hours for older workers should remain limited.

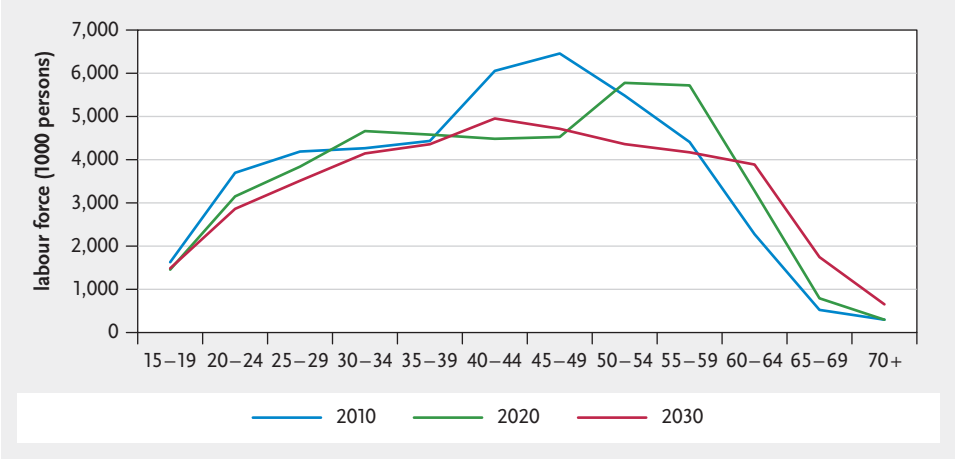

Figure 3-5 Labour force by age groups

Sources: Economix, CE

Compared to the effect of demographic development, increased labour market participation among women and older persons has a weaker influence on the total size of the labour force as well as on the age structure of the labour force. To demonstrate this, changes in the labour force can be broken down into a population effect and a participation rate effect. The population effect can be calculated by extrapolating the number of labour force at constant participation rates (as in 2010) but changing population numbers. The participation rate effect is calculated conversely, by extrapolating the labour force at changing participation rates, but at constant population numbers.[19]

This calculation gives a clear picture (Figure 3-6): solely as a result of the declining population, there will be 7 million fewer people in the labour force in the year 2030.

19 Furthermore, a composite effect is achieved by simultaneously changing both components

Increasing participation rates cannot fully compensate this loss. However, they will reduce it by 2.9 million persons and the positive composite effect will contribute to reducing the loss by 0.3 million. From the age of 60, rising participation rates will significantly impact on the size of the labour force, and this will be strengthened by the growing population in these age groups.

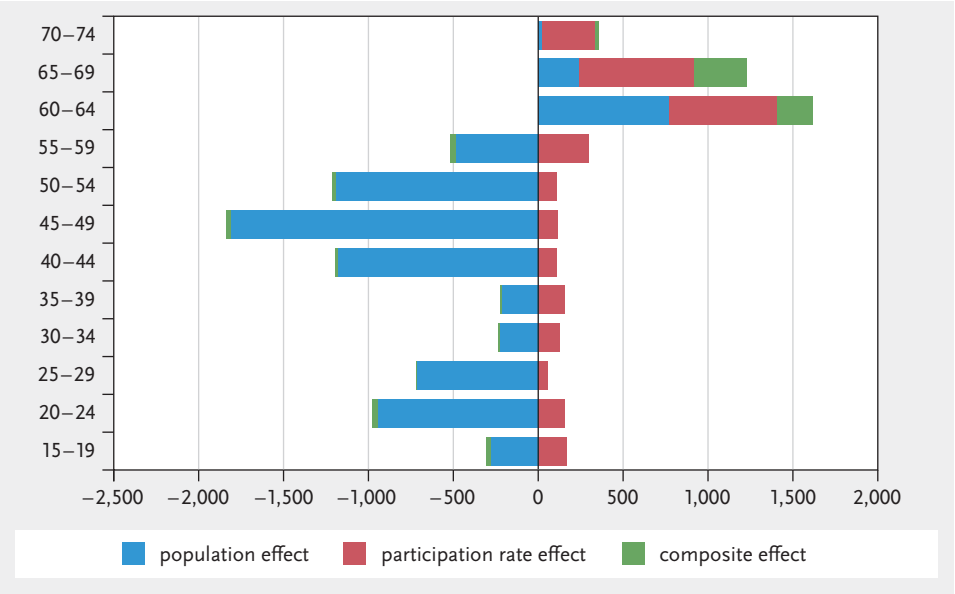

Figure 3-6 Population and participation rate effects on the labour force 2010–2030, 1000 persons

Sources: Economix, CE

The population effect will have a strong negative impact on the age group between 40 and 50 years old in particular. The size of the labour force will decrease by a total of 4.2 million due to this population effect alone. Moreover, the dwindling number of younger persons under 30 will reduce the labour force by further 1.9 million. On the other hand, the share of the population that is 60+ will grow by 1 million and, in general, higher participation rates will have a positive effect.

Changes in the demographic structure of labour supply could hardly be less favourable: not only will the number of younger workers decline significantly, but the middle-aged population will shrink even more, and the number of older people will increase noticeably. Therefore, the inflow of newly trained workers as well as the number of experienced and efficient middle-aged workers is at risk. The growing number of older workers will prove unable to compensate for these losses, either in terms of numbers, or in terms of a labour performance equivalent to that of younger workers.

Repercussions of low birth rates which have been evident for a long time and are accepted by the population, are now beginning to appear. More so than for previous generations, when weighing-up career life and family life women have, since the sixties, tended to favour employment. The general conditions required to combine both aspects, which is predominantly the case in Scandinavia and in France, were not established in Germany and were apparently not desired by politics or society. As the birth rates of days gone by cannot be changed, the economy and society now have to face up to the reality of demographic change.

If labour market participation rises more slowly:

The situation could be even more unfavourable than we have assumed in our projections:

- The labour force will decline further by half a million if it is not possible to increase the female participation rate of women under 40 in a sustainable way. This could be the case if the measures designed to improve the balance between work and family life are not enforced, or if these measures do not generate the desired results.
- There would be approximately 1.2 million fewer persons in the labour force in the year 2030 if the participation rate of older people only increases by half of what has been predicted. This could happen if companies and the state are not able to offer adequate incentives to prevent the older workforce from leaving the labour market, or if there is not an adequate number of jobs available for older workers, or if older workers prefer to take early retirement and exit the labour market because it is better than any of the other incentives being offered.

  Furthermore, it will be more difficult to compensate for such losses on the supply side by means of immigration, even though there is a large potential for immigration resulting from the expansion of the free movement of workers from the new EU member states. In parallel, we also expect that a growing number of workers will emigrate due to the effects of globalisation. The net effect on the labour market will therefore be less significant than the immigration rate alone would lead us to believe.

  If the development of labour supply takes an even less favourable route than is set out above, it will affect the overall economic development. A further decline in labour supply of 1.7 million will cause a decline of production capacity by 0.2 % per year; a factor which can hardly be compensated by stronger productivity growth. We expect productivity to grow by 1.7% per year provided that the productivity potential is fully exploited. This would mean that economic growth would be directly affected and would drop to an annual average of 1.3% between 2010 and 2030.

3.4 Working hours

Working volume, which measures the sum of hours worked by all persons employed throughout the year, has not changed much in recent years. The expansion of jobs resulted in a reduction in the average number of working hours per year. For the forecast period 2010 to 2030, we assume a reversal of this process: the projected decline in the workforce will be compensated by increased working hours – as a result, the working volume will largely remain constant. According to our estimations, by the year 2030 the average annual working hours per worker will increase by 4 %, whereas they fell by 8 % between 1995 and 2010. Longer working hours are therefore closely related to a shortage of labour. Thus, there will be a strong focus on this from 2020 onwards.

The extension of annual working hours predominantly results from lengthening the working hours for part-time employees. For full-time employees, this margin is likely to remain low as we expect high productivity gains to increase workloads.

For part-time workers, we expect that:

- As a result of the improved balance between work and family life which we have predicted, working hours will increase for women that work part-time. In parallel, the number of women that work full-time will also increase due to the demand for a highly skilled workforce.
- Working hours will be extended for those in peripheral employment *(geringfügige Beschäftigung*). This will be achieved by converting a selection of peripheral jobs into regular part-time jobs, or by increasing the income threshold for those in peripheral employment.
- Part-time employment will increase among older workers as a result of prolonging employees' working lives.
- The effects of increasing part-time work in some labour market sectors and the transformation of part-time employment into full-time employment cancel each other out, meaning that we can expect the part-time share to remain constant. Therefore, the adaptation process only leads to changes in the average number of working hours. Due to a decline in peripheral employment and an increase in regular part-time work, the working hours of part-time employees will rise by a sixth. This means an additional 2.8 hours for a 20-hour week.

Looking at other countries, increasing the average number of working hours for part-time workers seems to be realistic. In 2008 the average working hours for part-time workers in France and Sweden amounted to 23.4 and 23.8 hours per week, respectively. This was a third higher than in Germany, where the length of part-time work was only 17.9 hours per week (Eurostat, European Labour Force Survey). Lengthening working hours for part-time employees in Germany seems to be in line with the desires and the willingness of many women to work longer hours. An evaluation on the basis of the Socio-Economic Panel carried out by the IAB (Institute for Employment Research of the German Federal Employment Agency) showed that women working in regular part-time jobs would be willing to work an additional 4 hours and those in peripheral employment would be willing to work an additional 9 hours (Wagner, 2011). We do not think that this potential of involuntary part-time work can be fully exploited, as there is usually a wide gap between dreams and reali-

The effects of increasing working hours for part-time employees...

The assumed increase of 2.8 hours per week would increase labour supply by 1.4 million part-time workers or by 0.7 million full-time workers. This would partly compensate for the decline in labour supply. If it is not possible to successfully increase working hours, average annual economic growth will be 0.1 percentage points lower than what has been predicted in this forecast (i. e. 1.4 % instead of 1.5 %). On the other hand, if the working hours for part-time workers are increased to a greater extent than what we have predicted, this would have a positive effect on economic growth.

ty. However, increasing the average number of working hours seems to be possible if the balance between work and family life is improved.

3.5 Qualification and occupational structure of the labour force

We believe that the shortage of skilled workers will lead to increased investments in human capital. On one hand, the population is aware of the fact that access to a well-paid, safe, and less stressful job goes hand in hand with good qualifications. This increases participation in vocational training and reduces the number of workers who do not have any formal training. On the other hand, companies and the government will adopt extensive measures to promote participation in vocational training and to reduce the number of workers that do not have any formal training (see chapter 2.4.1).

3.5.1 Labour force by formal training

As a result, the labour force will be increasingly better qualified. In particular the share of persons employed and the number of job-seekers that have a tertiary education will rise significantly. In parallel, the share of the labour force that does not have any formal training will decline (Figure 3-7).

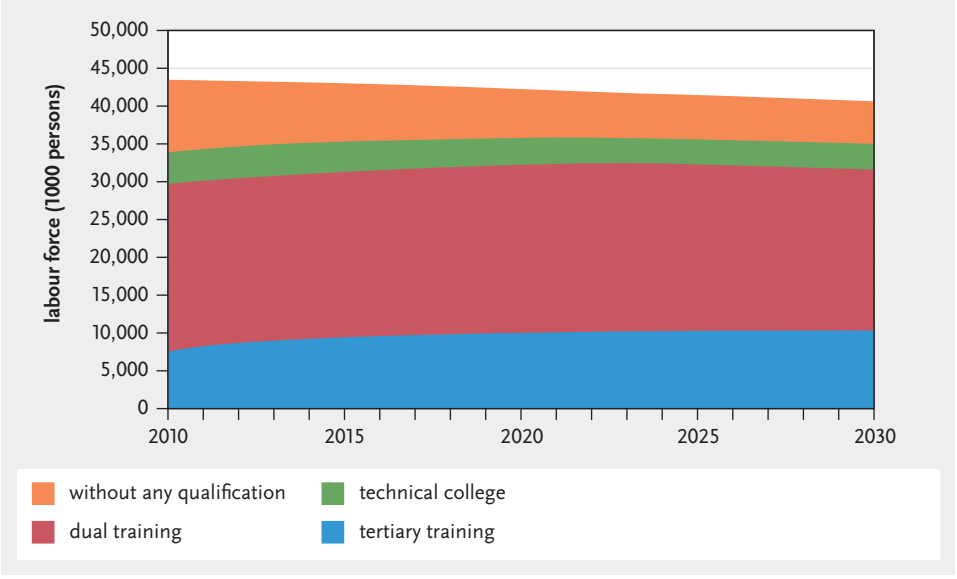

Figure 3-7 Count of labour force by formal training

Sources: Economix, IER, category "not stated" was excluded

The number of university graduates will increase significantly, namely from 17 % in 2010 to 26 % in 2030. The demand for a highly skilled workforce will not be at the expense of the dual training system. The number of people who complete dual vocational training will rise slightly from 51 % to 52 % over the forecast period. Dual vocational training will retain its importance if more youths from socio-economically disadvantaged backgrounds are integrated into the dual vocational training system. This predominantly means that far more youths with a migration background need to be incorporated in the dual training system. This is the only way to finally significantly reduce the share of the labour force that does not have any formal training (a figure that has remained constant for a long time), namely from 22 % in 2010 to 14 % in 2030. It still remains to be seen, but the structure of immigration will play an important role in this. The share of the labour force with a technical college qualification (*Fachschulabschluss*) will fall from 9.6 % in 2010 to 8.2 % in 2030.

In absolute terms, the trend towards a highly skilled workforce will cause the following changes to occur compared to 2010:

- The number of persons in the labour force with tertiary training will rise by 2.85 million by the year 2030. This means a growth rate of 38 %.
- The number of persons in the labour force with dual vocational training will fall by 950 000, although their share in the total labour force will stay the same. This means a decrease of 4 %.
- The number of people in the labour force with technical college training will fall by 840 000.
- Finally, the number of persons without any formal training will decline by 3.9 million.

3.5.2 Labour force by occupation

The occupation in which workers with a particular vocational training end up in is largely determined by the field of vocational training taken, however this classification is by no means conclusive. There are fields, such as engineering, where only half of all engineers work inside their field; 10 % work as managers and 9 % work as accountants, information technology officers or office clerks. Incidentally, engineering is distributed over almost all of the 88 occupational groups. Often, careers do not follow a straight path, therefore the borders of occupational fields overlap in both directions – upwards, to jobs where higher skills are required, and downwards, to jobs where skill requirements are less important. In our forecast we believe that this is – beyond individual career development – strongly determined by labour supply.

In the overall results, i. e. the size of the labour force, the development of the total labour force is shown in Figure 3-8. It shows the count and the change of labour supply in 34 occupational groups, and is arranged according to changes in the period 2010–2030.[20]

20 For detailed results see Annex, Table 2.1.2

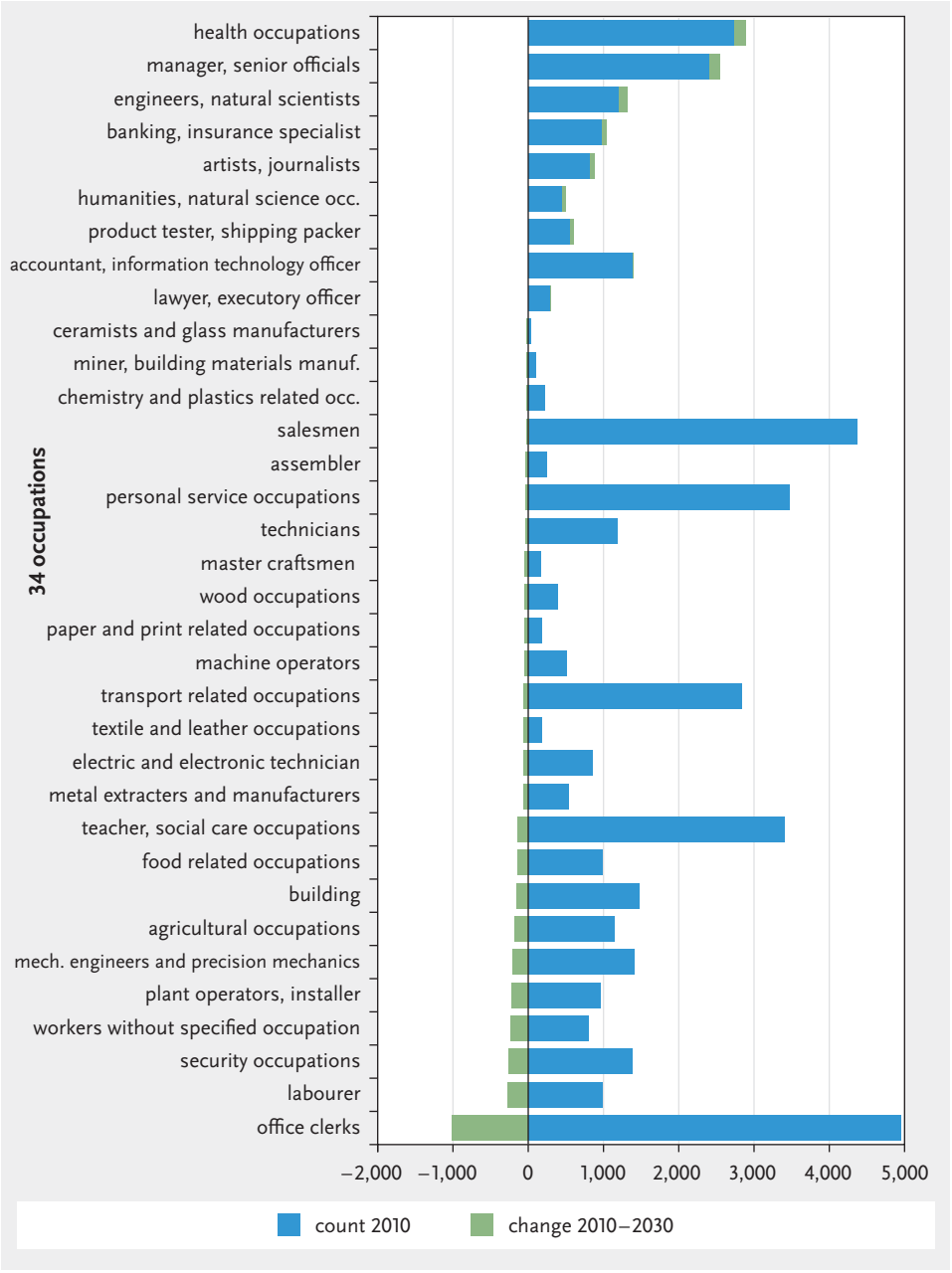

Figure 3-8 Labour force by occupation
34 occupational groups, ranking by change 2010 to 2030 (1000 persons)

Sources: Economix, IER

We expect labour supply to grow in:

- Health occupations, where labour supply will increase by 140 000 (+5 %) by the year 2030. The occupational group of social care and welfare will expand by 82 000 (+4 %). However, the number of teachers will decline by 200 000 (-14 %), and the number of religious professionals will decrease by 28 000 (-38 %)
- We expect there to be significant growth in labour supply for management occupations (+132 000; +5 %)
- Associated with the intensified promotion of tertiary education, labour supply will grow for highly qualified engineers and natural scientists (+114 000; +9 %), banking and insurance specialists (+62 000; +6 %), artists and journalists (+61 000; +8 %), as well as in occupations related to humanities and natural science (+45 000; +10 %)
- Besides the specialists, labour supply in the occupational group of product testers and shipping packers will increase (+38 000; +7 %) as well as the number of accountants and information technology officers (+9 000; +1 %)

This should not hide the fact that some occupations will gain significant importance in relative terms than one would expect from only looking at the number of additional workers. Thus, growth will be particularly high in the following occupational groups: chemists, physicists, mathematicians (+25 %), special technicians (+14 %), other sales service occupations (+11 %) and body care occupations (+11 %).

The strongest decreases in labour supply are shown for:

- Office clerks (-1 million; -21 %). This decrease is expected to be partly caused by an increase in financial and commercial professionals, business administration and similar qualifications. It can be expected that higher educational qualifications, especially Bachelor degrees, will become more important than dual training
- We also expect there to be a strong decrease in unskilled labourers (-277 000; -28 %), security occupations (-260 000; -19 %), plant operators and plant installers (-217 000; -23 %), mechanical engineers (-206 000; -15 %), agricultural occupations (-183 000; -16 %), and building occupations (-162 000; -11 %)

A significant relative decline in labour supply will also include occupations that only have a small number of workers, e. g. ceramists (-49 %), butchers (-42 %), or spinners (-41 %).

In some occupations, labour supply will increase between 2010 and 2020, but will then decrease between 2020 and 2030 due to the strong effects of demographic decline. This will affect occupations relating to personal services and social care.

A strong increase in healthcare occupations between 2010 and 2020 is also expected as a result of the ageing population. However, unlike occupations relating to personal services and social care, the number of workers in healthcare occupations will continue to increase slightly after 2020. This shows a trend towards a more health-con-

scious population. Labour supply can be increased in these occupations through immigration, by providing better training conditions (e. g. in nursing/care occupations), or by increasing wages.

3.5.3 Summary

In our calculations we assume that the structural change in labour supply will reflect adaption to labour demand. This is caused by the increasing shortage of skilled workers, which will prompt companies and Public Employment Services to ensure opportunities for lifelong learning or retraining the workforce. Therefore, transitional periods for changes between different labour market sectors can be shortened without having to lower occupational standards. However, it is also possible that, in a context of skilled workers shortage, companies will be willing to employ persons who do not entirely fulfil their skill requirements.

A rapid adjustment of supply to demand can also be expected because when workers make their occupational and career choices, they also take demand into consideration. There will be more readily available information on the recruitment behaviour of companies, unemployment trends, and last but not least the long-term trends in the occupational labour market and this information will therefore form the basis of individual decisions. This will contribute to accelerating the adjustment process. However, a fast matching of supply and demand is hampered by the increasing complexity of tasks and by the required level of employees' qualifications and skills, thus the ability to adapt to demand will not advance in all areas of the segmented labour market.

There is some freedom concerning occupational choice before entering the labour market; i. e. when youths make their career choices, when non-employed persons decide in which particular occupational field they would like to work in when re-entering the labour market, and who is going to immigrate to Germany. These movements within the labour market are discussed in the following section.

3.6 Labour market dynamics: labour force inflows and labour force outflows

3.6.1 Preliminary remarks: methodology

The general aspiration of the trend towards a highly skilled workforce is, as we have seen, connected to a series of assumptions:

- First of all, it is crucial to know what the skills structure of young graduates of the training system will be like.
- What skills will people who are exiting the labour market have? They may exit the labour market for a number of reasons: early retirement, taking a career break, prematurely terminate employment or because they emigrate.

- What skills will immigrants who are entering the labour force have?
- What skills will persons entering the labour market from non-employment[21] have?
- What will the occupational career of persons who change their job during their working life look like?

The changes in the structure of the labour force by qualifications and occupations are therefore the results of complex labour market dynamics.

In order to get a labour force estimate differentiated by occupations and qualifications, past labour force inflows and labour force outflows were analysed and estimated for the forecast period. As it is stated elaborately in the Methodological Report (Kriechel, Vogler-Ludwig 2013), labour supply in the flow model is calculated from labour force inflows and labour force outflows and from shifts within the labour force. These flows are shown in Figure 3-9.

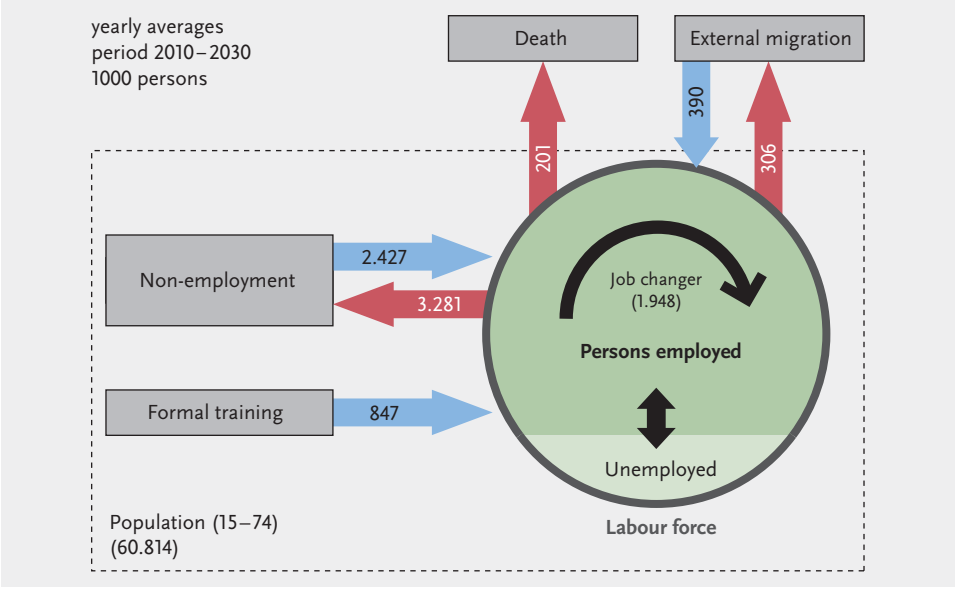

Figure 3-9 Labour force inflows and outflows

Source: Economix

Labour force inflows consist of:

- Inflows of formal education and training graduates
- Inflows of immigrants
- Inflows of non-employed persons

21 From the so-called *Stille Reserve* (secret reserve)

Labour force outflows consist of:

- Exits into unemployment
- Exits into non-employment
- Outflows of emigrants
- Outflows caused by death

Furthermore, the labour supply in the flow-model consists of persons in the labour force, who:

- Change their job
- Switch between gainful activity and unemployment and vice versa. Here, not the total number of entries and exits in the respective labour status are observed, but only the labour status changes which are related to an occupational change

Every single element of this flow model has been estimated. It should be noted that the inflow from formal education and training, from immigration, as well as from non-employed persons (therefore the inflows "from outside") can flow into gainful activity as well as into unemployment. To simplify this, the results of the prognosis are only displayed as a total inflow into labour force. The same is valid for outflows out of the labour force: they can flow out of gainful activity as well as out of unemployment. Movements within the labour force (the number of job changers and the number of persons who switch between gainful activity and unemployment) are also of significance. The estimates are based on an analysis of past flows which were obtained from the German national accounts (*Volkswirtschaftliche Gesamtrechnung* of the German Federal Statistical Office) and from the German Job Vacancy Survey (*gesamtwirtschaftliche Stellenangebotserhebung*; for more details please refer to the Methodological Report).

Apart from the analysis of the past, which has a certain influence on the prognosis, we had to assume how the government and organisations would react to possible labour market bottlenecks, as well as assuming educational behaviour, the skills structure of migrants and the probability of occupational change. These assumptions are introduced in the following sub-sections.

3.6.2 Overall development

According to our estimates there will be 6.74 million inflows and 6.86 million outflows per year over the forecast period. This means an inflow rate of 15.9 % and an outflow rate of 16.2 % of the labour force, which shows the high turnover capacity of the labour market and which is the basis for the adjustment of supply and demand. About 13 % of labour inflows are graduates from formal education and training, 36 % derive from non-employment, and 6 % are immigrants. A further 29 % consist of people who change occupations, and 17 % were originally unemployed.

This means that on average 847 000 youths will enter the labour force from the education system per year over the forecast period. Approximately 390 000 persons will

immigrate and 306 000 persons will emigrate, resulting in an annual net migration of 86 000 persons who will be available to work in the German labour market. Annual inflows from non-employment will amount to 2.4 million persons. This number includes persons who enter labour force after they have taken a break from work – e. g. for family reasons – as well as persons who were previously not economically active. In parallel, almost 3.3 million persons will leave the labour market per year. This number will therefore flow into non-employment. Considering the shrink-

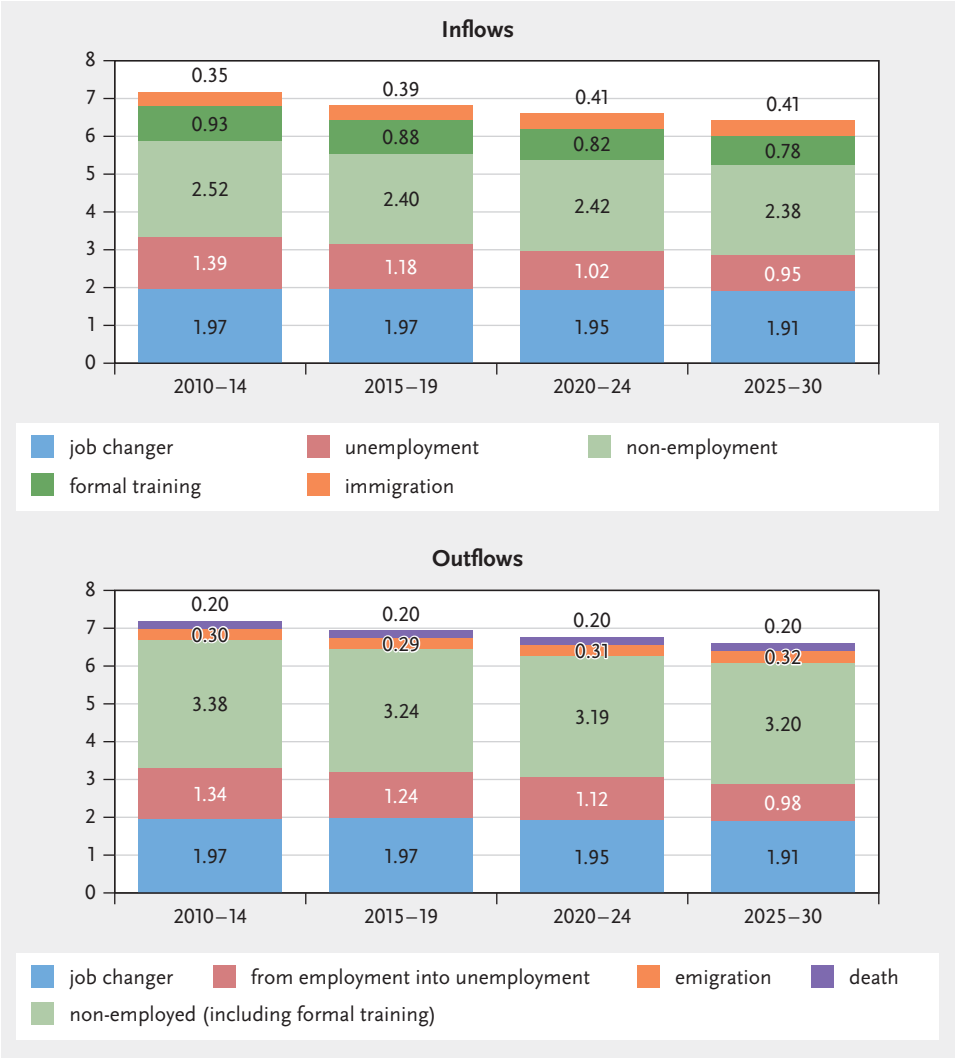

Figure 3-10 Labour force inflows and outflows
Annual averages (million persons)

Source: Economix

ing working-age population, this figure is much higher than the inflows into the labour force from non-employment. This is caused by the fact that a vast number of people will retire and will not enter the labour market again. Therefore, the labour market will lose 124 000 persons annually.

Shifts within the labour force are of crucial importance for changes in the qualification and occupational structure of labour supply. Herewith, labour market developments can be detected that are not related to demographic change. On average 2 million persons will change jobs per year, which is the equivalent of 5 % of all persons employed. This is an important source for labour market flexibility.

Differences in the inflow and outflow structures concerning unemployment are of great significance for changes in the qualification and occupational structure of labour supply. The balance of the alternation of unemployed and employed persons is not zero, as there are people who exit the labour market after unemployment and never enter it again. An annual average of 1.13 million unemployed people will take up work, whereas 1.16 million employed people will enter unemployment. The balance of gainful activity and unemployment is therefore negative and contributes to a rise in unemployment figures. However, exits from unemployment into non-employment will eventually lead to a fall in the number of unemployed persons.

Figure 3-10 summarizes the labour inflows and labour outflows.

3.6.3 More university graduates from the educational system[22]

Our analyses show that between 2006 and 2010 the number of university graduates rose by approximately a third. The higher number of *Abiturienten*[23], which is associated with reducing the number of secondary school years, as well as the introduction of Bachelor courses explain this growth. As these are very isolated occurrences, we do not expect the graduation rate in tertiary education to increase at the same pace in the future. However, the total number of persons entering the labour force from tertiary education will increase, although not as strongly as in the past.

We estimate that the annual inflow of youths who complete vocational training will decrease from 947 000 in 2010 to 711 000 in 2030 (Figure 3-11). Labour inflows from tertiary education will remain almost constant at 270 000 per year throughout the forecast period. This means that the share of university graduates entering the labour market will increase from 31 % to 37 %.

The declining inflow numbers will mainly relate to dual training graduates, as entries into the labour market from dual training will fall by 146 000 to 337 000 per

22 The inflow from the educational system is estimated on the basis of data from the German education statistics. The estimate is based on data for graduates in 29 fields of education, separated into 4 main groups, from 1995 to 2010. Based on the analysis of these past trends and the expert findings on demographics and education (Düll 2013b), participation rates are pre-assessed up to the year 2030 and are then updated with the population aged between 15 and 24 (see Methodological Report, Kriechel, Vogler-Ludwig 2013).

23 Persons leaving school with a university entrance certificate

The impact of the university reform:
The increase of the university graduates rate is influenced by the introduction of Bachelor degrees, which is a lower level than the former *Diplom* degree. This has two effects: it can be assumed that graduates with a Bachelor degree will, due to their theoretical training, be able to partially substitute for workers with initial vocational dual training certificates and workers who completed further training within the dual vocational training system leading to the *Meister* degree (Master craftsmen), as the skill requirements tend to rise in the corresponding occupational fields. At the same time, graduates with a Bachelor degree will also replace *Diplom* graduates in the labour force. A Bachelor degree will be sufficient for employees to perform some of the work which was formerly the responsibility of *Diplom* graduates, especially as companies also place value on professional practice.

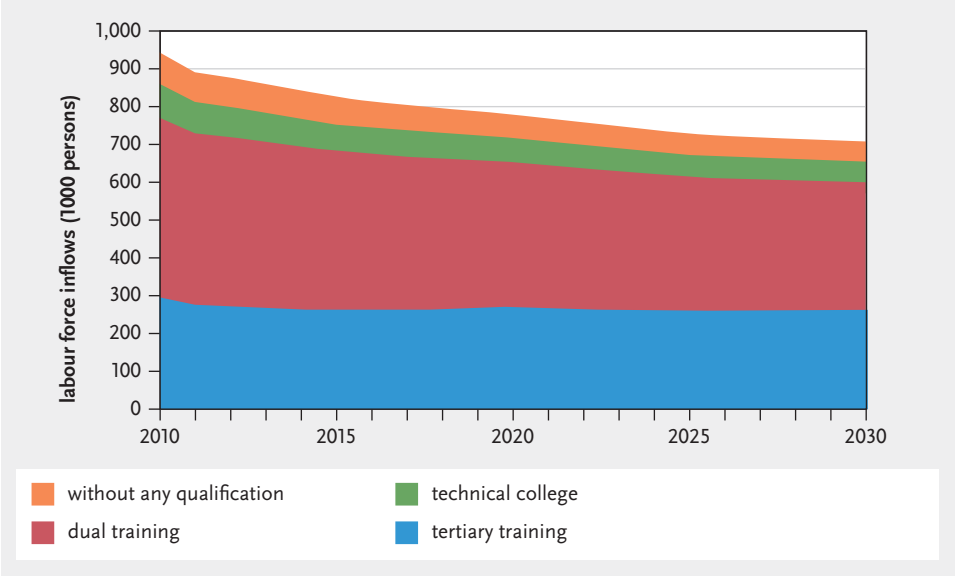

Figure 3-11 Labour force inflows from the training system
1000 persons

Source: Economix

year. Also, the number of technical college graduates and the number of persons without any formal training will decline, but this will not be of a great significance on account of their low share of total entries into labour market.

For university graduates, there will be deviations in fields of study. We expect there to be a significant increase in medically-related subjects. Likewise, the proportion of mathematics graduates and natural sciences graduates will also increase. The number of law, economics and social sciences graduates will fall slightly. We also expect that the proportion of females graduating in subjects that are often dominated by women, such as humanities and cultural studies, to decline in favour of natural sciences, engineering and medical subjects.

We expect the share of persons entering the labour market from the dual training system to decline, namely from 51 % to 47 %. There will be distinct shifts within the dual training system: according to our estimations, this will cause a significant decline in the number of people completing training in metal working and manufacturing occupations. The share of persons completing training in building occupations will decline sharply, too. On the other hand, the number of salesmen and service, shipping und transport related occupations as well as organisation, administration and office jobs will increase. The share of persons leaving the dual system after completing training in healthcare and social occupations, as well as in other occupations related to personal services, will rise notably.

The share of persons entering the labour market after leaving technical college will fall from barely 10 % to 8 %. As shown in the text box, this group of formal training graduates will face competition from Bachelor degree graduates.

We assume that efforts over the past few years to reduce the proportion of youths without any formal training will continue. Demographic change per se favours measures that attempt to integrate young people from underprivileged backgrounds into the dual vocational training system (Düll 2013b). However, the share of the young labour force that does not have any formal training will decline only slightly from 8.8 % to 7.5 %. Over the forecast period, we expect that there will be considerable difficulties in sustainably reducing the proportion of youths without any formal training, even with increased efforts. This is due to the fact that some layers of the population are not yet ready to participate in the formal training system in a sustainable way, and also because employers' demands for enhanced skill requirements increase competition on the labour market – and this competition is shaped by the level of competitors' formal training.

If the inflow rates from the educational system into the labour market were to remain constant...

– perhaps, because catch-up effects caused by the academic reform have been fully exploited; the number of school graduates with a university entrance qualification stops increasing; the strong integration of youths from educationally-deprived backgrounds is unsuccessful; or because dual vocational training is able to hold its ground – then the total number of university graduates that leave university between 2010 and 2030 will be 30 % less instead of 10 % less. In 2030, there will be almost 60 000 fewer university graduates compared to if we were assume that inflow rates will increase.

With a constant number of university graduates between 2010 and 2030, the number of annual exits from dual vocational training would only decline by 22 % instead of by 30 %. If the number of graduates were to remain the same, the number of exits from dual training in the year 2030 would be 37 000 higher than we have forecast. The difference compared to technical school graduates would be approximately 9000 higher.

If there was not a trend towards a highly skilled workforce, in 2030 the number of youths exiting the educational system without any formal training would be 21 % higher (11 000 persons) than the results of our model. This would not only lead to higher unemployment, but would also have a negative impact on the development of productivity and on the process of specialisation in knowledge based services. This, in turn, would have a negative impact on growth potential.

The proportion of young persons in Germany who have an immigration background will increase. According to the variant of the 12th coordinated population projection which we used for this forecast, net immigration will rise to 200 000 persons per year. Furthermore, there is usually a higher birth rate among migrants. Thus, the share of 20 to 25 year olds in Germany will rise from 23 % in 2010 to 38 % in 2030. The share of 25 to 30 year olds with an immigration background in relation to the population in this age group will rise from 25 % to 39 %. A proportion of these youths and young adults will immigrate to Germany during the forecast period. The number of children born in Germany to migrant parents will also increase.

Nevertheless, educational opportunities will improve as a result of new immigration policies and the educational level of parents. Furthermore, it is assumed that, given the projected shortage of skilled workers and, in some occupations, the noticeable shortage of apprentices, this will improve the chances for youths with an immigration background to enter the dual vocational training system. Demographic change will also further improve the effectiveness of transitional systems, i. e. from the educational system into the labour market. In this way, some, but not all of the problems with the education system can be overcome. As we can see from the past, implementing education reforms and making adjustments to the education system are tedious and lengthy processes, so we need to assume that the school system will take its time in overcoming these social barriers. This will primarily be a disadvantage for the educationally-deprived strata.

As a final point, some youths leave the education system without any qualifications because they do not want to participate in the labour market and because they choose a different lifestyle.

3.6.4 An increasing level of education among immigrants

As set out in chapter 1, variant 1-W2 of the 12th coordinated population projection was used to estimate the immigration level. It predicts that net migration will rise to 200 000 persons by 2020 and will remain at that level thereafter. We used this variant because in view of the declining labour supply, we consider that a continuous level of immigration to Germany is very likely. Nevertheless, we also decided to use this variant in order to keep our forecast consistent with the official statistics and the official forecasts. If the assumed net immigration is not realised and the migration balance is zero for the forecast period, the population projection of the German Federal Statistical Office estimates that there would be 3.2 million fewer persons of working age (15–74 years old) and that labour supply would also be approximately 2.3 million lower.

In recent years, predominantly people of working age have immigrated to Germany. Between 2006 and 2010, only around 13 % of immigrants were either under 18 or over 65 years old (Bundesamt für Migration und Flüchtlinge 2011). However, the labour market is not readily available for all immigrants. There are entry barriers to

the labour market, such as insufficient German language knowledge, their foreign qualifications are not recognised, legal conditions, limited knowledge of the German labour market, and immigrating students. These are all factors which contribute to the fact that during the first year of immigrating, the labour market participation rate of immigrants is approximately a quarter lower than the participation rates of the rest of the population. Thus, the inflows into unemployment are almost double. At the same time, the share of non-employed persons in the first year of immigrating is higher than for those who immigrated earlier.

Provided that the migration policy intensifies efforts to facilitate (highly) qualified workers to enter the German labour market, labour participation rates will rise. Given the projected shortage of skilled workers, companies will also try to attract skilled workers from abroad. We assume that the labour participation of immigrants in their first year of immigrating will rise by four percentage points, namely from 48 % in 2010 to 52 %. Furthermore, we believe that in the subsequent years the participation rate of immigrants will, on average, be equal to the participation rates of the rest of the population. It is also quite possible that, after a certain amount of time, the participation rate of immigrants will be above average.

The share of the working age population who is emigrants and 're-migrants' is also high – in 2010, the share of persons who were under 18 and over 65 was only 14 % (Bundesamt für Migration und Flüchtlinge 2011). There may be a higher proportion of workers among emigrants than among immigrants. Based on our estimations, the annual balance of workers moving to Germany from abroad and joining the labour force will increase from 30 000 in 2010 to 110 000 in 2020, and then it will fall to 80 000 in the period up until the year 2030.

Not only is the balance of the annual immigrating labour force of key importance for the labour supply, but also the skills profiles of immigrants and emigrants. To estimate the skills profiles of immigrants, the findings from the latest studies which provide information on the characteristics of immigrant inflows were used. These findings show that the skills profiles of immigrants has changed considerably as part of globalisation and amended immigration regulations: an increasing number of highly qualified immigrants are immigrating to Germany.

We expect that for future developments this trend will continue, because the demand for highly skilled workers is rising and the international mobility of skilled workers and managers will become more important in the course of accelerating globalisation. We also expect that the share of immigrants over 25 years old with tertiary training will rise from 42 % to 56 % by 2030 (see Table 3-1).

Table 3-1 Qualification of immigrants
% share of formal training groups on immigration of 25 to 65 year olds

	2010	2020	2030
tertiary training	42.1	49.1	56.0
dual training	23.0	19.1	15.2
technical college	7.2	6.1	5.0
without any qualification	27.7	25.8	23.8
Total	**100.0**	**100.0**	**100.0**

Source: Economix

Based on these assumptions, the number of highly skilled immigrants will increase by almost 70 % over the forecast period (see Figure 3-12). Although there is currently a declining proportion of immigrant workers who do not have any formal training, this figure will initially increase, as we expect that there will be a significant demand for unskilled or low-skilled labour, particularly in the service sector. We expect an increase of 30 % compared to 2010. Immigrants with dual training or with a technical college qualification, however, will only increase slowly at first and will then decline slightly after 2020 (see Figure 3-12). In these qualification segments, we see more potential for workers with an immigration background than for newly arrived immigrants.

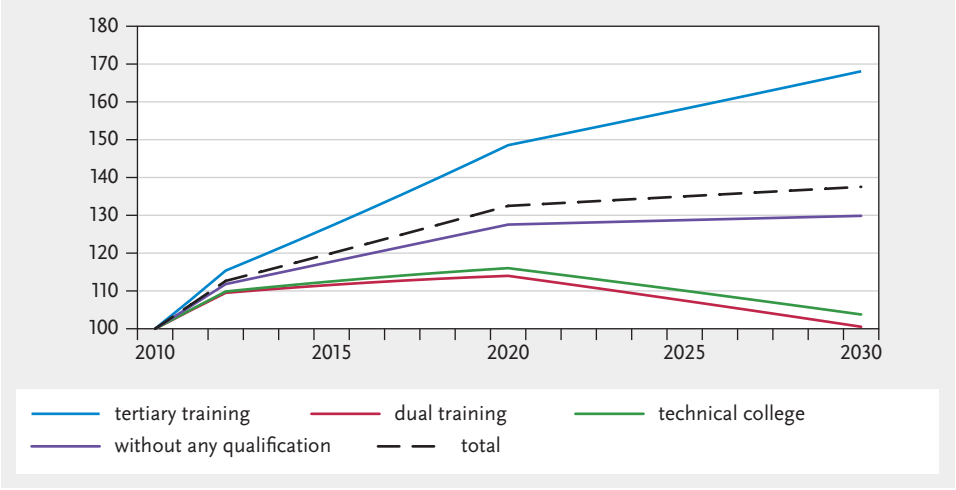

Figure 3-12 Immigrants entering employment in the first year of immigration
2010 = 100

Source: Economix

The demand for higher qualifications is visible from the occupational structure where immigrants will work in their first year of moving to Germany. As can be seen

in Table 3-2, we expect that the highest number of immigrants will work in personal service occupations, with 51 000 new entrants per year. There will be 29 000 new managers and senior officials as well as engineers and natural scientists per year. Furthermore, we expect that a high number of immigrants will be employed as salesmen (25 000), as teachers or in social care occupations (25 000), in construction (24 000) as well as artists and journalists (23 000). A very low number of immigrants will work in the textile and leather industry, paper and printing occupations, mining, building material manufacturing occupations as well as in the ceramic industry or as glass manufacturers.

Table 3-2 Occupations of working immigrants in the first year of immigration

34 occupational groups Ranked by immigration 2025–2030	Annual average 1000 persons		Change 2010–2014 to 2025–2030	
	2010–2014	2025–2030	1000 persons	%
personal service occ.	42.2	50.6	8.4	20.0
managers, senior officials	23.1	29.4	6.3	27.5
engineers, natural scientists	21.9	29.4	7.5	34.1
salesmen	20.5	25.4	4.8	23.6
teacher, social care occ.	22.2	24.7	2.4	10.9
building	21.6	23.9	2.3	10.6
artists, journalists	17.3	22.5	5.3	30.5
accountant, information technology officer	15.3	19.2	3.9	25.3
health occupations	14.6	18.5	3.9	26.7
humanities, natural science occ.	11.5	15.4	3.9	33.7
food related occ.	14.0	15.2	1.3	9.0
office clerks	14.7	15.1	0.4	2.5
workers without specified occupation	14.0	13.1	-0.9	-6.2
transport related occ.	8.9	10.9	2.1	23.3
agricultural occupations	8.5	9.2	0.7	7.9
technicians	5.1	6.2	1.1	21.4
labourer	6.2	6.1	-0.1	-1.4
security occupations	4.5	5.1	0.5	12.0
plant operators, installer	4.5	4.4	-0.1	-1.9
product tester, shipping packer	2.7	3.6	1.0	35.8
banking, insurance specialist	2.7	3.5	0.8	31.0
mechanical engineers and precision mechanics	2.7	2.8	0.2	6.3
metal extractors and manufacturers	1.7	1.8	0.1	8.4
electric and electronic technician	1.4	1.6	0.2	15.2
wood occupations	1.4	1.6	0.2	13.1
lawyer, executory officer	1.1	1.4	0.3	25.5
machine operators	1.0	1.2	0.1	11.1
assembler	0.9	1.0	0.1	12.7
chemistry and plastics related occ.	0.8	0.8	0.1	8.8

(Table 3-2 continued)

34 occupational groups Ranked by immigration 2025–2030	Annual average 1000 persons		Change 2010–2014 to 2025–2030	
	2010–2014	2025–2030	1000 persons	%
master craftsmen	0.6	0.5	0.0	-2.5
textile and leather occ.	0.5	0.4	-0.1	-12.4
paper and print related occ.	0.4	0.4	0.0	-8.1
miner, building materials manuf.	0.3	0.3	0.0	4.4
ceramists and glass manufacturers	0.2	0.2	0.0	-12.1
Total	**308.8**	**365.5**	**56.7**	**18.3**

Source: Economix

Immigration and the occupational integration of immigrants follow employment trends. This is plausible because labour is predominantly recruited from abroad once the domestic labour potential has been fully utilized. Furthermore, foreign workers will check the labour market situation before immigrating to Germany and they are most likely to apply for jobs where there are bottlenecks. The international mobility of skilled workers and managers will become more important in multinational companies.

The jobs where immigrants work in their first year of immigrating to Germany leads to the presumption that the gap between formal qualifications and practiced occupations, which has been very distinctive until now, will gradually diminish. As immigration will be more strongly determined by employers' demands, immigrants with suitable qualifications will be better selected from the start. As a result of intense migration pressures, immigrants have been forced to accept more or less any line of work that was offered. We expect this to significantly change.

We expect there to be greater improvements so that immigrants are able to use their foreign qualifications in Germany. This process will be supported by pressures of the shortage of skilled workers and by the implementation of the *Anerkennungsgesetz*[24], whereby German companies will increasingly recognise foreign qualifications and there will be increased participation in programmes which help to harmonise foreign formal qualifications with German formal qualifications.

If, with a tighter migration policy, it were possible to steer immigrant labour inflows towards occupational groups which are affected by a labour shortage, it would still be difficult for co-migrating life partners and other family members to find a job which even halfway matches their formal qualifications. One can expect that the partners of highly skilled immigrants are also highly qualified (compared to cases of immigration due to family reunification).

Unfortunately, no data regarding emigrants' skills structures is available. To simplify this matter, we assume that the skills structure of emigrants and those of immi-

24 German federal qualification recognition act which came into force on 1 April 2012.

grants barely differ from each other. In the context of globalisation, the international mobility of skilled workers and managers will increase. It can therefore be assumed that not only the immigration of highly skilled workers to Germany will increase, but also emigration from Germany. In any case, the migration balance is likely to be positive.

The net effect of the highly skilled workforce is likely to be positive, even though it appears that the share of highly qualified net migrants should be somewhat lower than the share of highly qualified immigrants. Even in the recent past (2005–2009), the migration balance for highly skilled persons aged between 25 and 64 for the EU and for Germany was slightly positive (Ette, Sauer 2010). Due to the positive migration balance of highly skilled workers, the process of employing workers with a migration background in the labour force by considering his/her qualifications will slowly improve.

The big challenge for politics is to put conditions in place that ensure that the immigrant labour force can participate in the labour market according to their level of skills. There is a danger that too many immigrants have to work in jobs which require low skills. Considering the skilled workers shortage, it is crucial to optimally place workers in employment according to their competences – that means making it possible for them to work in jobs where they can achieve the highest productivity. Politics and labour administration can do a lot to advance the knowledge of employers regarding the level of work experience and the skills of foreign workers and to eliminate any prejudices.

3.6.5 Occupational mobility of the workforce

Occupational mobility is one of the central adjustment mechanisms in the labour market. This can be a change of position combined with an occupational change, or even changing company (into the same or into a different sector) as well as within a company.

The transition matrix[25] for the German labour market shows that on average 4.8 % of all persons employed (i. e. almost two million persons employed) changed their job between 2006 and 2010. Employees tend to change jobs when the opportunity for occupational development arises, when the hiring demand of companies changes towards certain occupations, or if they have to change their job to avoid the threat of unemployment. All in all, we expect the annual rate of job changes, regarding

25 The total number of inflows and outflows of the labour market was estimated for the transition matrix. These estimates were then applied to the separate flows for employed, unemployed and non-employed persons, and inflows into and outflows out of the formal training system. Between 2006 and 2010 there was a labour force inflow of 7.4 million persons and a labour force outflow of 7.3 million persons. The estimate of the transition matrix was based on "*Mikrozensus*" data, data from the German Job Vacancy Study, German migration statistics, statistics regarding persons completing formal training, and on other statistics. For more details, see the Methodological Report, Kriechel, Vogler-Ludwig 2013.

Estimation of the matrix of occupational change:

The matrix shows the probability for all 88 occupational groups that a person employed in one of these occupational groups will change their job to one of the other remaining 87 occupational groups. This probability depends on:

- The scope of employment in the favoured occupational group, i. e. the higher the number of employees in the favoured occupational group, the higher the chances are of changing into this occupation;
- The similarity between the tasks of the original occupational group and the favoured occupational group. For example, all agricultural occupations are extremely similar to each other, whereas there are limited similarities between agricultural and manufacturing occupations and very few similarities between agricultural and medical occupations. Also, the probability of advancing into an occupation that has higher skills requirements is lower than the probability of a changing into an occupation which has lower skills requirements.
- On average, we assume for all occupational groups that 60 % of job changes will occur within the same occupational group, and only 40 % will involve moving into another occupational group. We estimated occupational transition probabilities for the future based on these assumptions.

employed persons, to remain unchanged during the forecast period. Although employees will, with respect to the skilled workers shortage, try to retain workers by offering premiums and benefits, they will also simultaneously take measures to attract potential job changers. Therefore, we assume that both effects will offset one another.

We know from the "*Mikrozensus*" data for the period 2006–2010 that the rate of changing jobs differs significantly from occupation to occupation. The rates are determined by the short employment duration in many low-skilled jobs as well as by the extent of the employment changes. However, we do not know which educational group is the subject of the change. This has to be estimated with the help of a theoretical examination (see text box).

As displayed in Figure 3-13, some occupational groups will increase the number of their employees, whereas some occupational groups will suffer losses due to job changes. The winners are personal service occupations, administrative and office jobs, health occupations, and, though to a lesser extent, managers, senior officials as well as teachers and those in social care occupations. The occupational group of salesmen, commercial and financial professionals will neither benefit nor suffer from job changes. Transport-related occupations, artists and journalists, as well as scientists and those in technical occupations will lose part of their workforce as a result of job changes. Also among the list of net-losers are manufacturing occupations as well as legal and security-related occupations. Finally, the number of workers without a specified occupation will suffer from job changes, as there will be a steady outflow from this occupational group due to formal training, measures that will improve labour market integration of immigrants over time, and people returning to work from economic inactivity.

The past has shown that it is predominantly younger people who change their job at the beginning of their professional career (see Figure 3-14). The increasing share of

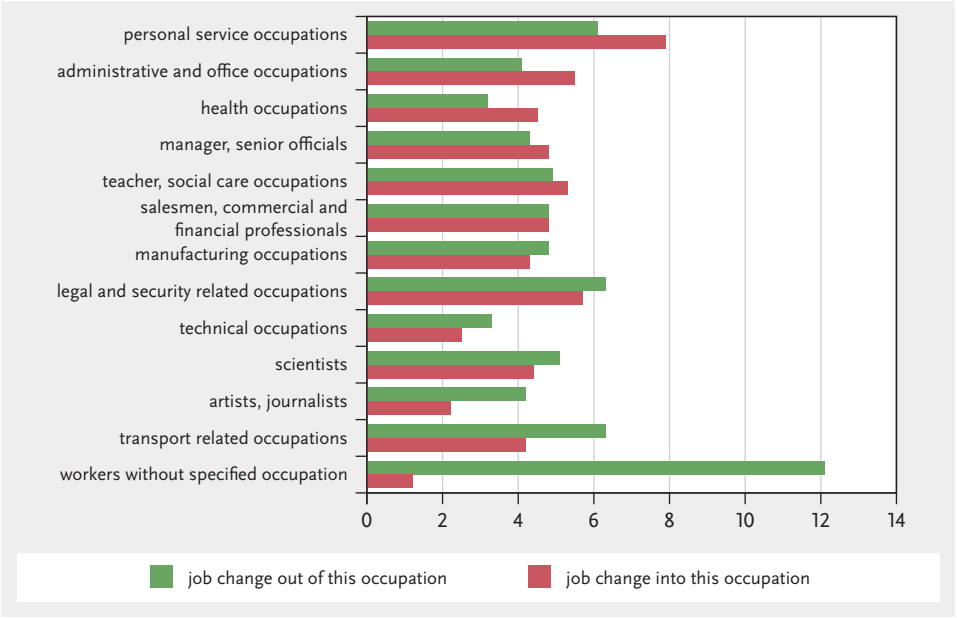

Figure 3-13 Job change rates
Job changes out of/into an occupation, % share of persons employed
Average 2010–2030

Source: Economix

older workers therefore questions the continued functioning of this central adjustment mechanism of supply and demand. This labour market momentum generated by job changers can only be sustained if older workers would also be willing to and would be able to change their jobs more often in the future. However, this would only be possible if human resource management strategies were implemented so that they would:

- allow a more flexible assignment of labour
- increase employment among older workers
- provide career prospects and vocational training for older workers, too
- allow further investments in lifelong learning which is spread over the whole of an employee's career life, as well as investing more in older workers.

This requires human resource managers to rethink how to establish age-appropriate workplaces and a sustainable personnel policy. We believe that this requires: an implementation of long-term personnel development plans that help to find employment possibilities for ageing employees; providing technical solutions for the needs of older workers; and especially measures which preserve the capacity to learn and which improve employees' adaptability to new situations throughout their working life. Studies on personnel policies which focus on older workers found that the capacity to learn in old age is highly related to how intellectually demanding a per-

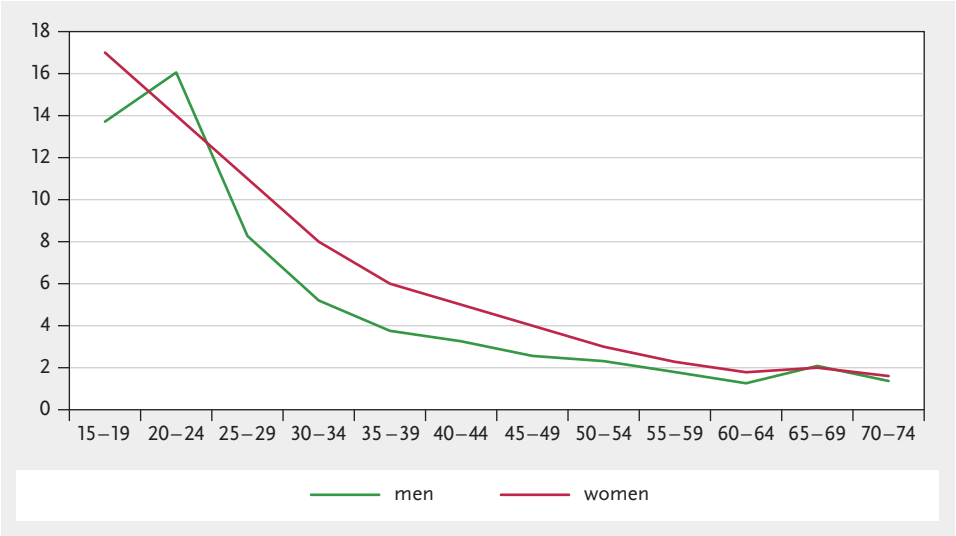

Figure 3-14 Job changer by age and gender
Job changes in the last 12 months, % share of persons employed;
Annual averages 2006–2010

Source: Federal Statistical Office (Mikrozensus)

son's working life had been (Lindley, Düll 2006). Another requirement is that older workers should be more willing to participate in continuing training.

The further development of the German lifelong learning system is crucial for the functioning of adjustment mechanisms in the labour market. Not only investments in lifelong learning, but also the transparency of the lifelong learning system needs to be increased, so that the knowledge and qualifications acquired through lifelong learning can be "traded" on the labour market just like the initial training. Only under this condition can the assumed job changer rates be achieved.

3.6.6 Unemployment

Restructuring the labour market will reduce opportunities in some occupational groups, whereas the prospects for other occupational groups will rise. Not all employed people can avoid taking a career break when changing jobs. Some of them will become unemployed and will find a new job (in the same line of work or in a new field) either after searching for a certain amount of time or after participating in labour market programmes. Some will exit the labour market never to return, either because they have reached retirement age, because they do not see any opportunities, or for other personal reasons.

Between 2006 and 2010, a period where unemployment declined, barely half of those who were unemployed took up employment, about a quarter remained unem-

ployed, and a further quarter exited the labour market by becoming non-employed (see Methodological Report, Kriechel, Vogler-Ludwig 2013).

Over the forecast period, we expect that the yearly averages between 2010 and 2030 will amount to 1.1 million unemployed people who will take up employment, and conversely, 1.2 million employed people will become unemployed. 2.3 million people will exit employment to become non-employed. Unemployment will decline due to demographic change and the long-term growth of the economy. However, labour market imbalances will remain because there will still be a gap in the future between the skills that companies require and the skills that unemployed people can offer.

We also expect that the general structure of persons affected by unemployment will not change[26]: It will still be the low-skilled workers that are predominantly affected by unemployment. At the same time, the skills requirements placed on the workforce will increase. This means that workers that have formal training – especially tertiary education graduates and technical college graduates – will be offered employment (see Figure 3-15). Conversely, workers without any formal qualifications will face higher entry barriers. The number of unemployed persons without any formal training will fall, but the proportion of these amongst all unemployed persons will rise.

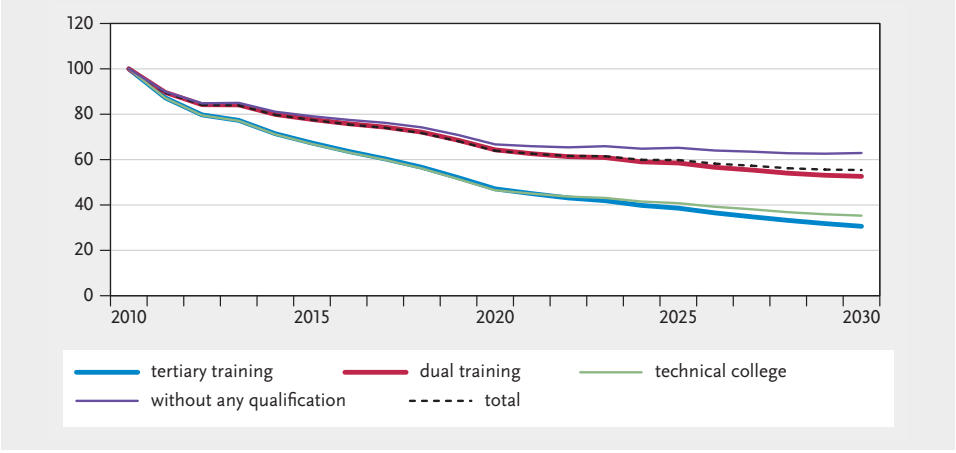

Figure 3-15 Unemployed by formal training
2010 = 100

Source: Economix

26 The German labour market statistics provide data concerning the number of unemployed persons by occupation. This data refers to registered unemployment and was applied to the unemployment figures of the "*Mikrozensus*". The IAB's estimations (Institute for Employment Research of the German Federal Employment Agency) concerning unemployed persons by formal training are available (IAB 2011). Based on this data, the structure of unemployment by occupation and by formal training can be calculated for the period 2006–2010. The starting point for this estimate is data from the "*Mikrozensus*" (labour force survey) regarding the structure of unemployment by formal training.

3.6.7 Inflow of non-employed persons into employment

Increasing labour supply can also be a result of inflows from non-employment, but at the same time, decreasing labour supply can be caused by employed persons entering non-employment, e. g. when they retire. The result of this process is an increasing replacement demand, a topic which is covered in chapter 2.

In the following section, information is given on how many non-employed persons are seeking employment or take up employment, e. g. after a career break for family reasons or for other reasons. Inflows from formal training and unemployment are not taken into account here.

Between 2006 and 2010, 14 % of non-employed persons took up work per year (see Kriechel, Vogler-Ludwig 2013). Figure 3-16 shows the projected inflow of non-employed persons into employment. According to these calculations, the occupational groups of artists, journalists, scientists, managers and senior officials, as well as health occupations will grow because of inflows from non-employment. In this regard, manufacturing occupations, administrative and office jobs, as well as other occupations will lose out. Inflows from non-employment into manufacturing occupations will decline by 17 % by the year 2030. There will be a 19 % decline in administrative and office jobs. Inflows into technical occupations will be 5 % lower. In con-

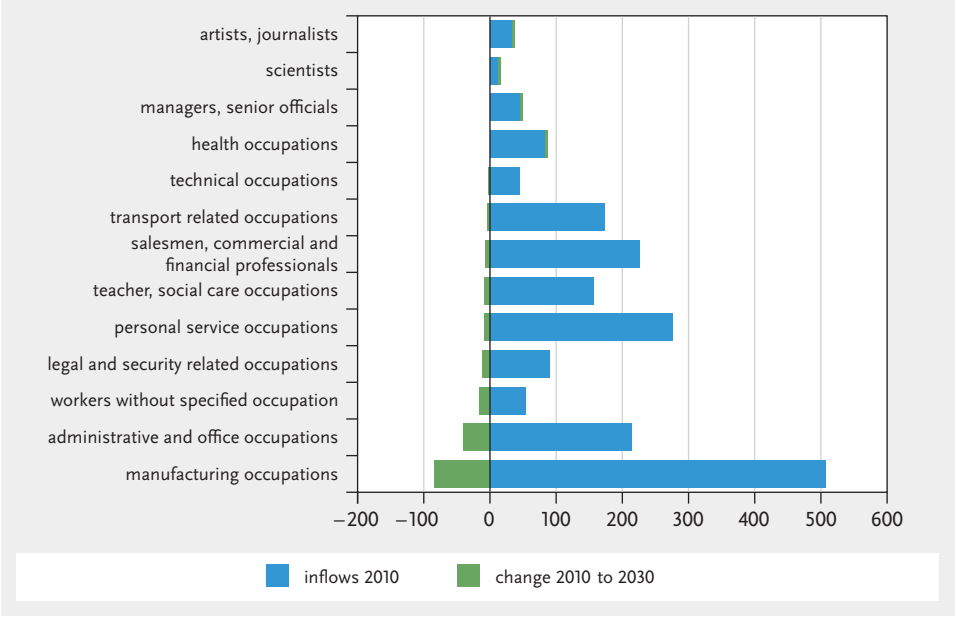

Figure 3-16 Inflows of non-employed persons into employment
1000 persons

Source: Economix

trast, inflows into science occupations will be 10 % higher. For artists and journalists, we estimate that inflows will increase by 5 %.

3.7 Summary

Demographic change will become very challenging for the German labour market. It will not only be the shrinking population that will restrict labour supply. The ageing population poses an even bigger problem. We assume that the number of younger and middle-aged persons in the labour force will significantly decrease and only the age group 60+ will grow. In view of this, the age structure of the labour force shifts from being a highly-productive middle-aged workforce to an age group whose performance is limited for various reasons: physically and mentally limited performance, health problems, and a lack of motivation due to the limited time left in their working life. This does not apply for all older workers, but the risk of these negative factors occurring increases with age.

We assume that these challenges will be addressed by a multitude of political measures as well as by behavioural changes among employers and employees. This includes the assumption that the working hours of part-time workers will increase. Furthermore, employers will need to implement a sustainable personnel policy that takes into account the working ability of their workers for as long as possible. The state will support these measures by expanding childcare provisions, promoting age-appropriate jobs, and by implementing a prudent recruitment policy abroad.

Nevertheless, these measures will be insufficient to prevent the decline of labour supply in Germany. Under these circumstances, economic growth will only be driven by high productivity. However, substantial efforts will be necessary to achieve this level of productivity with an ageing workforce. Therefore, it is anything but certain that the level of economic growth which we have estimated will actually be achieved. In an even worse case, when looking at the late reaction of companies and the government regarding the long foreseeable shortage of young workers, one can still expect that measures will only be adopted once it is already too late. Policy measures from a long-term point of view are of vital importance with respect to this demographic challenge.

Our assumption of high productivity growth is based on the expectation that it will be possible to increase the skills of the workforce significantly. We assume that a pronounced change in labour demand will lead to a rising share of tertiary education graduates in employment. Labour supply will follow this trend and will therefore meet the labour market's demand for skilled workers. We expect that labour supply will quickly adapt to changes in labour demand – less so with inflows from the educational system, but rather with a high share of job changers and a significant inflow of non-employed persons. Immigrant workers will also follow demand trends. All in all, while taking into account short-term labour market flows, we assess the flexibility

of labour supply to be high. Serious bottlenecks will therefore not so much be caused by an inadequate adjustment rate, but are more likely to be a result of the overall insufficient level of labour supply.

It will only be possible to ensure the supply of a highly skilled workforce if Germany chooses to invest in an effective lifelong learning system. Up to now, continuing training depended on the willingness and the possibilities of individuals and employers, thus only short-term, non-certified courses were predominantly available. We hope that the government will play an active part in this and that the cursory character of continuing training which has been in force until now will be transformed into a solid and clearly structured system with training standards for lifelong learning. This involves updating the knowledge of university graduates as well as supplementing the now highly specialised courses with associated fields of knowledge. It will be the key task of tertiary education institutions to develop appropriate offers. This includes promoting career development by offering suitable courses to graduates from dual vocational training. Modularised systems appear to be the most appropriate method of increasing participation in lifelong learning. Last but not least, government funding for lifelong learning is also a crucial factor, especially since there will be savings from initial vocational training due to the declining number of children. Increased participation in continued training will not succeed if employees and organisations have to cover all of the direct and indirect costs of the training themselves.

This is certainly a matter of urgency as we have already entered the phase where labour supply is in decline. It is very likely that employers will quickly introduce measures in order to overcome the shortage of skilled workers. However, they may be overstrained if they have to solve the problem alone. Maybe even more so, as the growing shortage of skilled workers increases the danger of poaching qualified workers. Governmental education policy is therefore requested to set up the institutional and financial framework for lifelong learning. This is not an easy task, as we well know, as there are 16 state *(Länder)* governments in Germany which need to be convinced and who then have to implement the measures. We therefore suggest an open method of coordination, whereby the state governments set goals for continuing training, provide appropriate measures and continuously report on their progress by means of a public monitoring system. This method proved to be effective for the European employment strategy and will most likely help to speed up the reform process in the German education system.

4 Bottlenecks in the labour market

4.1 Basic considerations

Labour shortage is a transitional phenomenon. As we know from the Job Vacancy Survey, companies stop scouting for new employees after four or five months if they are unable to successfully hire somebody within this time period. After this time, explicit labour shortages disappear as actions are adopted to cope with labour shortages: work is distributed differently among employees; working hours are increased; temporary employment is used; etc. Alternatively, technical and/or organisational measures are implemented and, as a last resort, contracts are renounced (Table 4-1).

Table 4-1 Company measures used in case of unsuccessful search for personnel
Companies which abandoned searching for personnel in the last 12 months (in %); multiple answers possible; data refers to the IV. quarter of each year

	2008	2009	2010	2011
Tasks were fulfilled by other staff members within regular working time	40.1	28.0	34.8	41.1
Tasks were fulfilled by other staff members (overtime, switch from part-time to full-time)	32.1	36.5	32.3	38.1
Contracts were renounced	24.0	25.4	23.6	40.3
Technical/ organisational changes were made	17.9	21.1	20.5	21.6
Use of temporary/ subcontracted work	10.3	13.2	9.1	10.9
No demand anymore due to an altered market situation	7.9	12.7	7.8	7.1
The vacancy was filled internally	6.8	8.4	7.4	7.1
Other reasons	4.7	2.9	3.8	3.1

Source: IAB (German Job Vacancy Survey)

In the short-term, labour shortages will be compensated for by changes in the existing labour force. This means that there will still be demand for skilled workers. In the long-term, however, solutions will be sought which enable companies to operate with fewer employees. As a result, labour shortages will disappear.

In our forecast, we assume that the continuing and intensifying limits on labour supply will prompt companies to resort to long-term adaptation measures. In view of the growing labour shortage, they will use all the productivity potential that is availa-

ble. This is implied in our forecast with a comparatively high productivity growth of 1.9 % per year (Table 1-1). Moreover, they will also increasingly make use of opportunities to outsource abroad, either through subcontracts or by founding new enterprises. Finally, contracts will be renounced if the necessary production capacity cannot be realised. In the long run, towards the end of our forecast period, the labour shortage problem will have virtually disappeared. By the year 2030, the economy will have adjusted to the shortage of workers, labour demand will have declined and a new – perhaps suboptimal – balance will have been achieved. This is the central message of our employment forecast, which predicts overall employment to decline by 1.4 million by the year 2030.

This process can be seen more clearly in a virtual comparison of the supply of and demand for skilled workers. We assume that the adjustment rate of labour supply will slow down, meaning that the supply structure, by occupations e. g., will remain unchanged for a period of five years. At the end of the five-year period, this virtual supply is then compared to the results of the model. In order to eliminate the level effect of the overall larger labour force, the structure of the labour force is imposed on the total number of persons employed. This comparison thus measures the structural effects of the decelerated adjustment. Five-year time periods have been taken because using a structure which does not change over 20 years would lead to an increasingly unrealistic world. After five years, the calculations start from the beginning and the difference between virtual supply and demand is generated again with the assumption that no further adjustments will occur on the supply side over the following five years.

This calculation generates the results shown in Figure 4-1: without adjusting the demand structure, there would be a shortage of almost 2 million workers with tertiary qualifications by the year 2015. In contrast, there would be a surplus of 2.2 million workers without any vocational training. However, these potential imbalances decrease significantly over the forecast period. The model thus also supports the theoretical view regarding the way in which the labour market is expected to adapt to bottlenecks. The imbalances in the year 2030 will only be a third or a fifth of the values of 2015.

Labour market and training policy measures will make a considerable contribution to this equilibrium. The efficiency of employment agencies, the alignment of training opportunities and bottlenecks in the labour market, the targeted recruitment of workers abroad, etc. are all factors which prevent imbalances from occurring. We have illustrated and explained further policy measures to avoid major labour market bottlenecks in chapter 5.

Nevertheless, in this rapid adjustment process between supply and demand, there is a danger of "missed opportunities". Adjustments on the demand side cause imbalances to gradually disappear, either due to low growth, high imports or the long-term loss of competitiveness. The USA and Great Britain are examples of what happens when there is no vocational training policy in place, which, in their cases, eventually

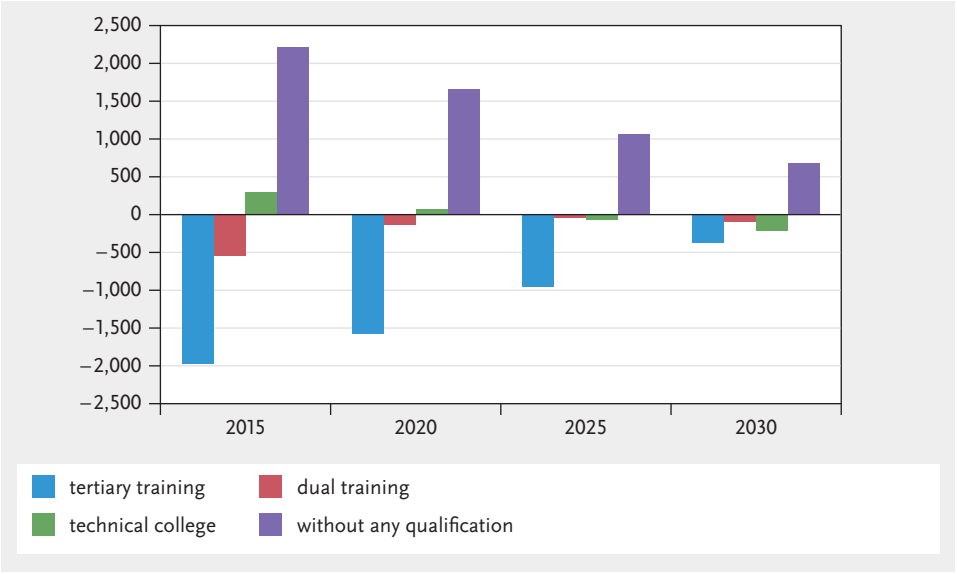

Figure 4-1 Skills shortages assuming fixed qualification supply structure
Balance of potential and actual number of persons employed by formal qualification (1000 persons)

Source: Economix

led to the loss of their industrial base. Germany is certainly different in this respect. The results of the model, however, show that because of the declining labour supply, a similar force is in place.

A corresponding picture can be seen for the calculation of the virtual skills shortage by occupation (Table 4-2). A continuous surplus of skilled workers in manufacturing jobs contrasts with a persistent lack of technical professions, scientists, managers, salesmen and commercial and financial professionals, as well as health occupations.

Table 4-2 Skills shortages assuming fixed occupational supply structure
Balance of potential and actual number of persons employed by occupation (1000 persons)

	2015	2020	2025	2030
manufacturing occupations	593	480	318	262
technical occupations	-136	-113	-127	-73
scientists	-33	-39	-31	-38
salesmen, commercial and financial professionals	-62	-40	-291	-181
transport related occupations	170	63	-21	-20
managers, senior officials	-197	-181	-142	-107
administrative and office occupations	52	25	80	95
legal and security related occupations	74	61	68	53
artists, journalists	-60	-56	-16	-36

(Table 4-2 continued)

	2015	2020	2025	2030
health occupations	-187	-142	-116	-161
teacher, social care occupations	-269	-214	79	35
personal service occupations	-70	68	124	113
workers without specified occupation	125	89	75	58

Source: Economix

It should be emphasized that long-term labour shortages determined in this way do not need to correspond to the short-term labour shortages. Long-term changes in labour demand are mirrored in the labour shortages, while the short-term labour requirements are measured by labour inflows and labour outflows.

4.2 Labour market balance by formal vocational training

The imbalances in the labour market can also be seen from the flows. The balance between labour inflows and labour outflows illustrates the shortage in the labour market.

Labour market balance

This is the annual difference between labour inflows (into the labour force) and labour outflows (from employment).

Usually, the balance is positive as labour outflows into non-employment are not taken into account. If these figures were also included, the balance would be identical to the change of the labour force.

A positive balance signifies a surplus of labour supply, whereas a negative balance denotes labour shortages. Labour inflows and labour outflows are indicators which include people who change occupations throughout the year as well as status changes between unemployment, employment and non-employment.

The overall balance between labour inflows and labour outflows was 0.95 million at the beginning of the forecast period and will sink to 0.90 million by the end of the forecast period. This reflects the fall in labour supply. In principle, it is to be expected that the labour inflows are higher than the labour outflows, as there are also outflows to non-employment. A declining balance thus shows an increasing shortage of workers, either due to a lower supply in the labour force, an increase in employment opportunities or high labour outflows into a non-employment status.

The various labour shortage ratios are portrayed as the relationship between net inflows and employment (Table 4-3). It shows that the smallest surplus in the labour force is among tertiary education graduates. This is the equivalent of only 1 % of the labour force and it will decrease by 0.3 percentage points from an initial 1.2 % over the forecast period. In the segment of skilled workers with dual vocational training, the surplus is 2.2 % and for technical college graduates it is 2.1 %. Among workers with no vocational training the figure is 4.2 %. The overall average is 2.2 %.

Table 4-3 Relative shortages by formal training
Index of average net inflows per person employed and temporal change of the net inflow rate

	Annual net inflows per person employed		Shortage-indicator*
	Average 2010–30 %	Change 2010–14 to 2025–30 %-points	
human medicine, veterinary medicine	0.6	-0.2	-137.9
law, economics and social sciences	0.9	-0.4	-122.8
mathematics, natural sciences	1.1	-0.4	-113.7
humanities and cultural studies, sports	1.0	-0.3	-111.9
engineering sciences	1.1	-0.2	-100.0
arts, art sciences	1.5	-0.5	-87.9
agricultural science, forestry and nutrition science	1.8	-0.3	-60.0
tertiary training	**1.0**	**-0.3**	**-113.5**
healthcare and social occ.	1.2	-0.3	-92.6
industrial and craft manufacturing occ.	1.5	-0.1	-69.8
organisation, administration and office occ.	1.4	0.0	-68.2
technical occ.	1.3	0.2	-66.9
metal working occ.	1.8	-0.2	-50.1
body care, guest relation, domestic and cleaning occ.	3.0	-0.6	8.2
salesmen and service occ., shipping and transport related occ.	2.6	-0.1	10.0
construction occ.	2.8	-0.3	14.6
private service occ.	2.7	0.0	17.0
farming, animal breeding, fishing	3.1	-0.3	36.0
other manufacturing occ.	3.5	-0.7	37.3
dual training	**2.2**	**-0.2**	**-21.0**
education related and nursing occ.	1.5	-0.2	-73.4
creative-artistic occ.	2.2	-0.3	-33.3
other occ.	2.1	0.0	-21.3
IT specialists, mathematicians, natural scientific occ.	2.1	0.5	4.6
commercial occ.	2.2	0.4	8.4
engineering occ.	2.5	0.7	46.0
technical college	**2.1**	**0.2**	**-12.2**
without any qualification, not stated	**4.2**	**1.3**	**196.8**
Total	**2.2**	**-0.1**	**0.0**

(*) The indicator is composed of normalised average net inflow figures for 2010 to 2030 and the change of these figures from 2010 to 2030. Thereby, average values for 2010 to 2014 and 2025 to 2030 are compared. Negative values refer to shortages, whereas positive values refer to surpluses for the respective partial labour market. It is 0 for the economy as a whole. See Kriechel, Vogler-Ludwig 2013, chapter 4.4.3.

Source: Economix

For tertiary training, the annual net inflow will fall by 0.3 percentage points, and for dual training it will decline by 0.2 percentage points. Both indicate an increasing shortage. Among technical college graduates, however, it will rise by 0.2 percentage points, thus signifying a surplus. These surpluses are particularly high among workers without vocational training. The initial net inflow of 3.7 % will rise further by 1.3 percentage points by the year 2030.

Skills shortages can be more clearly illustrated by the shortage indicator which we developed for this purpose. It takes into account the net inflow rate as well the changes over the period 2010 to 2030 (Table 4-3, text box).

Shortage indicator

The indicator consists of two components: the average net inflow rate (or net outflow rate) in a profession over the forecast period, and the changes in the net inflow rate (or the net outflow rate) between 2010 and 2030.

The net rate puts the labour market balance into relation to the number of employees in the respective labour market. The first component of the indicator reflects the permanent shortages (or surpluses) in the respective labour market, the second component shows how it changes over time, i. e. if the imbalances intensify or disappear over the forecast period. The indicator is standardised in the overall labour market. Values below 0 show relative shortages, whereas values above 0 show relative surpluses.

The situation will be tight, particularly for workers with a tertiary education who work in medical professions. The net inflow of 0.6 % is very low and over time it will fall even further (-0.2 percentage points). This will lead to the largest indicator value of -138 for labour shortages. There will also be low net inflows among lawyers, economists and social scientists as well as among mathematicians and natural scientists, meaning a significant decline in these figures. This will lead to index values of -123 and -114, respectively. Net inflows will decline in all fields of study and will thus lead to negative indicator values of -114.

Labour shortages will not be as severe among skilled workers with dual vocational training. On average the indicator value is -21. Compared to tertiary education, the lower labour shortage is primarily due to the high net inflow. At 2.2 % this is significantly higher than the net inflow of workers with tertiary education (1 %). Employment trends are a decisive factor in this regard, as they are positive among tertiary education graduates, yet are negative among skilled workers with dual vocational training.

In the segment of workers with dual vocational training, almost half of the vocational training fields show labour surpluses with indicator values below 0. The highest indicator values were generated for workers with vocational training in the fields of healthcare and social professions (-93), industrial and craft manufacturing occupations (-70), organisation, administration and office jobs (-69) as well as technical occupations (-68). On the other hand, surpluses of skilled workers with dual vocational training were shown in other manufacturing professions (+37), occupations in the fields of farming, animal breeding and fishing (+36), as well as in the category of private services (+17) and construction (+14).

For skilled workers who are technical college graduates, the indicator suggests that there will be labour shortages in the fields of education and nursing. In contrast, there will be a surplus of IT specialists, mathematicians, natural scientific assistants, commercial occupations and, in particular, engineering professions.

Workers without any vocational training will generate the high surpluses mentioned above with an indicator value of +197. This illustrates the accumulated surpluses in this segment and means that significant efforts will be necessary to make use of this potential source for skilled workers.

Nevertheless, it should be noted that our estimations of inflows and outflows contain various constants which could lead us to underestimate the reactions on the supply side. Thus, for example, it is presumed that the transition rate from unemployment to employment will not change. Our estimations thus reflect that these transfers will change employment, but that there are no additional underlying educational or political measures. In particular, there is no connection between unemployment in the labour market and the net inflows. Surely this is a good reason to further develop the forecast model.

4.3 Labour market balance according to occupation

For occupations, the index values for labour market shortages fluctuate between -44.5 and +169.6 (Table 4-4). The overall low labour shortage compared to the fields of formal training signify that vocational integration, for the most part, already compensates for the discrepancies between supply and demand. This is most likely caused by people who change professions.

Labour shortages predominantly appear in industrial and agricultural professions, such as among machine operators, in agriculture and forestry occupations and in printing occupations. Reduced labour inflow from dual vocational training is likely to be a crucial factor in this respect. This indicates the declining net inflows. Shortages also appear in the textile, clothing and leather industry and in chemistry-related occupations.

It is a similar situation for masters of trade, financial occupations and healthcare professions, albeit to a lesser extent. In these professions, the relative shortages are caused by low net inflows over the forecast period rather than because of changes over a period of time. There is a surplus in mining and among construction material manufacturers, security occupations and unskilled labourers, as well as among technicians and salesmen.

The way in which the model implements the adjustment of labour supply and labour demand is illustrated in a hypothetical calculation. In this calculation, it is assumed that inflows into the labour market do not change over a period of five years. The net

inflows are newly calculated from these inflows, whereby demand remains unchanged. The results of this alternative calculation are shown in Table 4-5.

The labour market net inflows calculated from the model are 30–40 % below the hypothetical values for engineers/natural scientists, managers, banking/insurance specialists or humanities and natural scientific professions. In the model, labour supply adapts to changes in labour demand and thus reduces the occurrence of bottlenecks. Conversely, net inflows in office jobs, printing occupations or professions in the textile and leather industry would be 30–40 % higher than the figure measured in the model. For individual occupations, the values are much higher. Only by excluding the adjustments which are contained in our model can we come to the conclusion that the German labour market is heading for bottlenecks in the intermediate qualification band.

Table 4-4 Relative shortages by occupation
Index of average net inflows per person employed and temporal change of the net inflow rate

Ranking of 34 occupational groups	Net inflows to persons employed		Shortage-indicator*
	Average 2010–30 %	Change 2010–14 to 2025–30 %-points	
machine operators	2.5	-0.2	-44.5
workers without specified occupation	4.9	-0.3	-40.7
agricultural occupations	3.3	-0.2	-39.7
paper and print related occ.	2.0	-0.1	-33.0
metal extractors and manufacturers	2.0	-0.1	-32.5
textile and leather occ.	2.5	-0.2	-27.9
chemistry and plastics related occ.	1.1	-0.1	-23.6
master craftsmen	0.2	0.0	-23.1
banking, insurance specialist	0.7	0.0	-20.4
health occupations	1.1	-0.1	-19.6
lawyer, executory officer	0.9	-0.1	-18.8
managers, senior officials	0.8	0.0	-17.8
engineers, natural scientists	0.9	0.0	-16.6
office clerks	1.5	-0.1	-15.4
accountant, information technology officer	1.6	-0.1	-14.6
mechanical engineers and precision mechanics	2.3	-0.1	-14.2
electric and electronic technician	1.7	-0.1	-14.0
ceramists and glass manufacturers	1.2	-0.1	-11.4

(*) The indicator is composed of normalised average net inflow figures for 2010 to 2030 and the change of these figures from 2010 to 2030. Thereby, average values for 2010 to 2014 and 2025 to 2030 are compared. Negative values refer to shortages, whereas positive values refer to surpluses for the respective partial labour market. It is 0 for the economy as a whole. See Kriechel, Vogler-Ludwig 2013, chapter 4.4.3.

(Table 4-4 continued)

Ranking of 34 occupational groups	Net inflows to persons employed		Shortage-indicator*
	Average 2010–30 %	Change 2010–14 to 2025–30 %-points	
wood occupations	2.6	-0.2	-10.9
humanities, natural science occ.	2.3	-0.1	-10.2
food related occ.	2.2	-0.1	-6.4
assembler	3.1	-0.2	-6.4
building	3.1	-0.2	-4.2
artists, journalists	2.0	-0.1	-4.0
plant operators, installer	1.1	0.0	1.1
personal service occ.	3.5	-0.2	1.6
product tester, shipping packer	6.3	-0.4	13.8
teacher, social care occ.	1.3	0.0	14.1
transport related occ.	3.6	-0.2	20.5
salesmen	2.1	-0.1	23.8
technicians	1.3	0.0	31.4
labourer	13.5	-0.8	56.2
security occupations	2.8	0.1	137.7
miner, building materials manuf.	1.9	0.2	169.6
Total	**2.2**	**-0.1**	**0.0**

(*) The indicator is composed of normalised average net inflow figures for 2010 to 2030 and the change of these figures from 2010 to 2030. Thereby, average values for 2010 to 2014 and 2025 to 2030 are compared. Negative values refer to shortages, whereas positive values refer to surpluses for the respective partial labour market. It is 0 for the economy as a whole. See Kriechel, Vogler-Ludwig 2013, chapter 4.4.3.

Source: Economix

Table 4-5 Adaptation of labour supply to changes in labour demand
Deviations between net inflows at constant supply structure and net inflows from the model calculations in %*

Occupational group	Deviation in %
engineers, natural scientists	-42.0
managers, senior officials	-40.7
banking, insurance specialist	-39.4
humanities, natural science occ.	-33.7
health occupations	-26.7
artists, journalists	-26.3

(*) The hypothetical balances are calculated with the inflows to the labour force assuming an unchanged labour supply structure by occupation. Exits from the labour force into employment are taken from the model calculations. The difference measures the hypothetical total balance from 2010–2030 as % of the balance resulting from the model calculations.

(Table 4-5 continued)

Occupational group	Deviation in %
lawyer, executory officer	-22.8
accountant, information technology officer	-19.1
product tester, shipping packer	-13.5
personal service occ.	-13.4
teacher, social care occ.	-13.2
salesmen	-8.3
transport related occ.	-3.1
technicians	2.0
security occupations	5.1
assembler	5.8
machine operators	7.3
miner, building materials manuf.	9.9
building	12.0
agricultural occupations	12.0
labourer	13.6
electric and electronic technician	14.0
wood occupations	14.0
workers without specified occupation	17.1
mechanical engineers and precision mechanics	17.5
food related occ.	20.7
chemistry and plastics related occ.	21.1
metal extractors and manufacturers	28.7
office clerks	29.9
paper and print related occ.	30.4
textile and leather occ.	42.1
plant operators, installer	62.6
ceramists and glass manufacturers	100.5
master craftsmen	155.2
Total	**0.0**

(*) The hypothetical balances are calculated with the inflows to the labour force assuming an unchanged labour supply structure by occupation. Exits from the labour force into employment are taken from the model calculations. The difference measures the hypothetical total balance from 2010–2030 as % of the balance resulting from the model calculations.

Source: Economix

4.4 Overall ranking

Measuring labour market balances in this detail is a methodical challenge. It not only requires a high degree of precision when measuring labour inflows and labour outflows, but it also requires a model which describes the adaptation of supply and demand in response to emerging imbalances. These adaptations have largely been taken into account. This is not only important because of the behaviour which is expected in reality. It is also a result of labour market mechanics, where the compliance of stock changes and the balances of inflows and outflows are required in every part of the labour market for both labour supply and labour demand.

Potential undesirable developments only appear in the short-term. From a long-term point of view, like this one, it is assumed that the mismatch between supply and demand will even out over the course of the adjustment process. As adjustments in labour supply and labour demand will occur at various speeds, the excess demand – i. e. the unrealised labour demand – is only measurable in the short-term. It remains hypothetical in the long-term.

Our calculations show that shortages will predominantly occur in the field of tertiary education. This will be caused by a strong demand for workers with higher education, despite increasing participation rates in training. All occupations will be affected to a different extent.

We do not see any general labour market bottlenecks in the intermediate qualification band, neither among workers with dual vocational training nor among workers that have a technical college background. In this segment, bottlenecks are most likely to occur in occupations where workers predominantly come from the dual vocational training system and who possess a high degree of specialisation, meaning that usually the industrial manufacturing professions are affected. There will be a considerable surplus in the segment of workers who do not have any vocational training. It seems that even in the future the influx will significantly exceed demand in this segment. This potential should be used by extending training measures.

The distinctive bottlenecks in the intermediate qualification band, which were predicted by the BiBB-IAB consortium in their latest long-term forecast (BiBB/IAB 2012), only arise in our calculations on the assumption that labour supply will adjust to the changes in labour demand at a markedly slow rate. The situation described in the BiBB-IAB report that "... there will be an increasing mismatch between supply and demand with respect to professional specialisation" (page 5) does not emerge in our model because we do not believe that labour supply and labour demand are independent from one another. The hypothetical calculations which have constant supply and demand structures merely show the direction of the structural change, but by no means show the magnitude of the expected shortage of skilled workers. According to our estimations, the flexibility of the labour market significantly contributes to the rapid reduction of imbalances.

It can therefore be concluded that it is not so much the precise alignment of supply and demand that matters, but rather that there is an adequate amount of flexibility in the labour market. Although, looking at the fields of vocational training, there are certain shortages and surpluses in the labour market. These disappear quickly when the vocational integration of workers is taken into account. It shows that the labour market possesses a high degree of professional adaptability which we expect to continue in the future.

From a political perspective, this prioritises the promotion of basic skills rather than further professional specialisation. Companies' demand for specialised workers who can be used productively in a specific workplace has to be related to the labour market's demand for flexible, productive workforces in many workplaces. In fact, there is a divide between work-related training within companies and basic training provided during vocational training. While the former is financed by companies, we consider the latter to be the worker's and the state's responsibility. In light of the structural change in the labour market, this labour market oriented vocational training assumes particular importance.

5 Conclusions and recommendations

It has been less than a decade in which Germany has achieved a dramatic turnaround. The country which was long criticised for being unwilling to reform is now one of the most competitive economies in the world and is admired for its resilience during the crisis. The turnaround was successful because companies restructured themselves, politics introduced fundamental reforms into the labour market, and into other areas of the economy, and workers took the situation into their own hands by using their initiative to assume responsibility for full employment and tolerating prudent wage policies. It was a historical compromise between capital and labour, based on the principles of the social market economy. At the core of this compromise was the realisation that work – or human capital – is the decisive growth factor which needs to be developed and secured for the long-term. However, the price of this compromise was large differences in income and wealth.

Germany will now reach a new turning point which will be triggered by demographic change. Up to the year 2030, and thereafter, the population – and thus also labour supply – will not only decline but will also age considerably. With the baby boom generation of the 1960s exiting the labour market, we will feel the full effects of the lack of young generations. This will continuously reduce the supply of skilled workers and, as a result, will force the currently dynamic economy into a period of slower growth. Moreover, economic growth will solely be determined by productivity, which, in view of the ageing working population, will be much more difficult to achieve than it has been to date. Furthermore, reduced occupational mobility among older workers will decelerate structural change.

This is the demographic challenge that Germany is facing today. In the context of our report, we have, on numerous occasions, addressed the conceivable political and economic reactions and added necessary elements from our estimations. Thus, we have created a forecast for the year 2030, which assumes that actors at different levels will react to undesirable developments by introducing effective measures in order to achieve equilibrium again. In this chapter, we will summarise these measures in a reform programme (Table 5-1).

Nevertheless, politicians should also take a look at the period after the year 2030. If the low birth rate continues, as has been predicted in the 12th coordinated population forecast, demographic change and the low level of labour inflow among young

workers completing vocational training will remain an ongoing topic long after the year 2030. In the long-term, family policy predominantly faces the challenge of developing a more family friendly society in which employment and offspring are not at odds with one another. For this to happen, not only the expansion of high quality childcare opportunities is required, but also the redistribution effects of the tax system and the structure of the state pension scheme need to be improved so that it can benefit families that have children.

Economic policy and structural policy

Shifting to higher growth, which Germany experienced during the last decade, can predominantly be traced back to structural reforms, although the clever macro policy should not be discounted. The transformation of German industry into a supplier of high quality technical and scientific services was fundamental for this process and was a decisive factor for entering the knowledge economy. We assume that this transformation will continue to pick up pace over the next two decades, especially as Asian competitors advance in high-tech markets. It is crucial to have a forward-looking strategy in this aspect as retaining industries which are in jeopardy is just as ineffective as their massive funding is detrimental.

We recommend a structural policy which focuses less on individual sectors and more on competitiveness. Continuation of the open markets policy will provide companies with opportunities and development options, whereby they can quickly assert their competitive advantage in a global economy. Alongside research and innovation, expanding the sustainability and the further development of the social model is a crucial factor. Business models which focused on long-term goals and attempted to find the social balance were factors which protected Germany during the economic and financial crisis and which will also contribute to growth in the future.

In general, we expect that the industrial sector – supported by numerous specialised service providers – will transform itself into the "project manager" of the global value chain. The building sector, trade and the financial services industry will also follow this pattern. As a result, the manufacturing of products will lose importance compared to the management of production chains and the marketing of goods. On the other hand, it will become more important to hold financial investments in production plants all over the world than to expand national production facilities. Management and finance will thus become key functions which Germany will need in the global economy. For this reason, we recommend that Germany refrains from a structural policy which is tailored to each sector and instead focuses on integrating herself into the global economy.

There is no doubt that macro policy currently has a key role. We expect that Germany and other European countries will do everything they can to stabilise the euro and to avoid another global economic downturn. The economic risks of the eurozone collapsing are too high to follow separatist arguments. Germany will also carry the burdens of adjustment which will arise from stabilisation, at least in the form of weaker growth if not in the form of debt relief.

There is also another problem: the permanent trade surplus in Germany and in other countries is a major cause of the debt problems which the competitively weak countries of the EU are experiencing today. This is the time bomb which the real economy has put to the euro. In order to defuse this bomb, the economic power in today's deficit countries needs to be sustainably improved. We expect German trade surpluses to significantly decline by the year 2030 and that direct investments abroad will increase. This rebalancing of international trade needs to be politically supported, both with regard to the euro and the opportunities of globalisation.

Labour market policy

We expect that under any governing coalition, the fundamental principles of the Harz reforms from 2005 regarding financial benefits for unemployed persons will not be reversed. This burdens employees with considerably higher financial risks if they become unemployed, but they are also freed from the unemployment trap and led to increased employment. The risk of unemployment will fall further as a result of the economic and demographic trends which we have predicted. The lower unemployment rate will have repercussions on expenditure for active labour market policy and other employment policies. In particular, measures will be withdrawn which redistributed employment opportunities for the unemployed – such as "mini jobs". Measures to create employment will be downsized, as can already be seen today, and they will focus on groups which exhibit recruitment difficulties, even in a favourable labour market situation.

Labour market policy will focus much more on today's prevailing topic of labour shortage and will have to ensure that the labour supply grows in all sectors. This includes[27]:

- Increasing the female workforce by taking measures to improve relations between family life and work life. This particularly involves expanding childcare facilities and nursing/residential care for old people.
- Creating a sustainable human resource policy which provides jobs that are not age discriminatory and which prepares the workforce for a long working life.
- Controlling the number of immigrants coming to Germany in line with the demand for skilled workers.
- Increasing working hours, especially for part-time workers. This includes minimising the amount of marginal employment and an increased use of flexible working models.
- Promoting career advancement among workers by offering continuing education and vocational re-training.

In Germany, we expect that there will be more interest among female workers taking part in the formal economy and thus the participation rate among women will grow. Therefore, the key issue is not so much persuasion, but rather the conditions for

27 In this field of policy action, many overlaps with other policy areas exist, especially in family policy, occupational safety policy, immigration policy etc. These overlaps are taken into account here. Education policy will be addressed in the following section.

improving the relationship between family life and working life. It all started in Germany with the Childcare Funding Act (*Kinderförderungsgesetz*) of 2008 which, despite some implementation issues, will lead to considerable growth in extra-familial care of babies and toddlers. Together with the expansion of full-time schools and other services, which will be provided to support families, this will have the expected positive effects on the female participation rate.

The participation rate among older men and women will pose a bigger challenge. We presume that policies and companies will not only provide considerable incentives to win over older workers, but that by fairly reshaping the workplace to the needs of older workers, they will also be able to keep them in the labour market. The rise of the legal retirement age to 67, which will be fully put in place by the year 2030, will not create more than an obligation for workers to offer their work. It remains to be seen whether they will find jobs again – especially if they have lost their job. Thus, in order to extend the years of working life, retaining and developing the performance of older workers is a crucial factor. There will have to be increased efforts in labour market policy regarding this issue, either by means of training or by placing older workers in suitable jobs. This will be an essential step, particularly in jobs which are physically and mentally challenging. In addition, small and medium-sized enterprises will especially need to be advised and supported so that they can implement the changes in their work organisation.

Older workers' performance is strongly dependent on their employment history, especially with the intellectual incentives they gain throughout their working life. Monotonous and unchallenging work jeopardises the ability to learn and to adapt in the long run. Sustainable human resource policies in companies will help to counteract this. Work organisation and the distribution of duties should be set up in such a way that workers' mental performance is fully utilised and workers' learning capabilities are maintained. This is the only way that productivity requirements can also be fulfilled by older workers. Apart from the necessary work organisation, flexibility and the distribution of responsibilities, a flexible structure with regard to working hours is also an essential aspect. Furthermore, companies have to consciously make use of their older employees' experience and ensure that there is a transfer of knowledge between their older and younger workers. Finally, a sustainable human resource policy has to offer a career path for older employees as well. Continuing education is thus a key measure in all this.

In light of the increasing demand for highly qualified and skilled workers, companies and labour market policies should ensure improved career advancement prospects and permeability in the working world. Assessment centres could contribute to this, whereby they would not only assess an applicant's skills profile, but would weigh up the applicant's competencies consistent with formal vocational training, if applicable. This would help to evaluate competencies which are acquired during professional training, and would also help older workers to demonstrate their knowledge in the external labour market. The German Labour Agency and the Chambers should play a key role in establishing and certifying competencies.

With respect to demographic change, immigration does not play a decisive part but it can contribute to minimising the shortage of skilled workers, especially as they generally serve the segments that have the strongest labour demand. We recommend changing the immigration rules which until now have predominantly focused on the country of origin, and instead establish immigration rules which are based on competences. A credit points system, which could also include aspects from the asylum law, would mean that immigrants would be aligned with the demand for skilled labour and thus, would also ensure that migrants are quickly integrated into the labour market.

The point of labour market policy is to fully utilise the available potential in order to expand labour supply. Besides the measures which are to be taken to improve better unity of family life and working life, this also predominantly includes a sustainable human resource policy. Labour market policy will focus on integrating workers into the labour market rather than activating the workforce. This includes flexible viewpoints regarding areas of life outside of work, maintaining work performance at an older age, and improving the permeability of the labour market. Furthermore, we invite companies to pursue a sustainable human resource policy which counteracts the deterioration of learning and adaptation abilities in a monotonous working environment.

Education policy

In our opinion, human capital is the pivotal element of economic and social development. Many people share this point of view, not least the numerous companies which made every effort to safeguard their employees during the crisis of 2008. Education and training are key factors for international competition, which is why many countries have since set up extensive training programmes.

Demographic change makes it difficult for Germany to maintain her position, as fewer and fewer graduates are expected to come from initial training. Vocational training and lifelong learning are the most important measures for maintaining growth. Therefore, we recommend that an approved, certified system for continuing training is set up and that it is made a central issue. However, this will not be possible without support from the government. Until now, continuing training has largely been a matter for private persons and companies. Thus, short-term and non-certified courses have dominated. In our opinion, the government needs to take an active part in this so that the cursory training which has been offered up until now is converted into a clearly structured system which has education standards, and wherein the resulting qualifications are of equivalent importance to the formal initial training. This means that there should be clear validation rules for the various courses of private training providers, as well as a modular training system which takes the training participants' need for flexibility into account. We suggest updating older university degrees, as well as supplementing the now highly specialised courses with related fields of study. We consider that it is the state's responsibility to set the structure and rules of such a training system and that it is the task of the universities, technical

colleges and private training institutions to suitably prepare people for the labour market.

However, this involves promoting career advancement among graduates who completed vocational training. Modularised systems seem to be the most appropriate method of increasing participation rates in lifelong learning and broadening the competences of highly specialised workers. Last but not least, government funding for lifelong learning is also a crucial factor, especially since there will be savings from initial vocational training due to the declining number of children. Increased participation in continued training will not succeed if employees and organisations have to cover all of the direct and indirect costs of the training themselves. The Australian education system has taken an interesting approach which shows how a modular system is able to also integrate adults in vocational training.

Haste is necessary, as we have already entered the phase where labour supply is in decline. It is very likely that employers will quickly introduce measures in order to overcome the shortage of skilled workers. However, they may be overstrained if they have to solve the problem alone. Maybe even more so, as the growing shortage of skilled workers increases the danger of poaching qualified workers. Governmental education policy is therefore requested to set up the institutional and financial framework for lifelong learning. This is not an easy task, as we well know, as there are 16 state governments in Germany which need to be convinced and who then have to implement the measures. We therefore suggest an open method of coordination, whereby the state governments set goals for continuing training, provide appropriate measures and continuously report on their progress by means of a public monitoring system. This method is used in the European employment strategy, and it may also help the German education system to accelerate reforms.

The dual vocational training system has long faced the challenge of reducing the specialisation of training regulations, and it has acted upon it. However, changes in the working environment are still advancing more quickly than can be seen from the regulations. Thus, it is important to concentrate on basic skills in the initial training which can then be supplemented with further modules in lifelong learning. With regard to dual vocational training, companies are expected to provide a higher level of training, especially those companies which are more interested in the quantity of manpower than in the quality of training. Last but not least, relations between schools and companies should remain flexible so that differing educational needs are satisfied and participants' career advancements remain secure. The Dutch education system is a good example of this.

The decisive shift in the workforce will be the result of a disproportionate decline in the number of workers who do not have any vocational training. We expect that the shortage of skilled workers will not only prompt policies, but will also prompt companies to invest in training their workforce. At the lower end of the qualification spectrum, this will involve increased efforts in integrating young people from educationally underprivileged backgrounds as well as broadening the scope of lifelong

learning. For this to happen, the primary and secondary school education system has to develop and implement effective strategies. The economy will only be successful in its training measures if primary and secondary education is improved.

The overall qualification structure will thus be determined by a chimney effect, wherein at the upper end there is a strong demand for tertiary education graduates and all the other levels are pulled upwards. There will be considerable opportunities for career advancement and workers will be able to use their skills at a higher level of both general and vocational education. Above all, displacing vocational training in the so-called transition system will come to an end, and it will open up new opportunities for those who are educationally disadvantaged. For the chimney effect to come about, education policies need to ensure better recognition of vocational practices.

Finally, the current educational approach at all levels of the education system needs to be put to the test. The school-based type of tertiary education which has been introduced by the "Bachelor reform", the introduction of eight years of high school, and last but not least, strong elements of school-oriented teaching already in kindergarten ensure that participants build up the required level of knowledge, yet their creative freedom is limited. In the long run, this is a dangerous route for a country that lives for innovation and creativity. Self-determination and free thought are just as important as accurate existing knowledge. This is rather similar to what the Chinese government wrote in its 12th five-year plan.[28]

倡导学术诚信，鼓励独立思考，保障学术自由，弘扬科学精神

Wen Jiabao (2012)

28 In the 12th five-year-plan 2012, the Chinese Government declared its goals to achieve a level of 4% of GDP for educational spending and to reform the educational system without delay. Among other goals, the government's targets included "... to promote academic values, to encourage the development of independent thinking, to extend academic freedom, and to facilitate scientific spirits" (Jiabao 2012).

Table 5-1 Reform programme

Field of policy action	Central government *(Bund)*	Regional governments *(Länder*/municipalities*)*	Companies/employers' associations	Employees/unions
Preserving employment for older workers	Promotion of old-age employment	Support of sustainable human resource policies in companies; Expansion of regional consulting programmes; Exchange of experience on regional/local levels	Sustainable human resource policies to ensure a long working life; Adjusting jobs to the needs of older workers; Flexible working hours	Preserving the ability to learn and to adapt
Activation and integration of unemployed persons	Expansion of placement services for older workers; Continuing training and vocational re-training for unemployed persons; Improved services for job seekers, especially for immigrants; Integration services for people re-entering the labour market	Activation of unemployed persons by the labour administration		
Balance of work life and family life	Expansion of childcare and pupil care	Expansion of childcare and pupil care; Expansion of all-day schools; Expansion of nursing/residential care institutions	Expansion of childcare; Longer working hours for part-time workers; Greater flexibility of part-time work schemes	Higher expenditure in care services
Immigration and integration	Assessment-centres and certification of professional skills; Validation procedures for foreign professional qualifications; Controlled migration policy; Promoting an open-minded society; Promoting further training for immigrants		Assessment-centres	

(Table 5-1 continued)

Field of policy action	Central government *(Bund)*	Regional governments *(Länder*/municipalities*)*	Companies/employers' associations	Employees/unions
Increasing educational opportunities	School support for socio-economically disadvantaged youths and people from educationally deprived backgrounds to improve access to higher educational qualifications	School support for socio-economically disadvantaged youths and people from educationally deprived backgrounds to improve access to higher educational qualifications; Reforming the now school-based type of education at all levels of education	Encouraging continuing training among staff	
Expanding continuing training	Establishing an approved and certified system of continuing training ; Determining validation rules; Promoting continuing training; Promoting professional career advancement	Expanding continuing training programmes (universities); Open process of coordination for formal training; Flexible combination of school-based and company-based training; Modular continuing training for persons with dual training	Cooperating with universities and other training providers	Lifelong learning
Industrial policy	Promoting R&D; Information technology systems; Free international trade; Development of human capital	Promoting R&D; Information technology systems; Development of human capital	Development of project management	
Macro policy	Stabilising the euro; Reducing trade surpluses; Integration into the world economy		Increasing direct investments in Asia and EU countries	

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Annex

Detailed results

1 Economic developments

1.1 Population by age and gender
1000 persons

	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
male, up to 14 years old	5604	-326	-105	-38	-98	5037
male, 15–19 years old	2121	-70	-190	-84	-24	1752
male, 20–24 years old	2537	-349	-52	-179	-82	1875
male, 25–29 years old	2504	100	-316	-33	-178	2076
male, 30–34 years old	2447	83	131	-297	-33	2331
male, 35–39 years old	2513	-66	113	145	-296	2409
male, 40–45 years old	3387	-885	-42	126	146	2732
male, 46–49 years old	3629	-274	-855	-26	125	2599
male, 50–54 years old	3156	408	-253	-824	-22	2465
male, 55–59 years old	2715	345	409	-229	-798	2442
male, 60–64 years old	2295	290	341	408	-213	3121
male, 65–69 years old	2116	19	279	338	401	3152
male, 70–74 years old	2279	-395	39	273	326	2522
male, 75+ years old	2792	835	254	186	365	4432
Male population	**40094**	**-285**	**-249**	**-234**	**-381**	**38945**
female, up to 14 years old	5312	-312	-101	-34	-96	4769
female, 15–19 years old	2017	-62	-181	-82	-23	1669
female, 20–24 years old	2431	-325	-40	-171	-80	1815
female, 25–29 years old	2436	69	-295	-27	-171	2012
female, 30–34 years old	2393	67	92	-284	-27	2241
female, 35–39 years old	2450	-52	81	102	-282	2300
female, 40–45 years old	3248	-801	-41	91	100	2597
female, 46–49 years old	3484	-251	-789	-31	91	2505
female, 50–54 years old	3093	361	-243	-771	-29	2411
female, 55–59 years old	2765	281	361	-230	-758	2419
female, 60–64 years old	2374	323	277	363	-218	3120
female, 65–69 years old	2287	3	319	283	360	3252
female, 70–74 years old	2648	-490	17	317	282	2774
female, 75+ years old	4722	761	181	147	386	6197

(Table 1 continued)

	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
Female population	**41663**	**-427**	**-363**	**-327**	**-465**	**40081**
total, up to 14 years old	10916	-638	-206	-72	-194	9806
total, 15–19 years old	4138	-133	-371	-166	-47	3421
total, 20–24 years old	4968	-674	-92	-350	-162	3690
total, 25–29 years old	4940	168	-612	-60	-349	4088
total, 30–34 years old	4841	150	223	-581	-60	4572
total, 35–39 years old	4963	-117	194	247	-578	4709
total, 40–45 years old	6635	-1685	-83	217	246	5329
total, 46–49 years old	7113	-524	-1644	-57	216	5104
total, 50–54 years old	6250	769	-496	-1595	-51	4876
total, 55–59 years old	5480	626	769	-459	-1556	4861
total, 60–64 years old	4669	614	618	771	-431	6241
total, 65–69 years old	4403	21	598	621	761	6404
total, 70–74 years old	4927	-885	56	590	608	5296
total, 75+ years old	7515	1596	434	333	751	10629
Total	**81757**	**-712**	**-612**	**-561**	**-846**	**79026**

Source: Economix, CE, Federal Statistical Office: 12th coordinated population projection (variant 1W-2)

1.2 Economic indicators

	2010	2015	2020	2025	2030
Per-capita-income, at 2000 prices (in 1000 euro)	27505	30647	33499	35936	38686
Labour force (in 1000 persons)	43712	43288	42561	41786	40846
Persons employed (in 1000 persons)	40603	41080	40627	39975	39169
Unemployed (in 1000 persons)	3109	2208	1933	1811	1677
Unemployment rate (%)	7.1	5.1	4.5	4.3	4.1
Working hours (Index)	100.0	99.8	99.9	102.0	104.0
Labour productivity (GDP/persons employed; Index)	100.0	110.7	122.1	133.0	145.0
Price index (2000=100)	115.4	122.4	131.4	141.8	154.8

Source: Economix, CE, IER

1.3 Productivity by sector
GDP/persons employed, index (2010=100)

Sector	1995	2010	2015	2020	2025	2030
01 agriculture, forestry, fishing and aquaculture	56.5	100.0	104.7	113.3	118.9	129.4
02 mining, extraction of rock and ores	104.2	100.0	105.1	111.2	117.4	123.1
03 food and beverages	107.9	100.0	117.2	136.3	143.0	154.6
04 textiles, wearing apparel, leather products	68.9	100.0	94.3	97.6	100.1	102.5
05 wood, cork, straw	69.6	100.0	98.4	103.7	107.0	112.6
06 paper products and printing	59.5	100.0	105.9	113.3	120.3	126.9
07 refined petroleum, chemical, pharmaceutical products	58.1	100.0	99.3	108.0	124.5	137.6
08 rubber, plastic, glass, ceramic products	72.0	100.0	110.4	122.0	126.4	131.3
09 metal production and metal working	87.7	100.0	109.4	120.3	133.2	144.8
10 electrical equipment, electronic and optical products	37.1	100.0	126.7	147.7	167.5	189.3
11 mechanical engineering	99.4	100.0	104.5	125.6	138.9	160.3
12 vehicle manufacturing	96.4	100.0	126.3	131.7	119.0	121.3
13 furniture, other manufacturing, repair	65.1	100.0	101.7	118.5	131.0	137.4
14 energy supply	49.6	100.0	102.4	105.0	104.9	105.5
15 water supply, waste management services	69.1	100.0	108.7	121.8	139.1	163.3
16 construction	89.9	100.0	110.4	111.5	112.8	108.9
17 wholesale trade	46.2	100.0	113.0	129.4	136.1	145.2
18 retail trade	82.8	100.0	110.2	120.7	119.0	119.7
19 transport, warehousing	87.9	100.0	127.0	143.1	154.0	163.9
20 postal and courier activities	95.5	100.0	117.3	129.5	135.7	143.4
21 accommodation, hotels and restaurants	139.1	100.0	93.2	100.4	106.4	119.0
22 publishing, motion picture, broadcasting	71.9	100.0	99.1	105.1	124.0	144.7
23 telecommunications	21.3	100.0	130.6	166.7	207.0	256.2
24 IT, information services	51.1	100.0	134.4	145.8	173.4	201.2
25 financial services, insurance, financial intermediaries	85.8	100.0	102.4	108.1	114.6	135.4
26 real estate	104.4	100.0	103.4	104.6	100.1	92.8
27 accounting, management consulting	103.0	100.0	114.5	128.4	149.3	173.6
28 architecture, engineering; technical testing and analysis	124.8	100.0	108.2	121.5	125.4	134.6
29 research and development	69.9	100.0	114.3	131.3	151.8	168.6
30 other scientific and technical services	195.2	100.0	102.2	108.6	125.2	148.0
31 renting and leasing of goods	83.7	100.0	102.9	107.6	116.0	123.1
32 employment agencies	81.5	100.0	123.2	146.9	166.4	171.1
33 travel agencies, tour operators, reservation services	189.6	100.0	100.8	101.5	101.8	102.9
34 other business service providers	111.2	100.0	110.6	116.1	119.0	119.7
35 public administration; social security	74.5	100.0	112.0	122.2	130.5	139.0
36 education	107.9	100.0	99.3	98.4	106.1	113.3
37 healthcare	73.6	100.0	113.7	128.2	141.6	153.8
38 social work, nursing homes	67.4	100.0	110.8	121.8	143.3	163.7
39 arts, culture, gambling and betting	110.3	100.0	100.9	107.7	123.1	129.6
40 sports, entertainment, recreation	96.6	100.0	108.1	119.6	144.6	169.5
41 interest groups	80.7	100.0	100.3	104.2	117.8	130.4
42 repair of consumer goods	111.2	100.0	90.3	83.4	82.4	79.5
43 other personal services	97.6	100.0	106.6	118.4	139.7	156.9
44 personal domestic services	101.3	100.0	99.0	103.9	122.6	141.0
Total	**79.5**	**100.0**	**110.7**	**122.1**	**133.0**	**145.0**

Source: Economix, CE

1.4 Average wages by sector

Per person employed/year (self-employed and social insurance contributions excluded)

Sector	1995	2010	2015	2020	2025	2030
01 agriculture, forestry, fishing and aquaculture	94.6	100.0	104.9	117.8	124.9	132.7
02 mining, extraction of rock and ores	73.8	100.0	111.8	123.8	135.4	146.7
03 food and beverages	82.9	100.0	113.2	125.8	130.8	137.4
04 textiles, wearing apparel, leather products	73.5	100.0	108.0	130.9	158.4	191.4
05 wood, cork, straw	92.0	100.0	103.4	113.2	120.1	129.8
06 paper products and printing	86.6	100.0	111.4	121.4	137.6	149.0
07 refined petroleum, chemical, pharmaceutical products	67.4	100.0	104.8	121.3	137.1	149.6
08 rubber, plastic, glass, ceramic products	80.2	100.0	115.6	132.6	140.7	149.6
09 metal production and metal working	83.7	100.0	114.9	125.9	142.7	169.7
10 electrical equipment, electronic and optical products	68.1	100.0	117.3	138.3	159.3	176.8
11 mechanical engineering	75.4	100.0	122.0	138.2	140.6	145.7
12 vehicle manufacturing	67.4	100.0	115.4	126.2	135.1	140.8
13 furniture, other manufacturing, repair	71.9	100.0	115.5	134.3	161.8	186.4
14 energy supply	64.1	100.0	102.8	120.2	138.5	159.7
15 water supply, waste management services	75.6	100.0	115.6	133.6	153.7	177.5
16 construction	84.7	100.0	113.6	123.3	133.6	142.8
17 wholesale trade	77.1	100.0	108.0	120.1	119.3	119.9
18 retail trade	78.8	100.0	114.2	127.0	129.8	133.6
19 transport, warehousing	80.1	100.0	124.9	136.1	141.4	145.7
20 postal and courier activities	113.3	100.0	122.9	140.9	151.1	162.9
21 accommodation, hotels and restaurants	113.8	100.0	97.4	105.2	111.5	121.0
22 publishing, motion picture, broadcasting	84.8	100.0	104.1	110.7	125.8	138.5
23 telecommunications	72.7	100.0	116.9	127.4	129.8	133.1
24 IT, information services	54.2	100.0	125.2	128.3	139.2	146.9
25 financial services, insurance, financial intermediaries	72.8	100.0	112.7	124.5	132.3	149.6
26 real estate	95.3	100.0	115.3	123.6	124.8	125.1
27 accounting, management consulting	78.3	100.0	111.3	122.0	131.6	143.2
28 architecture, engineering; technical testing and analysis	76.4	100.0	114.0	125.4	133.2	141.3
29 research and development	69.1	100.0	121.1	135.7	148.3	158.6
30 other scientific and technical services	81.4	100.0	119.5	134.9	146.0	156.8
31 renting and leasing of goods	83.5	100.0	110.3	119.2	124.6	130.0
32 employment agencies	67.9	100.0	114.6	127.6	135.4	133.5
33 travel agencies, tour operators, reservation services	75.3	100.0	122.3	148.8	178.7	215.9
34 other business service providers	82.0	100.0	113.1	121.5	126.1	128.1
35 public administration; social security	71.8	100.0	114.8	128.3	138.8	149.6
36 education	83.8	100.0	103.8	106.8	118.5	129.8
37 healthcare	80.8	100.0	107.1	113.6	117.0	118.2
38 social work, nursing homes	82.4	100.0	107.1	113.6	126.2	137.5
39 arts, culture, gambling and betting	93.0	100.0	102.3	106.5	108.4	105.9
40 sports, entertainment, recreation	90.8	100.0	102.3	106.5	118.8	128.4
41 interest groups	79.2	100.0	102.1	106.2	120.0	131.7
42 repair of consumer goods	71.4	100.0	102.5	106.6	118.4	127.3
43 other personal services	85.6	100.0	101.4	106.1	117.7	125.8
44 personal domestic services	78.5	100.0	101.3	104.1	114.4	121.7
Total	**80.6**	**100.0**	**111.5**	**122.2**	**131.5**	**140.4**

Source: Economix, CE

2 Labour market developments

2.1 Labour force

2.1.1 Labour force by age and gender

1000 persons

Gender and age group	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
male, 15–19 years old	891.1	-22.8	-79.3	-3.7	+25.5	810.7
male, 20–24 years old	1949.3	-262.4	-36.1	-118.4	-44.2	1488.2
male, 25–29 years old	2218.1	+83.9	-284.5	-33.8	-159.7	1824.0
male, 30–34 years old	2323.6	+70.0	+114.1	-288.3	-38.7	2180.7
male, 35–39 years old	2413.5	-67.4	+103.2	+134.5	-285.8	2298.0
male, 40–45 years old	3250.3	-850.4	-42.0	+117.7	+137.5	2613.1
male, 46–49 years old	3436.2	-257.3	-809.6	-24.2	+119.7	2464.8
male, 50–54 years old	2899.2	+380.1	-229.4	-756.1	-16.6	2277.2
male, 55–59 years old	2351.9	+325.5	+385.6	-174.7	-689.6	2198.7
male, 60–64 years old	1300.8	+247.6	+299.1	+360.1	-37.6	2170.1
male, 65–69 years old	292.3	+32.7	+105.3	+218.6	+276.8	925.8
male, 70–74 years old	162.6	-14.8	+15.9	+74.8	+95.6	334.1
male, 75+ years old	0.0	0.0	0.0	0.0	0.0	0.0
Male labour force	**23489.0**	**-335.6**	**-457.7**	**-493.3**	**-617.1**	**21585.3**
female, 15–19 years old	737.0	-9.7	-60.5	-8.9	+17.4	675.3
female, 20–24 years old	1747.4	-224.5	-22.8	-95.9	-30.0	1374.2
female, 25–29 years old	1970.4	+76.9	-225.1	-6.6	-126.6	1689.0
female, 30–34 years old	1941.8	+95.5	+116.9	-204.0	+13.7	1963.9
female, 35–39 years old	2020.2	-1.4	+112.0	+133.5	-204.8	2059.5
female, 40–45 years old	2804.8	-666.8	-12.5	+101.9	+112.1	2339.5
female, 46–49 years old	3021.0	-191.4	-672.6	-8.9	+101.6	2249.7
female, 50–54 years old	2583.8	+327.0	-183.3	-638.1	-6.4	2083.0
female, 55–59 years old	2056.2	+264.9	+334.7	-124.7	-559.8	1971.3
female, 60–64 years old	974.5	+226.0	+229.8	+284.4	+2.6	1717.4
female, 65–69 years old	231.5	+36.1	+94.4	+200.9	+257.1	819.9
female, 70–74 years old	134.7	-21.2	+19.8	+85.0	+100.1	318.3
female, 75+ years old	0.0	0.0	0.0	0.0	0.0	0.0
Female labour force	**20223.2**	**-88.7**	**-269.4**	**-281.2**	**-322.9**	**19261.0**
total, 15–19 years old	1628.1	-32.6	-139.8	-12.6	+42.9	1486.0
total, 20–24 years old	3696.7	-487.0	-59.0	-214.2	-74.2	2862.4
total, 25–29 years old	4188.5	+160.7	-509.6	-40.4	-286.2	3513.0
total, 30–34 years old	4265.4	+165.5	+230.9	-492.2	-24.9	4144.6
total, 35–39 years old	4433.8	-68.9	+215.2	+268.0	-490.6	4357.5
total, 40–45 years old	6055.1	-1517.2	-54.5	+219.7	+249.6	4952.6
total, 46–49 years old	6457.2	-448.7	-1482.3	-33.1	+221.3	4714.5
total, 50–54 years old	5483.0	+707.1	-412.6	-1394.2	-23.0	4360.2
total, 55–59 years old	4408.1	+590.4	+720.3	-299.4	-1249.4	4170.0
total, 60–64 years old	2275.3	+473.5	+528.9	+644.6	-34.9	3887.5
total, 65–69 years old	523.8	+68.8	+199.7	+419.5	+533.9	1745.7
total, 70–74 years old	297.3	-36.0	+35.7	+159.8	+195.7	652.5
total, 75+ years old	0.0	0.0	0.0	0.0	0.0	0.0
Total	**43712.1**	**-424.3**	**-727.0**	**-774.6**	**-940.0**	**40846.3**

Source: Economix, CE

2.1.2 Labour force by occupation
1000 persons

Occupation	Count 2010	Development				Count 2030
		2010 –2015	2015 –2020	2020 –2025	2025 –2030	
01 agricultural occupations	519.7	-21.4	-30.3	-24.2	-36.0	407.8
02 livestock keeper	84.5	-1.3	-2.0	-1.3	+1.4	81.3
03 administrative, consulting and technical specialists in agriculture and livestock keeping	30.2	-2.3	-0.7	+1.6	+3.4	32.1
04 horticultural occupations	455.2	-17.1	-20.5	-15.5	-13.0	389.1
05 forester, hunter	57.1	+0.5	-0.8	-1.1	-2.1	53.7
06 miner	51.7	-6.8	-5.9	-3.4	-1.5	34.2
07 mineral processing operator	10.1	-0.3	-0.2	+0.0	+0.3	9.9
08 stone processing operator	25.0	-0.6	-0.1	+0.6	+0.7	25.6
09 building materials manufacturer	9.2	-0.7	-0.4	+0.2	+0.6	8.9
10 ceramist	15.6	-4.0	-2.7	-1.2	+0.3	8.0
11 glass manufacturer	22.0	-2.8	-2.1	-1.5	-1.5	14.1
12 chemistry related occupations	162.2	+4.7	-4.5	-8.9	-3.8	149.8
13 plastics related occupations	60.0	-5.8	-4.1	-0.7	+0.8	50.3
14 paper manufacturer and processor	39.6	-1.1	-0.5	-1.3	-1.0	35.6
15 printer	136.9	-14.0	-10.4	-10.9	-7.9	93.7
16 wood machining occupations	38.9	+1.8	-0.3	-0.9	-1.3	38.3
17 metallurgical and semi-finished goods occupations	48.7	-2.3	-1.7	-0.6	+0.4	44.4
18 foundry related occupations	60.7	-0.2	-0.2	-1.2	-1.1	58.1
19 non-cutting metal former	28.1	-3.4	-2.6	-1.8	-0.9	19.4
20 cutting metal former	252.9	+5.1	-7.9	-4.4	-6.2	239.5
21 metal refining occupations	31.9	-3.3	-2.6	-1.7	+0.3	24.5
22 metal welding and soldering occupations	118.0	-9.4	-7.8	-5.8	-4.2	90.7
23 metal and plant manufacturer	464.0	-29.4	-32.3	-32.0	-28.6	341.7
24 metal sheet constructor, installer	495.3	-31.8	-17.8	-25.1	-20.3	400.2
25 mechanical engineer	518.6	-6.6	-25.5	-10.6	-18.2	457.7
26 vehicle manufacturer	516.9	-41.6	-38.4	-6.1	-16.8	413.9
27 toolmaking and mould making occupations	140.7	-8.6	-10.4	-7.5	-8.8	105.5
28 precision mechanic	231.3	+2.0	-10.4	-1.6	+3.0	224.3
29 electric and electronic technician	851.1	-22.3	-16.9	-11.0	-12.2	788.8
30 assembler	241.6	-16.8	-10.1	-2.9	+1.8	213.6
31 spinner	5.1	-0.6	-0.6	-0.5	-0.3	3.0
32 textile manufacturer	19.3	-1.3	-2.1	-1.7	-0.6	13.6
33 textile processor	115.1	-5.8	-9.7	-12.9	-11.0	75.7
34 textile finisher	7.9	-0.4	-0.3	-0.4	-0.3	6.4
35 tanner, dyer, leather processor	34.7	-1.6	-2.8	-2.1	-1.2	27.1
36 baker, pastry cook	172.8	-18.9	-18.5	-8.2	-11.9	115.3
37 butcher	114.0	-17.8	-14.5	-7.0	-8.1	66.6
38 cook	632.1	+35.5	-24.0	-13.0	-34.0	596.6
39 beverage manufacturer	19.3	-2.9	-2.0	-0.5	+0.4	14.3
40 food producer	46.9	-2.6	-1.5	+2.3	+1.9	47.0
41 building constructor	337.8	-43.3	-21.8	-27.8	-19.1	225.8
42 civil engineer	172.6	-3.9	+4.4	-3.1	-2.4	167.5
43 construction labourer	133.9	-14.4	-8.5	-8.7	-6.4	95.9
44 construction finisher	423.6	-2.6	+18.4	-5.3	-2.9	431.2

(Table 2.1.2 continued)

Occupation	Count 2010	Development				Count 2030
		2010 –2015	2015 –2020	2020 –2025	2025 –2030	
45 interior decorator, upholsterer	76.1	-6.9	-2.0	-1.3	+1.5	67.5
46 wood, plastics processing occupations	353.1	-14.1	-8.6	-12.0	-6.3	312.1
47 painter, varnisher	335.0	-9.0	+4.2	-1.4	-0.1	328.7
48 product tester, shipping packer	558.2	-13.8	-4.9	+26.7	+30.3	596.5
49 labourer	982.0	-106.9	-82.9	-44.2	-43.2	704.9
50 machine and plant operator	452.7	-24.0	-17.7	-7.3	-8.9	394.9
51 machine setter	58.5	+0.2	+1.1	+3.1	+1.7	64.6
52 engineer	1101.3	+42.7	+27.5	+33.2	-16.1	1188.6
53 chemist, physicist, mathematician	109.0	+7.9	+6.6	+6.0	+6.5	136.1
54 technician	930.9	+11.7	-5.3	-3.9	-17.3	916.1
55 special technician	141.0	+4.9	+4.8	+4.8	+5.1	160.7
56 engineering draftsman	119.0	-9.8	-11.7	-10.3	-11.3	75.8
57 master craftsman	169.0	-10.3	-11.4	-9.1	-10.2	127.9
58 sales force	1900.4	-47.0	-73.3	+65.2	+22.3	1867.5
59 trained wholesale, retail salesman; purchase, sale specialist	1363.2	+4.4	-31.9	+41.9	+9.5	1387.2
60 sales representative	364.9	-27.6	-35.1	-24.6	-26.3	251.3
61 banking, insurance specialist	985.3	+38.7	+34.6	+36.5	-48.3	1046.8
62 other sales service occupations	754.5	-15.6	+8.7	+35.6	+55.9	839.1
63 surface transport related occupations	1352.9	-70.0	-16.7	+18.7	+11.1	1296.0
64 waterborne and air transport	70.4	-6.2	-1.1	+0.6	+0.6	64.3
65 telecommunication occupations	236.7	-10.7	-3.4	+4.4	+6.4	233.4
66 stock and transport workers	1184.1	-21.2	-9.2	+25.1	+10.3	1189.1
67 business management, consulting and controlling occupations	2018.7	+81.3	+56.7	+13.9	-30.9	2139.8
68 political representatives, senior officials	398.1	+4.2	+3.6	+1.2	+2.0	409.1
69 accountant, information technology officer	1385.7	+5.7	+33.6	-4.0	-26.8	1394.3
70 office clerks	4963.4	-225.2	-248.1	-270.0	-275.2	3944.9
71 security guard	721.3	-22.8	-25.2	-25.8	-15.8	631.7
72 other security related occupations	664.7	-49.6	-46.1	-42.1	-35.8	491.1
73 lawyer, executory officer	295.9	+12.1	+9.2	-3.1	-10.5	303.7
74 authors, journalists and linguists	283.6	+9.8	+7.3	-8.0	-1.7	291.2
75 artist	532.7	+31.8	+22.0	-5.2	+5.2	586.5
76 medical doctors, pharmacists	531.6	+18.4	+7.1	+8.0	+11.5	576.6
77 other healthcare occupations	2214.0	+62.8	+19.9	-10.3	+22.4	2308.8
78 social care, welfare occupations	1881.7	+122.6	+84.8	-75.0	-49.8	1964.2
79 teacher	1458.0	+38.4	+6.5	-130.9	-114.2	1257.7
80 humanities, natural science occupations	458.8	+16.1	+16.7	+5.1	+7.3	503.9
81 religious professionals	73.6	-1.7	-6.0	-11.7	-8.9	45.3
82 body care occupations	490.4	+53.1	+23.9	-21.1	-2.7	543.5
83 hotel and restaurant business occupations	991.4	+65.2	-40.5	-6.9	-42.4	966.8
84 housekeeper, food processor	431.6	+28.4	+2.5	-28.3	-20.9	413.4
85 cleaning and waste disposal occupations	1559.4	+16.6	-11.3	-31.2	-25.6	1508.0
86 family members as helpers (agriculture excluded)	12.6	-3.9	-1.5	-0.0	+0.6	7.8
87 with not (yet) determined occupation	124.0	-19.0	-13.7	-9.4	-6.8	75.2
88 without specified occupation	669.9	-65.8	-47.3	-38.1	-25.5	493.2
Total	**43712.1**	**-424.3**	**-727.0**	**-774.6**	**-940.0**	**40846.3**

Source: Economix, IER

2.1.3 Labour force by formal training

1000 persons, categories 09 and 28 = not stated

Formal training	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
01 humanities and cultural studies, sports	1628.1	+245.9	+163.4	+2.9	-45.0	1995.3
02 law, economics and social sciences	2496.2	+758.4	+490.0	+156.5	-165.5	3735.5
03 mathematics, natural sciences	719.2	+188.1	+148.4	+79.5	+2.9	1138.2
04 human medicine, veterinary medicine	592.9	+140.2	+113.8	+75.2	+29.8	952.0
05 agricultural science, forestry and nutrition science	170.6	+21.1	+12.0	+0.0	-19.5	184.2
06 engineering sciences	1615.3	+153.0	+100.3	+64.7	-11.6	1921.7
07 arts, art sciences	345.9	+100.1	+66.4	+13.9	-35.5	490.9
08 other	7.2	+1.5	+0.8	-0.5	-1.7	7.3
01–09 tertiary training	**7575.4**	**+1608.2**	**+1095.2**	**+392.2**	**-246.0**	**10425.0**
10 farming, animal breeding, fishing	596.5	+0.8	-22.7	-24.7	-25.1	524.9
11 industrial and craft manufacturing occ.	409.7	-5.4	-19.9	-23.6	-14.7	346.1
12 metal working occ.	2165.6	-4.8	-75.0	-64.4	-86.7	1934.7
13 other manufacturing occ.	1861.4	+72.1	-24.9	-42.4	-89.8	1776.4
14 construction occ.	1197.0	-7.4	+18.8	-39.1	-34.2	1135.1
15 technical occ.	790.7	-37.1	-41.5	-26.8	-20.6	664.7
16 salesmen and service occ., shipping and transport related occ.	5337.8	-17.7	-101.9	+73.4	-14.7	5277.0
17 organisation, administration and office occ.	4786.7	-175.8	-241.3	-259.0	-206.2	3904.4
18 private service occ.	1045.5	+3.4	-24.2	-50.2	-32.9	941.5
19 healthcare and social occ.	2241.8	+271.3	+187.2	+30.7	+49.3	2780.3
20 body care, guest relation, domestic and cleaning occ.	1610.4	+256.6	+97.5	+6.3	-6.7	1964.1
21 other occ.	200.5	-78.7	-47.2	-24.3	-7.7	42.5
10–21 dual training	**22243.8**	**+277.3**	**-295.1**	**-444.2**	**-490.0**	**21291.8**
22 engineering occ.	2006.7	-316.1	-228.5	-145.0	-91.8	1225.2
23 commercial occ.	608.0	-206.7	-61.9	+11.8	+54.4	405.7
24 IT specialists, mathematicians, natural scientific occ.	62.1	-11.4	-5.7	-2.7	-1.0	41.3
25 creative-artistic occ.	90.1	-6.8	+3.1	+6.5	+3.2	96.2
26 education related and nursing occ.	1312.7	+12.3	+27.1	+32.6	+80.9	1465.6
27 other occ.	122.7	+19.2	+7.5	-10.6	-13.8	125.0
22–28 technical college	**4202.4**	**-509.6**	**-258.4**	**-107.5**	**+32.0**	**3358.9**
29 without any qualification	**9591.2**	**-1799.3**	**-1267.0**	**-613.4**	**-233.7**	**5677.8**
not stated	**99.3**	**-1.0**	**-1.7**	**-1.8**	**-2.1**	**92.8**
Total	**43712.1**	**-424.3**	**-727.0**	**-774.6**	**-940.0**	**40846.3**

Of these

MINT tertiary training [03;06]	2334.5	+341.0	+248.8	+144.2	-8.7	3059.9
MINT dual training [15]	790.7	-37.1	-41.5	-26.8	-20.6	664.7
MINT technical college [22;24]	2068.8	-327.6	-234.1	-147.7	-92.8	1266.5
MINT (total)	**5194.1**	**-23.7**	**-26.9**	**-30.3**	**-122.1**	**4991.1**

Source: Economix, IER

2.1.4 Participation rates by age and gender
Labour force as % of population

	1995	2010	2015	2020	2025	2030
male, 15–19 years old	40.1	42.0	42.4	42.4	44.2	46.3
male, 20–24 years old	76.6	76.8	77.1	77.3	78.3	79.4
male, 25–29 years old	88.4	88.6	88.4	88.2	88.0	87.9
male, 30–34 years old	95.3	94.9	94.6	94.2	93.9	93.6
male, 35–39 years old	96.8	96.1	95.9	95.7	95.5	95.4
male, 40–44 years old	96.4	96.0	95.9	95.8	95.7	95.6
male, 45–49 years old	95.3	94.7	94.8	94.8	94.8	94.8
male, 50–54 years old	92.1	91.9	92.0	92.1	92.2	92.4
male, 55–59 years old	75.0	86.6	87.5	88.3	89.1	90.0
male, 60–64 years old	33.4	56.7	59.9	63.1	66.2	69.5
male, 65–69 years old	10.5	13.8	15.2	17.8	23.6	29.4
male, 70–74 years old	5.7	7.1	7.8	8.5	10.9	13.2
men (average 20–64)	**85.2**	**87.9**	**87.8**	**87.7**	**87.7**	**88.5**
female, 15–19 years old	34.7	36.5	37.2	37.6	38.9	40.5
female, 20–24 years old	72.3	71.9	72.3	72.6	74.1	75.7
female, 25–29 years old	75.5	80.9	81.7	82.4	83.2	83.9
female, 30–34 years old	77.4	81.1	82.8	84.4	86.0	87.6
female, 35–39 years old	78.9	82.4	84.2	85.9	87.7	89.5
female, 40–44 years old	79.2	86.4	87.4	88.3	89.2	90.1
female, 45–49 years old	76.1	86.7	87.5	88.2	89.0	89.8
female, 50–54 years old	70.6	83.5	84.3	84.9	85.6	86.4
female, 55–59 years old	51.8	74.4	76.2	78.0	79.7	81.5
female, 60–64 years old	16.3	41.0	44.5	48.1	51.4	55.0
female, 65–69 years old	7.0	10.1	11.7	13.9	19.5	25.2
female, 70–74 years old	3.9	5.1	5.3	6.1	8.8	11.5
women (average 20–64)	**67.7**	**77.5**	**78.1**	**78.7**	**79.6**	**81.5**
total, 15–19 years old	37.5	39.3	39.8	40.1	41.6	43.4
total, 20–24 years old	74.5	74.4	74.8	75.0	76.2	77.6
total, 25–29 years old	82.2	84.8	85.1	85.4	85.6	85.9
total, 30–34 years old	86.7	88.1	88.8	89.4	90.0	90.7
total, 35–39 years old	88.1	89.3	90.1	90.9	91.7	92.5
total, 40–44 years old	88.0	91.3	91.7	92.1	92.5	92.9
total, 45–49 years old	85.9	90.8	91.2	91.5	91.9	92.4
total, 50–54 years old	81.5	87.7	88.2	88.6	89.0	89.4
total, 55–59 years old	63.4	80.4	81.9	83.2	84.5	85.8
total, 60–64 years old	24.6	48.7	52.0	55.5	58.8	62.3
total, 65–69 years old	8.6	11.9	13.4	15.8	21.5	27.3
total, 70–74 years old	4.5	6.0	6.5	7.2	9.7	12.3
Total (average 20–64)	**76.6**	**82.8**	**83.0**	**83.3**	**83.7**	**85.0**

Source: Economix, CE

2.2 Persons employed

2.2.1 Persons employed by sector
1000 persons

Sector	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
01 agriculture, forestry, fishing and aquaculture	672.1	+9.0	-20.2	-18.9	-38.7	603.3
02 mining, extraction of rock and ores	85.5	-10.3	-11.1	-7.9	-5.7	50.6
03 food and beverages	857.3	-64.2	-53.1	+8.6	-15.7	732.9
04 textiles, wearing apparel, leather products	167.0	-6.4	-21.3	-22.6	-19.3	97.4
05 wood, cork, straw	134.9	+4.6	-3.2	-3.2	-5.3	127.8
06 paper products and printing	353.3	-9.0	-5.2	-13.2	-9.6	316.3
07 refined petroleum, chemical, pharmaceutical products	485.1	+27.3	-26.3	-62.6	-42.3	381.1
08 rubber, plastic, glass, ceramic products	603.7	-31.5	-27.9	-3.0	-5.7	535.6
09 metal production and metal working	1144.0	-32.5	-34.1	-72.9	-50.3	954.4
10 electrical equipment, electronic and optical products	863.3	+30.1	+21.8	+27.5	+28.4	971.1
11 mechanical engineering	1044.4	+107.8	-115.2	-55.6	-67.6	913.7
12 vehicle manufacturing	949.9	-136.9	-19.7	+86.5	-39.7	840.2
13 furniture, other manufacturing, repair	561.4	+29.2	-42.9	-24.5	+2.6	525.8
14 energy supply	249.5	-7.8	-13.3	-5.8	-7.2	215.5
15 water supply, waste management services	235.1	-6.2	-11.4	-11.5	-12.0	193.9
16 construction	2379.2	-57.9	+56.2	-75.5	-41.7	2260.4
17 wholesale trade	1723.7	-2.9	-70.1	+30.9	-2.2	1679.5
18 retail trade	4068.2	-133.0	-242.1	+91.9	+16.9	3802.0
19 transport, warehousing	1579.7	-161.0	-53.3	-11.8	-15.4	1338.1
20 postal and courier activities	413.5	-28.4	-13.2	+4.6	+1.8	378.2
21 accommodation, hotels and restaurants	1670.4	+160.5	-91.2	-24.8	-105.9	1609.0
22 publishing, motion picture, broadcasting	412.5	+26.9	-1.3	-38.5	-26.0	373.7
23 telecommunications	169.1	-11.1	-5.5	-2.9	-5.8	143.7
24 IT, information services	657.7	-62.4	+45.1	-12.7	+2.0	629.8
25 financial services, insurance, financial intermediaries	1236.7	+49.1	+37.2	+53.5	-60.3	1316.3
26 real estate	431.1	-5.3	-9.4	-6.8	-6.6	402.9
27 accounting, management consulting	1161.1	+131.3	+101.3	+27.6	-4.9	1416.4
28 architecture, engineering; technical testing and analysis	560.0	+53.8	+39.1	+31.4	-15.1	669.1
29 research and development	170.1	+20.4	+14.8	+10.5	+9.2	225.0
30 other scientific and technical services	483.0	+40.6	+16.8	-10.9	-23.0	506.6
31 renting and leasing of goods	138.6	+14.4	+7.4	+3.6	+2.3	166.2
32 employment agencies	647.0	+25.0	+25.8	+50.9	+115.8	864.6
33 travel agencies, tour operators, reservation services	104.6	+1.2	-4.9	-4.1	-3.3	93.6
34 other business service providers	1677.4	+59.4	+39.9	+37.3	+58.6	1872.5
35 public administration; social security	2758.0	-109.9	-131.7	-112.3	-107.6	2296.6

(Table 2.2.1 continued)

Sector	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
36 education	2488.4	+141.6	+77.3	-173.2	-145.6	2388.5
37 healthcare	2480.3	+64.9	-6.1	-2.7	+37.1	2573.6
38 social work, nursing homes	1748.9	+113.8	+63.1	-86.1	-48.8	1791.0
39 arts, culture, gambling and betting	392.4	+38.6	+11.6	-25.8	-1.3	415.5
40 sports, entertainment, recreation	248.5	+16.2	-0.8	-25.6	-17.4	220.9
41 interest groups	704.5	+46.9	-0.9	-74.0	-54.6	621.7
42 repair of consumer goods	77.5	+5.0	-0.2	-7.2	-4.9	70.2
43 other personal services	737.5	+62.7	+12.2	-54.5	-32.0	725.9
44 personal domestic services	876.4	+73.4	+13.3	-65.8	-39.0	858.2
Total	**40603.0**	**+477.0**	**-452.5**	**-652.0**	**-805.9**	**39169.5**

Source: Economix, IER

2.2.2 Persons employed by occupation
1000 persons

Occupation	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
01 agricultural occupations	437.9	+0.1	-19.8	-20.8	-32.4	365.0
02 livestock keeper	82.0	-0.3	-1.9	-1.2	+1.5	80.0
03 administrative, consulting and technical specialists in agriculture and livestock keeping	26.5	-1.1	-0.1	+1.8	+3.6	30.7
04 horticultural occupations	425.9	-8.4	-17.9	-14.5	-11.8	373.2
05 forester, hunter	55.1	+1.3	-0.7	-1.0	-2.0	52.7
06 miner	50.7	-6.3	-5.9	-3.3	-1.4	33.8
07 mineral processing operator	9.7	-0.1	-0.2	+0.1	+0.3	9.7
08 stone processing operator	23.1	-0.0	+0.1	+0.8	+0.8	24.8
09 building materials manufacturer	8.4	-0.5	-0.3	+0.2	+0.6	8.5
10 ceramist	14.9	-3.7	-2.6	-1.1	+0.3	7.7
11 glass manufacturer	20.9	-2.4	-2.0	-1.5	-1.4	13.6
12 chemistry related occupations	157.3	+6.7	-4.4	-8.5	-3.5	147.6
13 plastics related occupations	56.8	-4.8	-3.8	-0.4	+1.0	48.8
14 paper manufacturer and processor	37.6	-0.5	-0.4	-1.2	-0.9	34.7
15 printer	126.0	-10.8	-9.2	-10.1	-7.2	88.7
16 wood machining occupations	36.4	+2.6	-0.0	-0.7	-1.2	37.1
17 metallurgical and semi-finished goods occupations	47.5	-1.8	-1.7	-0.5	+0.4	43.9
18 foundry related occupations	59.2	+0.5	-0.2	-1.1	-1.0	57.4
19 non-cutting metal former	26.8	-3.0	-2.5	-1.7	-0.9	18.8
20 cutting metal former	238.9	+9.5	-6.8	-3.5	-5.3	232.8
21 metal refining occupations	30.6	-2.9	-2.5	-1.7	+0.4	23.9
22 metal welding and soldering occupations	107.0	-6.4	-6.6	-5.2	-3.5	85.3
23 metal and plant manufacturer	456.7	-25.5	-32.8	-31.6	-28.2	338.5

(Table 2.2.2 continued)

Occupation	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
24 metal sheet constructor, installer	474.8	-24.8	-16.5	-23.9	-19.1	390.5
25 mechanical engineer	482.4	+4.2	-22.0	-8.5	-15.9	440.2
26 vehicle manufacturer	484.8	-31.9	-35.4	-4.2	-14.8	398.5
27 toolmaking and mould making occupations	136.7	-7.0	-10.3	-7.3	-8.5	103.6
28 precision mechanic	224.0	+4.8	-10.1	-1.2	+3.4	220.9
29 electric and electronic technician	811.5	-9.7	-14.3	-9.4	-10.2	767.8
30 assembler	220.1	-10.7	-7.8	-1.7	+3.1	202.9
31 spinner	4.7	-0.5	-0.6	-0.5	-0.3	2.8
32 textile manufacturer	18.0	-0.9	-1.9	-1.6	-0.6	12.9
33 textile processor	101.6	-2.4	-8.2	-12.4	-10.4	68.2
34 textile finisher	7.5	-0.3	-0.3	-0.4	-0.3	6.2
35 tanner, dyer, leather processor	32.9	-1.0	-2.6	-2.0	-1.1	26.1
36 baker, pastry cook	162.6	-16.0	-17.7	-7.8	-11.4	109.7
37 butcher	108.0	-16.0	-14.0	-6.8	-7.8	63.4
38 cook	596.4	+46.1	-21.7	-12.0	-32.7	576.2
39 beverage manufacturer	18.6	-2.6	-2.0	-0.5	+0.4	13.9
40 food producer	45.3	-2.1	-1.4	+2.4	+1.9	46.1
41 building constructor	315.0	-36.6	-20.0	-26.7	-18.1	213.6
42 civil engineer	160.5	-0.4	+5.3	-2.6	-1.9	161.0
43 construction labourer	109.4	-8.4	-5.9	-7.9	-5.4	81.8
44 construction finisher	400.2	+4.8	+19.8	-4.1	-1.7	418.9
45 interior decorator, upholsterer	70.9	-5.4	-1.6	-1.0	+1.7	64.7
46 wood, plastics processing occupations	331.1	-7.3	-7.0	-11.0	-5.3	300.5
47 painter, varnisher	299.6	+0.6	+7.5	+0.2	+1.5	309.5
48 product tester, shipping packer	454.0	+11.8	+7.2	+29.3	+33.9	536.2
49 labourer	659.7	-36.2	-43.3	-36.3	-32.3	511.6
50 machine and plant operator	419.5	-15.0	-14.7	-6.1	-7.3	376.4
51 machine setter	57.8	+0.6	+1.0	+3.2	+1.7	64.3
52 engineer	1066.0	+59.7	+29.9	+35.5	-14.1	1177.0
53 chemist, physicist, mathematician	104.0	+10.0	+7.1	+6.4	+6.9	134.3
54 technician	896.9	+25.3	-3.4	-1.9	-15.5	901.3
55 special technician	125.8	+9.6	+6.6	+5.7	+5.9	153.6
56 engineering draftsman	117.7	-8.9	-11.9	-10.2	-11.3	75.3
57 master craftsman	167.2	-9.0	-11.7	-9.0	-10.2	127.2
58 sales force	1679.4	+11.4	-49.9	+71.2	+30.5	1742.7
59 trained wholesale, retail salesman; purchase, sale specialist	1348.1	+14.5	-34.9	+42.3	+10.1	1380.1
60 sales representative	360.9	-25.0	-35.7	-24.5	-26.2	249.5
61 banking, insurance specialist	962.1	+49.3	+34.2	+37.4	-47.3	1035.6
62 other sales service occupations	707.6	-0.9	+12.7	+37.2	+57.9	814.4
63 surface transport related occupations	1233.8	-37.0	-5.0	+22.1	+15.6	1229.5
64 waterborne and air transport	68.1	-5.3	-1.0	+0.6	+0.7	63.1
65 telecommunication occupations	228.4	-7.7	-3.1	+4.6	+6.7	228.9
66 stock and transport workers	996.6	+25.4	+11.9	+29.6	+16.7	1080.2
67 business management, consulting and controlling occupations	1962.3	+106.1	+58.0	+17.6	-27.5	2116.5
68 political representatives, senior officials	393.0	+7.5	+3.0	+1.5	+2.3	407.3

(Table 2.2.2 continued)

Occupation	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
69 accountant, information technology officer	1308.1	+32.4	+40.6	+1.1	-22.3	1359.9
70 office clerks	4711.5	-137.8	-226.8	-253.3	-260.4	3833.2
71 security guard	580.4	+12.1	-8.0	-20.0	-10.0	554.5
72 other security related occupations	654.9	-44.2	-46.9	-41.6	-35.4	486.8
73 lawyer, executory officer	287.0	+16.0	+9.7	-2.4	-9.8	300.6
74 authors, journalists and linguists	269.8	+15.1	+8.6	-7.1	-0.9	285.4
75 artist	500.4	+42.1	+24.8	-3.8	+6.7	570.2
76 medical doctors, pharmacists	521.5	+23.9	+6.9	+8.6	+12.1	573.1
77 other healthcare occupations	2137.2	+85.9	+19.7	-7.1	+25.7	2261.3
78 social care, welfare occupations	1780.7	+148.9	+88.6	-70.6	-45.4	1902.2
79 teacher	1423.2	+54.5	+6.5	-128.8	-112.4	1243.1
80 humanities, natural science occupations	426.3	+27.0	+20.5	+7.3	+9.4	490.4
81 religious professionals	72.1	-1.0	-6.0	-11.6	-8.8	44.6
82 body care occupations	464.0	+59.7	+25.2	-20.1	-1.4	527.3
83 hotel and restaurant business occupations	911.6	+84.8	-34.2	-4.6	-39.6	918.1
84 housekeeper, food processor	410.9	+34.3	+3.5	-27.6	-20.1	400.9
85 cleaning and waste disposal occupations	1295.4	+73.2	+16.3	-24.8	-17.2	1342.9
86 family members as helpers (agriculture excluded)	12.5	-3.8	-1.5	-0.0	+0.6	7.7
87 with not (yet) determined occupation	101.4	-13.4	-11.0	-8.9	-6.2	61.8
88 without specified occupation	572.7	-37.3	-35.0	-35.1	-22.7	442.6
Total	**40603.0**	**+477.0**	**-452.5**	**-652.0**	**-805.9**	**39169.5**

Source: Economix, IER

2.2.3 Persons employed by formal training

1000 persons, categories 09 and 28 = not stated

Formal training	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
01 humanities and cultural studies, sports	1589.0	+268.2	+164.4	+6.2	-42.4	1985.4
02 law, economics and social sciences	2439.5	+788.4	+489.5	+161.3	-160.6	3718.2
03 mathematics, natural sciences	702.1	+197.2	+148.4	+80.7	+4.2	1132.6
04 human medicine, veterinary medicine	578.9	+147.8	+113.8	+76.1	+30.7	947.3
05 agricultural science, forestry and nutrition science	166.6	+23.5	+12.1	+0.4	-19.2	183.3
06 engineering sciences	1575.9	+176.2	+101.9	+67.4	-9.3	1912.0
07 arts, art sciences	338.1	+104.3	+66.3	+14.6	-34.7	488.6
08 other	7.1	+1.6	+0.8	-0.5	-1.7	7.3
01–09 tertiary training	**7397.1**	**+1707.1**	**+1097.2**	**+406.2**	**-233.0**	**10374.7**
10 farming, animal breeding, fishing	555.7	+13.0	-18.7	-22.0	-22.4	505.6
11 industrial and craft manufacturing occ.	380.6	+3.5	-16.8	-21.4	-13.0	332.9

(Table 2.2.3 continued)

Formal training	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
12 metal working occ.	2015.7	+40.1	-60.6	-55.4	-76.9	1862.9
13 other manufacturing occ.	1735.3	+106.5	-14.2	-35.0	-80.7	1712.0
14 construction occ.	1114.7	+17.5	+24.1	-33.9	-29.2	1093.3
15 technical occ.	733.9	-18.5	-35.5	-23.4	-17.5	639.0
16 salesmen and service occ., shipping and transport related occ.	4974.3	+92.0	-70.8	+86.2	+2.6	5084.4
17 organisation, administration and office occ.	4460.2	-69.6	-207.8	-235.5	-185.7	3761.7
18 private service occ.	974.4	+24.6	-18.0	-45.2	-28.7	907.2
19 healthcare and social occ.	2092.5	+303.7	+191.5	+37.5	+56.0	2681.2
20 body care, guest relation, domestic and cleaning occ.	1504.9	+276.8	+102.3	+11.8	-0.5	1895.3
21 other occ.	185.7	-70.3	-44.3	-23.0	-7.2	40.8
10–21 dual training	**20728.0**	**+719.4**	**-168.7**	**-359.2**	**-403.1**	**20516.3**
22 engineering occ.	1964.0	-292.9	-225.3	-142.0	-89.1	1214.6
23 commercial occ.	593.4	-197.5	-60.7	+12.0	+54.5	401.6
24 IT specialists, mathematicians, natural scientific occ.	60.7	-10.7	-5.6	-2.6	-0.9	41.0
25 creative-artistic occ.	88.0	-5.8	+3.1	+6.5	+3.4	95.2
26 education related and nursing occ.	1284.8	+24.9	+27.3	+33.7	+82.2	1453.0
27 other occ.	120.6	+20.1	+7.3	-10.4	-13.5	124.1
22–28 technical college	**4111.5**	**-461.9**	**-253.9**	**-102.8**	**+36.6**	**3329.5**
29 without any qualification	**8273.7**	**-1488.8**	**-1126.1**	**-594.8**	**-204.6**	**4859.5**
not stated	**92.7**	**+1.1**	**-1.0**	**-1.5**	**-1.8**	**89.4**
Total	**40603.0**	**+477.0**	**-452.5**	**-652.0**	**-805.9**	**39169.5**
Of these						
MINT tertiary training [03;06]	2278.0	+373.4	+250.2	+148.1	-5.1	3044.6
MINT dual training [15]	733.9	-18.5	-35.5	-23.4	-17.5	639.0
MINT technical college [22;24]	2024.7	-303.6	-230.9	-144.6	-90.0	1255.6
MINT (total)	**5036.6**	**+51.3**	**-16.1**	**-19.9**	**-112.6**	**4939.2**

Source: Economix, IER

2.3 Replacement demand

2.3.1 Replacement demand by age

1000 persons

Age	Count 2010	2010–2015	2015–2020	2020–2025	2025–2030	count 2030
15–29	35.8	+15.3	+0.5	-4.6	-4.7	42.4
30–49	121.0	-24.4	-2.9	+8.7	+2.6	105.0
50–59	553.0	-48.4	+17.0	-39.1	-132.9	349.5
60–64	382.6	-26.3	-12.6	+34.8	-1.4	377.1
65+	156.9	+8.4	+22.2	-4.7	+10.4	193.1
Total	**1249.4**	**-75.5**	**+24.1**	**-4.9**	**-125.9**	**1067.1**

Source: Economix, ROA

2.3.2 Replacement demand by occupation
1000 persons

Occupation	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
01 agricultural occupations	25.3	-10.2	-2.4	-2.1	-3.1	7.4
02 livestock keeper	2.2	-0.1	-0.0	-0.1	-0.4	1.5
03 administrative, consulting and technical specialists in agriculture and livestock keeping	0.7	+0.0	+0.1	+0.0	-0.1	0.6
04 horticultural occupations	12.1	-1.1	+1.1	+0.0	-1.9	10.3
05 forester, hunter	2.5	-0.5	-0.1	-0.2	-0.3	1.5
06 miner	3.0	+0.1	-0.2	-0.3	-0.3	2.3
07 mineral processing operator	0.7	+0.3	+0.1	-0.1	-0.1	0.9
08 stone processing operator	1.1	-0.0	+0.1	+0.1	-0.0	1.2
09 building materials manufacturer	0.6	-0.0	+0.0	+0.0	-0.0	0.6
10 ceramist	0.9	-0.2	-0.1	-0.1	-0.1	0.4
11 glass manufacturer	0.9	-0.1	-0.1	-0.1	-0.1	0.5
12 chemistry related occupations	5.3	+0.0	-0.1	-0.2	-0.9	4.1
13 plastics related occupations	1.6	+0.1	+0.1	-0.0	-0.1	1.5
14 paper manufacturer and processor	1.1	+0.1	+0.0	+0.0	-0.2	1.1
15 printer	6.3	-1.2	-0.6	-0.6	-0.8	3.1
16 wood machining occupations	1.7	-0.2	-0.1	-0.2	-0.2	1.1
17 metallurgical and semi-finished goods occupations	1.6	+0.2	+0.1	+0.2	+0.1	2.2
18 foundry related occupations	1.7	+0.2	+0.5	+0.1	-0.3	2.3
19 non-cutting metal former	1.2	-0.2	-0.1	-0.1	-0.2	0.6
20 cutting metal former	7.1	-0.3	+0.2	-0.3	-0.9	5.8
21 metal refining occupations	0.8	+0.1	+0.1	+0.2	+0.0	1.1
22 metal welding and soldering occupations	3.5	+0.2	+0.0	-0.2	-0.6	2.9
23 metal and plant manufacturer	20.5	-2.1	-1.2	-1.5	-2.4	13.3
24 metal sheet constructor, installer	22.3	-3.5	-1.6	-2.1	-3.0	12.0
25 mechanical engineer	20.9	-3.2	-1.7	-1.5	-2.0	12.6
26 vehicle manufacturer	22.1	-1.9	-1.1	-0.1	-1.2	17.8
27 toolmaking and mould making occupations	6.0	-0.5	-0.4	-0.6	-0.7	3.8
28 precision mechanic	6.8	-0.6	-0.4	-0.5	-0.6	4.7
29 electric and electronic technician	35.9	-5.4	-2.9	-2.2	-2.9	22.6
30 assembler	6.6	+0.1	+0.3	-0.6	-1.2	5.2
31 spinner	0.5	-0.1	-0.1	-0.1	-0.0	0.2
32 textile manufacturer	0.7	-0.1	-0.0	-0.0	-0.1	0.4
33 textile processor	7.4	-2.6	-1.3	-0.9	-0.9	1.8
34 textile finisher	0.6	-0.1	-0.1	-0.0	-0.0	0.3
35 tanner, dyer, leather processor	1.5	-0.3	-0.1	-0.0	-0.2	0.9
36 baker, pastry cook	7.8	-1.5	-0.6	-0.4	-0.7	4.6
37 butcher	4.1	-0.5	-0.2	-0.4	-0.6	2.6
38 cook	16.1	-0.4	+0.5	-0.4	-1.9	13.9
39 beverage manufacturer	0.8	-0.1	-0.0	-0.0	-0.1	0.5
40 food producer	0.7	+0.1	+0.3	+0.2	-0.2	1.1
41 building constructor	23.4	-4.0	-2.4	-2.7	-2.8	11.5
42 civil engineer	5.9	+1.8	+1.5	-0.4	-1.2	7.7
43 construction labourer	4.8	-0.4	-0.2	-0.4	-0.4	3.4
44 construction finisher	16.1	+0.3	+1.5	+0.8	-0.9	17.8
45 interior decorator, upholsterer	2.2	-0.3	+0.2	+0.2	-0.2	2.0
46 wood, plastics processing occupations	16.5	-1.7	-0.7	-0.8	-1.7	11.6
47 painter, varnisher	14.4	-1.3	+0.1	+0.0	-0.8	12.5

(Table 2.3.2 continued)

Occupation	Count 2010	Development				Count 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
48 product tester, shipping packer	11.8	+1.2	+1.3	-0.0	-2.3	12.0
49 labourer	22.6	-0.4	-1.3	-2.7	-3.2	15.0
50 machine and plant operator	10.4	+1.2	+1.1	+0.3	-1.8	11.1
51 machine setter	1.7	+0.8	+0.8	+0.6	+0.1	4.0
52 engineer	25.1	+0.4	+3.8	+4.0	-1.2	32.0
53 chemist, physicist, mathematician	3.1	-0.4	+0.0	+0.2	-0.1	2.8
54 technician	22.2	+2.3	+3.7	+1.3	-3.7	25.7
55 special technician	3.5	-0.2	-0.1	-0.1	-0.4	2.7
56 engineering draftsman	6.1	-1.1	-0.5	-0.6	-0.8	3.2
57 master craftsman	4.6	+0.6	+0.7	+0.2	-0.8	5.3
58 sales force	49.7	-3.6	+1.7	-1.5	-7.0	39.4
59 trained wholesale, retail salesman; purchase, sale specialist	30.0	-4.2	+1.3	+2.3	-0.6	28.7
60 sales representative	11.0	-1.3	+0.4	+0.5	-1.3	9.3
61 banking, insurance specialist	22.2	+1.7	+0.8	+0.8	-1.9	23.6
62 other sales service occupations	13.4	-0.9	+1.4	+2.2	+0.4	16.6
63 surface transport related occupations	39.6	-3.7	+1.2	+0.2	-5.4	32.0
64 waterborne and air transport	1.5	-0.1	+0.2	+0.1	-0.0	1.7
65 telecommunication occupations	5.9	+0.3	+0.4	-0.3	-1.0	5.4
66 stock and transport workers	32.2	-3.4	+0.3	-0.3	-2.9	25.8
67 business management, consulting and controlling occupations	42.0	-1.6	+7.1	+11.4	+2.2	61.0
68 political representatives, senior officials	12.1	+1.0	+0.1	-0.9	-1.8	10.5
69 accountant, information technology officer	25.0	+1.5	+4.5	+5.7	+0.1	36.8
70 office clerks	152.2	-13.4	-2.7	-7.9	-22.7	105.6
71 security guard	19.8	-1.3	-0.1	-1.6	-3.2	13.5
72 other security related occupations	25.0	-2.9	-1.6	-2.7	-2.6	15.2
73 lawyer, executory officer	7.1	-0.6	+0.6	+0.9	+0.6	8.5
74 authors, journalists and linguists	6.6	-0.2	+0.6	+0.9	-0.0	7.8
75 artist	8.2	-0.1	+1.4	+2.6	+1.2	13.3
76 medical doctors, pharmacists	16.7	-1.7	-0.2	+0.9	-0.9	14.7
77 other healthcare occupations	47.9	+3.7	+4.5	-0.4	-5.4	50.3
78 social care, welfare occupations	30.5	+9.5	+7.5	+2.5	-5.3	44.8
79 teacher	46.9	-2.2	-3.4	-3.3	-3.5	34.4
80 humanities, natural science occupations	4.9	+1.0	+1.7	+2.0	+1.2	10.8
81 religious professionals	4.2	-1.8	-0.0	-0.1	-0.5	1.8
82 body care occupations	11.6	-2.2	-0.1	+0.3	-0.4	9.2
83 hotel and restaurant business occupations	19.7	-3.4	+1.0	+0.9	-0.8	17.5
84 housekeeper, food processor	11.4	+0.5	+0.7	-0.2	-2.8	9.6
85 cleaning and waste disposal occupations	36.0	-0.0	+4.4	+0.6	-5.8	35.2
86 family members as helpers (agriculture excluded)	1.4	-0.8	-0.3	-0.1	-0.0	0.2
87 with not (yet) determined occupation	18.5	+0.6	-3.4	-2.3	-1.8	11.6
88 without specified occupation	38.5	-9.2	-3.4	-3.0	-2.7	20.3
Total	**1249.4**	**-75.5**	**+24.1**	**-4.9**	**-125.9**	**1067.1**

Source: Economix, ROA

2.3.3 Replacement demand by formal training

1000 persons, categories 09 and 28 = not stated

Formal training	Replacement demand 2010	Development				Replacement demand 2030
		2010–2015	2015–2020	2020–2025	2025–2030	
01 humanities and cultural studies, sports	47.5	+4.0	+4.0	+2.0	-3.6	54.0
02 law, economics and social sciences	61.9	+18.2	+17.5	+10.3	-8.8	99.1
03 mathematics, natural sciences	16.9	+4.0	+5.4	+4.8	-0.7	30.3
04 human medicine, veterinary medicine	17.8	+1.4	+2.8	+3.1	-0.9	24.1
05 agricultural science, forestry and nutrition science	5.0	-0.0	+0.5	+0.1	-1.0	4.5
06 engineering sciences	40.1	+3.1	+7.2	+5.8	-3.1	53.1
07 arts, art sciences	7.8	+2.0	+2.2	+1.6	-1.2	12.4
08 other	0.2	+0.0	+0.0	-0.0	-0.1	0.2
01–09 tertiary training	**197.2**	**+32.7**	**+39.6**	**+27.7**	**-19.5**	**277.7**
10 farming, animal breeding, fishing	23.1	-6.1	-0.5	-1.2	-3.1	12.2
11 industrial and craft manufacturing occ.	16.4	-0.1	-0.6	-1.2	-2.3	12.3
12 metal working occ.	82.0	-3.9	-1.6	-4.6	-9.8	62.1
13 other manufacturing occ.	63.5	-1.0	+0.3	-2.8	-8.4	51.5
14 construction occ.	55.2	-1.4	+1.2	-2.1	-6.0	46.9
15 technical occ.	20.9	-0.4	+0.9	-0.2	-2.9	18.3
16 salesmen and service occ., shipping and transport related occ.	134.9	-6.6	+5.2	+0.8	-15.1	119.2
17 organisation, administration and office occ.	128.9	-9.1	+0.0	-1.4	-14.1	104.3
18 private service occ.	30.9	-2.3	-0.5	-1.5	-3.1	23.6
19 healthcare and social occ.	44.5	+9.9	+9.5	+3.4	-4.7	62.6
20 body care, guest relation, domestic and cleaning occ.	38.3	+0.8	+5.5	+2.5	-4.7	42.4
21 other occ.	13.8	-6.2	-3.0	-1.5	-0.6	2.3
10–21 dual training	**652.3**	**-26.3**	**+16.4**	**-9.8**	**-74.9**	**557.8**
22 engineering occ.	67.8	-13.6	-4.9	-4.2	-7.0	38.1
23 commercial occ.	16.3	-3.8	-0.1	+0.8	+0.6	13.8
24 IT specialists, mathematicians, natural scientific occ.	1.5	-0.2	+0.0	+0.0	-0.1	1.2
25 creative-artistic occ.	2.5	-0.1	+0.3	+0.2	-0.3	2.7
26 education related and nursing occ.	29.9	+1.6	+3.2	+1.7	-1.5	34.8
27 other occ.	3.1	-0.4	+0.0	-0.0	-0.4	2.3
22–28 technical college	**121.2**	**-16.5**	**-1.6**	**-1.5**	**-8.6**	**93.1**
29 without any qualification	**278.6**	**-65.4**	**-30.4**	**-21.3**	**-23.0**	**138.6**
Total	**1249.4**	**-75.5**	**+24.1**	**-4.9**	**-125.9**	**1067.1**
Of these						
MINT tertiary training [03;06]	56.4	+7.2	+12.5	+10.5	-3.9	82.8
MINT dual training [15]	20.9	-0.4	+0.9	-0.2	-2.9	18.3
MINT technical college [22;24]	68.5	-13.6	-4.9	-4.2	-7.0	38.8
MINT (total)	**145.8**	**-6.8**	**+8.5**	**+6.1**	**-13.8**	**139.9**

Source: Economix, ROA

2.4 Total demand

2.4.1 Total demand by occupation

Annual averages of the periods in 1000 persons

Occupation	2010–2014	2015–2019	2020–2024	2025–2030	2010–2030
01 agricultural occupations	22.4	9.2	7.4	2.9	10.1
02 livestock keeper	2.7	1.5	1.7	2.0	2.0
03 administrative, consulting and technical specialists in agriculture and livestock keeping	0.8	0.6	1.0	1.4	1.0
04 horticultural occupations	10.5	7.5	9.2	8.9	9.0
05 forester, hunter	2.0	1.8	1.7	1.3	1.7
06 miner	1.8	1.9	2.1	2.2	2.0
07 mineral processing operator	0.7	1.0	1.0	1.0	0.9
08 stone processing operator	1.1	1.1	1.3	1.4	1.3
09 building materials manufacturer	0.8	0.5	0.7	0.7	0.7
10 ceramist	0.2	0.1	0.3	0.5	0.3
11 glass manufacturer	0.2	0.3	0.3	0.3	0.3
12 chemistry related occupations	6.3	4.9	3.3	3.5	4.4
13 plastics related occupations	0.1	0.8	1.5	1.8	1.1
14 paper manufacturer and processor	1.1	1.0	1.0	1.0	1.0
15 printer	2.5	2.7	2.2	2.1	2.4
16 wood machining occupations	2.3	1.5	1.3	0.9	1.5
17 metallurgical and semi-finished goods occupations	1.7	1.5	1.8	2.2	1.8
18 foundry related occupations	2.0	2.1	2.3	2.3	2.2
19 non-cutting metal former	1.0	0.4	0.5	0.5	0.6
20 cutting metal former	8.6	5.5	6.7	4.9	6.4
21 metal refining occupations	-0.3	0.4	0.7	1.2	0.5
22 metal welding and soldering occupations	1.0	2.3	2.7	2.4	2.1
23 metal and plant manufacturer	15.6	11.0	10.5	8.7	11.3
24 metal sheet constructor, installer	17.3	13.9	12.2	9.4	13.0
25 mechanical engineer	17.1	12.3	14.6	10.0	13.3
26 vehicle manufacturer	16.5	11.7	17.6	15.5	15.3
27 toolmaking and mould making occupations	5.3	3.2	3.5	2.4	3.5
28 precision mechanic	8.9	3.8	5.1	5.5	5.8
29 electric and electronic technician	33.5	25.3	25.3	21.7	26.2
30 assembler	5.1	4.9	6.4	6.2	5.7
31 spinner	0.3	0.2	0.2	0.1	0.2
32 textile manufacturer	0.5	0.2	0.2	0.4	0.3
33 textile processor	5.8	2.7	0.8	0.1	2.2
34 textile finisher	0.4	0.4	0.3	0.3	0.3
35 tanner, dyer, leather processor	1.5	0.6	0.7	0.7	0.9
36 baker, pastry cook	5.0	2.4	3.7	2.8	3.4
37 butcher	1.4	0.6	1.8	1.3	1.3
38 cook	25.3	14.2	12.9	9.1	15.1
39 beverage manufacturer	-0.2	0.2	0.5	0.6	0.3
40 food producer	0.4	0.5	1.5	1.6	1.0
41 building constructor	13.6	13.5	10.8	9.0	11.6
42 civil engineer	6.9	9.0	9.0	7.8	8.2
43 construction labourer	4.0	3.0	2.6	2.5	3.0
44 construction finisher	17.5	20.0	18.6	17.8	18.4

(Table 2.4.1 continued)

Occupation	2010–2014	2015–2019	2020–2024	2025–2030	2010–2030
45 interior decorator, upholsterer	0.7	1.3	1.9	2.4	1.6
46 wood, plastics processing occupations	15.3	12.4	11.9	11.2	12.6
47 painter, varnisher	12.6	14.0	13.7	13.1	13.3
48 product tester, shipping packer	14.1	14.4	19.7	19.6	17.1
49 labourer	18.5	12.5	12.6	9.7	13.2
50 machine and plant operator	8.4	8.6	11.7	10.5	9.8
51 machine setter	1.7	2.9	4.2	4.3	3.3
52 engineer	39.1	31.9	40.1	30.3	35.1
53 chemist, physicist, mathematician	5.1	4.1	4.1	4.2	4.4
54 technician	18.3	24.8	29.6	24.2	24.2
55 special technician	4.6	4.5	4.3	4.0	4.3
56 engineering draftsman	4.2	2.3	2.4	1.3	2.5
57 master craftsman	4.0	3.1	4.3	3.6	3.7
58 sales force	54.5	35.4	57.9	49.7	49.4
59 trained wholesale, retail salesman; purchase, sale specialist	31.5	18.1	34.4	31.7	29.0
60 sales representative	6.6	2.4	5.0	4.7	4.7
61 banking, insurance specialist	32.0	33.0	32.2	18.1	28.3
62 other sales service occupations	18.9	13.8	21.6	27.5	20.8
63 surface transport related occupations	31.6	32.5	42.4	36.9	35.9
64 waterborne and air transport	1.7	1.1	1.9	1.8	1.6
65 telecommunication occupations	-1.0	5.2	7.2	7.1	4.8
66 stock and transport workers	36.1	30.1	35.0	30.4	32.8
67 business management, consulting and controlling occupations	81.7	54.1	58.6	55.3	62.1
68 political representatives, senior officials	14.9	13.4	13.1	11.7	13.2
69 accountant, information technology officer	32.4	35.1	35.7	32.8	33.9
70 office clerks	117.5	89.0	84.5	63.7	87.5
71 security guard	20.0	16.4	13.7	12.9	15.6
72 other security related occupations	18.1	11.6	10.9	9.2	12.3
73 lawyer, executory officer	9.6	8.7	7.5	6.4	8.0
74 authors, journalists and linguists	9.9	8.2	6.3	7.6	8.0
75 artist	20.4	13.5	10.5	14.1	14.6
76 medical doctors, pharmacists	23.8	15.7	16.8	17.4	18.4
77 other healthcare occupations	66.8	56.1	56.1	57.3	59.0
78 social care, welfare occupations	74.4	60.3	40.8	37.6	52.5
79 teacher	61.6	43.1	18.9	13.3	33.2
80 humanities, natural science occupations	12.2	10.3	10.5	12.1	11.3
81 religious professionals	3.2	1.2	0.1	0.1	1.1
82 body care occupations	27.8	14.9	6.6	8.7	14.2
83 hotel and restaurant business occupations	31.5	14.8	15.2	11.2	17.8
84 housekeeper, food processor	20.3	13.4	7.8	6.8	11.8
85 cleaning and waste disposal occupations	45.2	41.1	36.7	34.5	39.1
86 family members as helpers (agriculture excluded)	0.3	0.1	0.2	0.3	0.3
87 with not (yet) determined occupation	15.6	15.1	12.9	11.2	13.6
88 without specified occupation	29.9	19.9	17.7	16.8	20.9
Total	**1366.9**	**1066.8**	**1088.7**	**965.8**	**1114.6**

Source: Economix, ROA, IER

2.4.2 Total demand by formal training

Annual averages of the periods in 1000 persons;
categories 09 and 28 = not stated

Formal training	2010–2014	2015–2019	2020–2024	2025–2030	2010–2030
01 humanities and cultural studies, sports	102.3	87.0	63.7	48.6	74.1
02 law, economics and social sciences	229.7	194.2	149.0	78.8	158.9
03 mathematics, natural sciences	55.7	53.8	47.7	33.4	47.0
04 human medicine, veterinary medicine	47.7	43.2	40.4	31.9	40.4
05 agricultural science, forestry and nutrition science	9.9	7.8	6.2	1.7	6.2
06 engineering sciences	76.4	66.4	70.0	53.8	66.1
07 arts, art sciences	30.4	25.0	17.8	7.5	19.6
08 other	0.7	0.4	0.2	-0.1	0.3
01–09 tertiary training	**552.9**	**477.8**	**395.1**	**255.5**	**412.5**
10 farming, animal breeding, fishing	22.7	12.6	11.5	9.3	13.8
11 industrial and craft manufacturing occ.	16.6	13.1	10.9	10.4	12.7
12 metal working occ.	86.5	65.1	66.2	50.8	66.4
13 other manufacturing occ.	82.7	62.2	56.3	40.1	59.4
14 construction occ.	58.1	57.5	50.2	43.7	52.0
15 technical occ.	13.3	13.1	16.9	15.6	14.8
16 salesmen and service occ., shipping and transport related occ.	155.4	114.2	148.0	128.0	136.0
17 organisation, administration and office occ.	117.1	76.5	73.7	71.8	84.2
18 private service occ.	37.0	24.9	18.9	19.1	24.7
19 healthcare and social occ.	107.8	97.0	79.1	75.5	89.2
20 body care, guest relation, domestic and cleaning occ.	90.7	67.0	50.2	45.1	62.4
21 other occ.	-1.1	-3.9	-1.6	0.8	-1.3
10–21 dual training	**786.9**	**599.4**	**580.2**	**510.3**	**614.0**
22 engineering occ.	26.7	1.6	17.0	22.0	17.1
23 commercial occ.	-22.9	-4.3	12.7	23.5	3.3
24 IT specialists, mathematicians, natural scientific occ.	-0.2	0.0	0.7	1.1	0.4
25 creative-artistic occ.	0.1	2.8	4.1	3.6	2.7
26 education related and nursing occ.	41.8	35.9	42.0	50.8	43.0
27 other occ.	9.1	4.5	1.2	-0.1	3.5
22–28 technical college	**54.5**	**40.6**	**77.8**	**101.0**	**17.5**
29 without any qualification	**-27.4**	**-50.9**	**35.6**	**99.0**	**18.1**
Total	**1366.9**	**1066.8**	**1088.7**	**965.8**	**1114.6**

Of these

MINT tertiary training [03;06]	132.2	120.2	117.8	87.2	113.0
MINT dual training [15]	13.3	13.1	16.9	15.6	14.8
MINT technical college [22;24]	26.4	1.6	17.7	23.1	17.5
MINT (total)	**171.9**	**135.0**	**152.4**	**125.9**	**145.3**

Source: Economix, ROA, IER

2.4.3 Total demand rate by occupation

Annual averages of the periods, total demand as % of persons employed
Persons employed in year x = mean of the sum of persons employed in year x-1, x, and x+1

Occupation	2010–2014	2015–2019	2020–2024	2025–2030	2010–2030
01 agricultural occupations	5.0	2.1	1.8	0.8	2.4
02 livestock keeper	3.3	1.8	2.1	2.5	2.5
03 administrative, consulting and technical specialists in agriculture and livestock keeping	3.1	2.3	4.0	4.8	3.7
04 horticultural occupations	2.4	1.8	2.3	2.3	2.2
05 forester, hunter	3.5	3.2	3.0	2.4	3.0
06 miner	3.7	4.5	5.7	6.3	5.0
07 mineral processing operator	7.5	10.5	10.9	10.7	9.9
08 stone processing operator	5.0	4.9	5.7	5.8	5.4
09 building materials manufacturer	10.0	7.0	8.5	9.1	8.7
10 ceramist	1.2	0.9	3.5	6.2	2.7
11 glass manufacturer	1.0	1.8	2.1	1.8	1.7
12 chemistry related occupations	3.9	3.0	2.1	2.3	2.8
13 plastics related occupations	0.2	1.7	3.2	3.6	2.2
14 paper manufacturer and processor	2.9	2.8	2.9	2.9	2.9
15 printer	2.0	2.4	2.2	2.3	2.2
16 wood machining occupations	6.0	3.9	3.3	2.5	3.9
17 metallurgical and semi-finished goods occupations	3.7	3.3	4.2	5.1	4.1
18 foundry related occupations	3.3	3.6	3.9	3.9	3.7
19 non-cutting metal former	4.0	1.9	2.4	2.7	2.8
20 cutting metal former	3.5	2.3	2.8	2.1	2.6
21 metal refining occupations	-1.0	1.4	2.7	5.0	2.0
22 metal welding and soldering occupations	0.9	2.4	2.9	2.8	2.2
23 metal and plant manufacturer	3.5	2.7	2.7	2.5	2.8
24 metal sheet constructor, installer	3.7	3.1	2.9	2.3	3.0
25 mechanical engineer	3.5	2.6	3.2	2.2	2.8
26 vehicle manufacturer	3.5	2.7	4.2	3.8	3.5
27 toolmaking and mould making occupations	3.9	2.5	3.0	2.2	2.9
28 precision mechanic	3.9	1.7	2.3	2.5	2.6
29 electric and electronic technician	4.1	3.2	3.2	2.8	3.3
30 assembler	2.4	2.4	3.2	3.1	2.8
31 spinner	5.7	5.3	4.6	4.8	5.2
32 textile manufacturer	3.1	1.3	1.6	2.7	2.2
33 textile processor	5.7	2.8	0.9	0.1	2.5
34 textile finisher	5.8	5.3	4.3	4.3	4.9
35 tanner, dyer, leather processor	4.5	2.0	2.4	2.7	2.9
36 baker, pastry cook	3.2	1.7	2.9	2.4	2.6
37 butcher	1.3	0.6	2.4	1.9	1.5
38 cook	4.1	2.2	2.1	1.5	2.5
39 beverage manufacturer	-1.2	1.2	3.3	4.4	1.8
40 food producer	0.9	1.2	3.5	3.5	2.3
41 building constructor	4.5	5.0	4.4	4.1	4.5
42 civil engineer	4.3	5.6	5.5	4.8	5.0
43 construction labourer	3.8	3.1	2.8	2.9	3.2

(Table 2.4.3 continued)

Occupation	2010–2014	2015–2019	2020–2024	2025–2030	2010–2030
44 construction finisher	4.3	4.9	4.4	4.2	4.4
45 interior decorator, upholsterer	1.0	2.1	3.0	3.7	2.5
46 wood, plastics processing occupations	4.6	3.9	3.8	3.7	4.0
47 painter, varnisher	4.2	4.6	4.5	4.2	4.4
48 product tester, shipping packer	3.0	3.1	4.1	3.8	3.5
49 labourer	2.9	2.1	2.2	1.8	2.3
50 machine and plant operator	2.0	2.2	3.0	2.8	2.5
51 machine setter	3.0	5.0	6.9	6.8	5.5
52 engineer	3.5	2.8	3.4	2.6	3.0
53 chemist, physicist, mathematician	4.6	3.5	3.3	3.2	3.6
54 technician	2.0	2.7	3.2	2.7	2.6
55 special technician	3.5	3.3	3.0	2.7	3.1
56 engineering draftsman	3.6	2.2	2.5	1.6	2.5
57 master craftsman	2.4	2.0	3.0	2.7	2.5
58 sales force	3.2	2.1	3.5	2.9	2.9
59 trained wholesale, retail salesman; purchase, sale specialist	2.3	1.3	2.6	2.3	2.1
60 sales representative	1.9	0.7	1.7	1.8	1.5
61 banking, insurance specialist	3.3	3.2	3.0	1.7	2.7
62 other sales service occupations	2.7	1.9	2.9	3.5	2.8
63 surface transport related occupations	2.6	2.7	3.5	3.0	3.0
64 waterborne and air transport	2.7	1.8	3.0	2.9	2.6
65 telecommunication occupations	-0.4	2.4	3.3	3.2	2.1
66 stock and transport workers	3.6	2.9	3.3	2.8	3.1
67 business management, consulting and controlling occupations	4.1	2.6	2.7	2.6	3.0
68 political representatives, senior officials	3.7	3.3	3.2	2.9	3.3
69 accountant, information technology officer	2.4	2.6	2.6	2.4	2.5
70 office clerks	2.5	2.0	2.0	1.6	2.0
71 security guard	3.4	2.8	2.4	2.3	2.7
72 other security related occupations	2.8	2.0	2.0	1.8	2.2
73 lawyer, executory officer	3.2	2.8	2.4	2.1	2.6
74 authors, journalists and linguists	3.6	2.9	2.2	2.7	2.8
75 artist	3.9	2.5	1.9	2.5	2.6
76 medical doctors, pharmacists	4.4	2.9	3.0	3.1	3.3
77 other healthcare occupations	3.0	2.5	2.5	2.5	2.6
78 social care, welfare occupations	4.0	3.1	2.1	2.0	2.7
79 teacher	4.2	2.9	1.3	1.0	2.4
80 humanities, natural science occupations	2.8	2.2	2.2	2.5	2.4
81 religious professionals	4.4	1.7	0.1	0.3	1.8
82 body care occupations	5.6	2.8	1.2	1.6	2.7
83 hotel and restaurant business occupations	3.3	1.5	1.6	1.2	1.9
84 housekeeper, food processor	4.7	3.0	1.8	1.6	2.7
85 cleaning and waste disposal occupations	3.4	3.0	2.7	2.6	2.9
86 family members as helpers (agriculture excluded)	3.2	1.1	3.5	4.7	3.1
87 with not (yet) determined occupation	16.2	18.2	17.6	17.2	17.3
88 without specified occupation	5.3	3.8	3.6	3.7	4.2
Total	**3.3**	**2.6**	**2.7**	**2.4**	**2.8**

Source: Economix, ROA, IER

2.4.4 Total demand rate by formal training

Annual averages of the periods, total demand as % of persons employed, categories 09 and 28 = not stated
Persons employed in year x = mean of the sum of persons employed in year x-1, x, and x+1

Formal training	2010–2014	2015–2019	2020–2024	2025–2030	2010–2030
01 humanities and cultural studies, sports	6.0	4.5	3.1	2.4	3.9
02 law, economics and social sciences	8.2	5.7	3.9	2.1	4.6
03 mathematics, natural sciences	7.0	5.6	4.4	2.9	4.7
04 human medicine, veterinary medicine	7.4	5.6	4.6	3.4	5.0
05 agricultural science, forestry and nutrition science	5.5	4.0	3.0	0.9	3.2
06 engineering sciences	4.6	3.7	3.7	2.8	3.6
07 arts, art sciences	7.9	5.3	3.5	1.5	4.1
08 other	9.1	4.7	2.3	-1.1	3.5
01–09 tertiary training	**6.8**	**5.0**	**3.8**	**2.4**	**4.2**
10 farming, animal breeding, fishing	4.0	2.2	2.1	1.8	2.5
11 industrial and craft manufacturing occ.	4.3	3.5	3.0	3.1	3.5
12 metal working occ.	4.2	3.2	3.3	2.7	3.3
13 other manufacturing occ.	4.6	3.4	3.1	2.3	3.3
14 construction occ.	5.1	5.0	4.4	3.9	4.6
15 technical occ.	1.8	1.9	2.5	2.4	2.2
16 salesmen and service occ., shipping and transport related occ.	3.1	2.3	2.9	2.5	2.7
17 organisation, administration and office occ.	2.6	1.8	1.8	1.9	2.0
18 private service occ.	3.7	2.5	2.0	2.1	2.6
19 healthcare and social occ.	4.8	3.9	3.0	2.8	3.6
20 body care, guest relation, domestic and cleaning occ.	5.5	3.7	2.7	2.4	3.4
21 other occ.	-0.7	-4.1	-2.6	1.8	-1.5
10–21 dual training	**3.7**	**2.8**	**2.7**	**2.5**	**2.9**
22 engineering occ.	1.4	0.1	1.2	1.8	1.1
23 commercial occ.	-4.6	-1.2	3.8	6.3	0.8
24 IT specialists, mathematicians, natural scientific occ.	-0.4	0.0	1.7	2.6	0.9
25 creative-artistic occ.	0.1	3.4	4.7	3.9	3.1
26 education related and nursing occ.	3.2	2.7	3.1	3.6	3.2
27 other occ.	7.0	3.1	0.8	-0.1	2.6
22–28 technical college	**1.4**	**1.2**	**2.3**	**3.1**	**2.0**
29 without any qualification	**-0.4**	**-0.8**	**0.6**	**2.0**	**0.3**
Total	**3.3**	**2.6**	**2.7**	**2.4**	**2.8**
Of these					
MINT tertiary training [03;06]	5.4	4.4	4.0	2.9	4.0
MINT dual training [15]	1.8	1.9	2.5	2.4	2.2
MINT technical college [22;24]	1.4	0.1	1.2	1.8	1.1
MINT (total)	**3.4**	**2.7**	**3.0**	**2.5**	**2.9**

Source: Economix, ROA, IER

2.5 Labour force inflows and outflows

2.5.1 Labour force inflows by occupation

Annual averages as % of labour force

Occupation	2010–2014	2015–2019	2020–2024	2025–2030	2010–2030
01 agricultural occupations	15.1	14.9	15.0	15.0	15.0
02 livestock keeper	20.5	19.5	19.2	19.0	19.5
03 administrative, consulting and technical specialists in agriculture and livestock keeping	13.6	13.7	13.8	13.8	13.7
04 horticultural occupations	24.4	23.2	22.9	22.8	23.3
05 forester, hunter	21.1	20.2	20.2	20.2	20.4
06 miner	10.2	10.0	10.1	10.0	10.1
07 mineral processing operator	14.4	14.0	13.8	13.7	14.0
08 stone processing operator	16.3	15.6	15.3	15.2	15.6
09 building materials manufacturer	15.1	14.5	14.4	14.3	14.6
10 ceramist	15.5	14.8	14.5	14.2	14.7
11 glass manufacturer	11.6	11.4	11.3	11.3	11.4
12 chemistry related occupations	10.0	9.4	9.2	9.0	9.4
13 plastics related occupations	16.2	15.4	15.1	14.9	15.4
14 paper manufacturer and processor	10.4	9.9	9.6	9.5	9.8
15 printer	13.7	13.2	13.2	13.1	13.3
16 wood machining occupations	16.8	16.1	16.1	16.0	16.2
17 metallurgical and semi-finished goods occupations	12.7	11.9	11.4	11.1	11.7
18 foundry related occupations	14.3	13.3	12.8	12.6	13.2
19 non-cutting metal former	12.9	12.7	12.8	12.7	12.8
20 cutting metal former	14.0	13.2	12.8	12.6	13.1
21 metal refining occupations	13.2	12.7	12.4	12.3	12.6
22 metal welding and soldering occupations	30.8	28.1	26.4	25.9	27.7
23 metal and plant manufacturer	16.8	15.7	15.0	14.8	15.5
24 metal sheet constructor, installer	14.2	13.5	13.2	13.0	13.5
25 mechanical engineer	12.9	12.4	12.1	12.0	12.3
26 vehicle manufacturer	16.1	15.2	14.6	14.4	15.0
27 toolmaking and mould making occupations	11.5	11.0	10.7	10.6	10.9
28 precision mechanic	11.9	11.3	11.1	11.0	11.3
29 electric and electronic technician	13.5	12.7	12.2	11.9	12.5
30 assembler	15.8	15.2	15.0	14.9	15.2
31 spinner	17.3	16.4	16.2	16.0	16.5
32 textile manufacturer	14.3	13.6	13.3	13.1	13.5
33 textile processor	17.8	17.1	17.0	16.8	17.1
34 textile finisher	14.4	13.6	13.2	13.0	13.5
35 tanner, dyer, leather processor	12.6	12.0	11.8	11.7	12.0
36 baker, pastry cook	16.6	15.8	15.5	15.3	15.8
37 butcher	16.3	15.8	15.7	15.5	15.8
38 cook	24.9	23.5	22.9	22.6	23.4
39 beverage manufacturer	13.6	13.4	13.5	13.3	13.4
40 food producer	13.8	13.2	13.0	12.8	13.2
41 building constructor	21.8	20.7	20.1	19.8	20.5
42 civil engineer	17.4	16.3	15.7	15.3	16.1
43 construction labourer	32.4	31.3	31.4	31.1	31.5

(Table 2.5.1 continued)

Occupation	2010–2014	2015–2019	2020–2024	2025–2030	2010–2030
44 construction finisher	19.6	18.6	18.1	17.8	18.5
45 interior decorator, upholsterer	15.0	14.6	14.6	14.4	14.6
46 wood, plastics processing occupations	17.3	16.3	15.8	15.5	16.2
47 painter, varnisher	21.2	20.0	19.5	19.2	19.9
48 product tester, shipping packer	17.9	17.6	17.9	18.0	17.9
49 labourer	28.4	27.3	27.2	26.8	27.4
50 machine and plant operator	14.4	13.8	13.6	13.4	13.8
51 machine setter	7.8	7.4	7.1	6.8	7.3
52 engineer	10.1	9.9	9.7	9.7	9.9
53 chemist, physicist, mathematician	15.2	15.3	15.3	15.3	15.3
54 technician	9.1	8.7	8.5	8.4	8.7
55 special technician	13.7	13.0	12.6	12.4	12.9
56 engineering draftsman	13.8	12.7	12.2	12.0	12.6
57 master craftsman	7.7	7.4	7.1	7.0	7.3
58 sales force	18.8	18.3	18.3	18.2	18.4
59 trained wholesale, retail salesman; purchase, sale specialist	14.9	14.1	13.6	13.4	13.9
60 sales representative	13.8	13.4	13.3	13.4	13.5
61 banking, insurance specialist	10.0	9.6	9.3	9.3	9.5
62 other sales service occupations	15.4	14.9	14.8	14.6	14.9
63 surface transport related occupations	21.3	20.0	19.5	19.3	20.0
64 waterborne and air transport	12.7	12.5	12.5	12.4	12.5
65 telecommunication occupations	19.1	18.1	17.6	17.4	18.0
66 stock and transport workers	22.6	21.6	21.3	21.1	21.6
67 business management, consulting and controlling occupations	12.6	12.2	12.0	12.0	12.2
68 political representatives, senior officials	10.2	10.1	10.0	10.0	10.0
69 accountant, information technology officer	17.6	17.0	16.7	16.6	17.0
70 office clerks	14.9	14.3	14.1	14.1	14.4
71 security guard	24.8	24.2	24.5	24.6	24.5
72 other security related occupations	10.4	10.3	10.4	10.5	10.4
73 lawyer, executory officer	8.6	8.4	8.3	8.3	8.4
74 authors, journalists and linguists	13.1	12.9	12.9	13.0	13.0
75 artist	13.4	13.2	13.3	13.3	13.3
76 medical doctors, pharmacists	8.4	8.5	8.7	8.8	8.6
77 other healthcare occupations	12.8	12.3	12.1	12.1	12.3
78 social care, welfare occupations	18.7	17.7	17.4	17.3	17.8
79 teacher	13.0	12.8	13.0	13.2	13.0
80 humanities, natural science occupations	16.5	16.5	16.5	16.5	16.5
81 religious professionals	13.7	13.9	14.4	14.9	14.2
82 body care occupations	14.7	14.4	14.4	14.5	14.5
83 hotel and restaurant business occupations	22.1	21.6	21.7	21.7	21.8
84 housekeeper, food processor	30.8	29.5	29.2	29.1	29.6
85 cleaning and waste disposal occupations	25.1	24.7	25.1	25.2	25.0
86 family members as helpers (agriculture excluded)	24.3	24.0	24.4	24.5	24.3
87 with not (yet) determined occupation	24.5	24.4	24.9	24.7	24.7
88 without specified occupation	15.9	15.5	15.6	15.6	15.6
Total	**16.5**	**15.9**	**15.6**	**15.6**	**15.9**

Source: Economix

2.5.2 Labour force outflows by occupation

Annual averages as % of labour force

Occupation	2010–2014	2015–2019	2020–2024	2025–2030	2010–2030
01 agricultural occupations	15.9	16.3	16.5	16.8	16.4
02 livestock keeper	19.8	19.5	19.1	18.2	19.1
03 administrative, consulting and technical specialists in agriculture and livestock keeping	13.2	13.9	12.6	11.2	12.7
04 horticultural occupations	25.2	24.3	23.9	23.6	24.2
05 forester, hunter	22.8	21.3	21.4	21.6	21.8
06 miner	12.7	12.6	11.6	10.6	11.8
07 mineral processing operator	13.7	10.8	10.9	10.5	11.4
08 stone processing operator	17.2	15.4	14.6	14.3	15.3
09 building materials manufacturer	11.5	15.1	13.6	12.4	13.1
10 ceramist	19.0	19.4	16.9	13.4	17.0
11 glass manufacturer	13.5	13.9	13.4	13.6	13.6
12 chemistry related occupations	9.3	9.4	10.2	9.5	9.6
13 plastics related occupations	18.6	16.9	15.3	14.4	16.2
14 paper manufacturer and processor	10.8	10.6	10.5	10.1	10.5
15 printer	16.8	15.6	15.6	15.1	15.7
16 wood machining occupations	15.2	16.1	16.4	16.7	16.1
17 metallurgical and semi-finished goods occupations	13.0	12.5	11.6	10.8	11.9
18 foundry related occupations	11.9	13.4	13.3	12.9	12.9
19 non-cutting metal former	11.7	14.6	14.2	13.4	13.5
20 cutting metal former	13.6	14.2	13.3	13.5	13.6
21 metal refining occupations	17.0	13.6	13.1	11.1	13.6
22 metal welding and soldering occupations	33.3	30.0	27.9	27.1	29.5
23 metal and plant manufacturer	17.9	17.5	16.9	16.7	17.2
24 metal sheet constructor, installer	15.2	14.8	14.5	14.4	14.7
25 mechanical engineer	13.9	13.9	12.8	13.2	13.4
26 vehicle manufacturer	17.3	16.9	15.0	15.2	16.1
27 toolmaking and mould making occupations	12.0	13.0	12.1	12.3	12.3
28 precision mechanic	11.1	12.4	11.5	11.0	11.5
29 electric and electronic technician	14.0	13.4	12.6	12.5	13.1
30 assembler	15.4	16.2	15.4	14.9	15.4
31 spinner	17.6	19.6	19.4	18.3	18.7
32 textile manufacturer	13.2	14.7	14.3	12.6	13.6
33 textile processor	18.4	18.9	19.9	19.7	19.3
34 textile finisher	15.6	14.2	14.3	13.7	14.4
35 tanner, dyer, leather processor	12.5	13.6	13.2	12.5	12.9
36 baker, pastry cook	18.9	18.4	17.1	17.2	17.8
37 butcher	19.1	19.2	17.8	17.9	18.5
38 cook	23.5	23.1	22.8	23.0	23.1
39 beverage manufacturer	18.2	15.8	14.0	12.3	14.9
40 food producer	15.1	14.1	12.3	11.9	13.3
41 building constructor	25.2	23.2	23.0	22.4	23.4
42 civil engineer	18.1	16.1	15.9	15.7	16.4
43 construction labourer	33.1	32.8	33.1	32.5	32.9
44 construction finisher	19.9	18.1	18.3	18.1	18.6

(Table 2.5.2 continued)

Occupation	2010–2014	2015–2019	2020–2024	2025–2030	2010–2030
45 interior decorator, upholsterer	17.7	15.9	15.3	14.5	15.8
46 wood, plastics processing occupations	18.0	17.3	16.7	16.2	17.0
47 painter, varnisher	22.0	20.0	19.5	19.3	20.2
48 product tester, shipping packer	18.0	17.4	16.7	16.5	17.1
49 labourer	29.6	29.2	28.8	28.1	28.9
50 machine and plant operator	15.2	14.9	14.1	14.0	14.5
51 machine setter	4.2	2.9	1.9	2.8	3.0
52 engineer	9.3	9.6	9.2	10.1	9.6
53 chemist, physicist, mathematician	13.1	13.5	13.9	13.9	13.6
54 technician	10.4	9.2	8.8	9.1	9.4
55 special technician	13.9	12.3	12.1	11.9	12.5
56 engineering draftsman	15.6	15.6	14.9	15.5	15.4
57 master craftsman	8.5	9.2	8.6	8.9	8.8
58 sales force	18.8	19.0	17.8	17.9	18.4
59 trained wholesale, retail salesman; purchase, sale specialist	14.9	14.6	13.1	13.3	13.9
60 sales representative	15.4	15.7	15.3	15.7	15.5
61 banking, insurance specialist	9.4	8.8	8.9	10.1	9.3
62 other sales service occupations	12.9	12.5	11.7	11.2	12.0
63 surface transport related occupations	22.8	21.2	20.0	19.9	20.9
64 waterborne and air transport	14.6	15.7	14.9	14.8	15.0
65 telecommunication occupations	23.1	18.8	17.5	17.0	19.0
66 stock and transport workers	22.2	21.3	20.6	20.6	21.2
67 business management, consulting and controlling occupations	10.6	11.5	11.7	12.2	11.5
68 political representatives, senior officials	9.7	10.1	10.1	10.1	10.0
69 accountant, information technology officer	17.6	16.8	16.9	17.3	17.2
70 office clerks	16.2	15.6	15.6	15.7	15.8
71 security guard	25.8	24.8	25.5	25.2	25.3
72 other security related occupations	11.5	11.9	12.0	12.0	11.9
73 lawyer, executory officer	7.7	6.8	7.5	8.1	7.6
74 authors, journalists and linguists	12.4	12.3	13.5	13.2	12.9
75 artist	10.9	11.4	12.6	12.3	11.8
76 medical doctors, pharmacists	6.7	7.6	7.8	7.9	7.5
77 other healthcare occupations	12.1	11.6	11.7	11.4	11.7
78 social care, welfare occupations	16.6	16.2	17.3	17.4	16.9
79 teacher	12.7	13.5	15.1	15.5	14.3
80 humanities, natural science occupations	14.8	14.4	15.0	15.1	14.9
81 religious professionals	14.1	15.2	17.9	18.5	16.5
82 body care occupations	12.7	13.5	15.2	14.8	14.1
83 hotel and restaurant business occupations	21.4	21.7	21.9	22.3	21.9
84 housekeeper, food processor	30.3	30.0	31.0	30.8	30.5
85 cleaning and waste disposal occupations	25.9	25.1	26.0	25.8	25.7
86 family members as helpers (agriculture excluded)	33.4	30.1	26.7	24.5	28.5
87 with not (yet) determined occupation	26.5	26.2	26.4	25.7	26.2
88 without specified occupation	17.9	17.5	17.6	17.1	17.5
Total	**16.5**	**16.1**	**16.0**	**16.0**	**16.2**

Source: Economix

2.5.3 Labour force inflows by formal training

Annual averages as % of labour force, categories 09 and 28 = not stated

Formal training	2010–2014	2015–2019	2020–2024	2025–2030	2010–2030
01 humanities and cultural studies, sports	14.5	13.0	12.2	11.8	12.8
02 law, economics and social sciences	13.8	11.1	10.0	9.9	11.1
03 mathematics, natural sciences	17.1	14.1	12.7	12.2	14.0
04 human medicine, veterinary medicine	8.9	7.6	7.0	6.7	7.5
05 agricultural science, forestry and nutrition science	17.6	15.5	14.8	15.3	15.8
06 engineering sciences	13.0	12.0	11.5	11.3	12.0
07 arts, art sciences	14.9	12.3	11.4	11.5	12.5
08 other	14.3	12.1	11.7	13.2	12.8
01–09 tertiary training	**13.9**	**11.8**	**10.9**	**10.7**	**11.8**
10 farming, animal breeding, fishing	20.1	18.9	18.6	18.6	19.0
11 industrial and craft manufacturing occ.	12.2	11.3	11.1	11.0	11.4
12 metal working occ.	15.0	13.6	12.9	12.7	13.5
13 other manufacturing occ.	19.4	17.2	16.2	15.8	17.1
14 construction occ.	20.0	18.1	17.1	16.7	17.9
15 technical occ.	9.6	9.4	9.4	9.4	9.4
16 salesmen and service occ., shipping and transport related occ.	17.6	16.7	16.5	16.6	16.9
17 organisation, administration and office occ.	14.0	13.6	13.6	13.7	13.7
18 private service occ.	16.4	15.7	15.8	15.9	16.0
19 healthcare and social occ.	13.4	12.1	11.5	11.1	12.0
20 body care, guest relation, domestic and cleaning occ.	23.0	20.7	19.8	19.3	20.6
21 other occ.	18.6	26.6	38.7	49.3	34.1
10–21 dual training	**16.5**	**15.4**	**15.1**	**15.0**	**15.5**
22 engineering occ.	15.2	16.7	18.2	19.4	17.4
23 commercial occ.	19.0	24.4	25.3	22.1	22.7
24 IT specialists, mathematicians, natural scientific occ.	27.7	28.8	26.9	23.9	26.7
25 creative-artistic occ.	18.7	19.4	18.6	17.8	18.6
26 education related and nursing occ.	16.5	15.6	14.9	13.9	15.1
27 other occ.	14.3	13.3	13.4	14.5	13.9
22–28 technical college	**16.3**	**17.2**	**17.5**	**17.1**	**17.0**
29 without any qualification	**19.1**	**21.9**	**24.5**	**25.8**	**22.9**
Total	**16.5**	**15.9**	**15.6**	**15.6**	**15.9**
Of these					
MINT tertiary training [03;06]	14.3	12.7	11.9	11.7	12.6
MINT dual training [15]	9.6	9.4	9.4	9.4	9.4
MINT technical college [22;24]	15.5	17.1	18.5	19.6	17.8
MINT (total)	**14.0**	**13.6**	**13.4**	**13.4**	**13.6**

Source: Economix based on data of the German Education Report and reports of the Federal Statistical Office (series 11.2 and 11.3)

2.5.4 Labour force outflows by formal training

Annual averages as % of labour force, categories 09 and 28 = not stated

Formal training	2010–2014	2015–2019	2020–2024	2025–2030	2010–2030
01 humanities and cultural studies, sports	13.1	13.4	13.1	13.1	12.8
02 law, economics and social sciences	12.5	12.3	11.7	11.3	10.7
03 mathematics, natural sciences	14.5	14.0	13.3	13.0	12.4
04 human medicine, veterinary medicine	7.2	7.4	7.5	7.7	7.5
05 agricultural science, forestry and nutrition science	16.1	15.3	15.8	15.5	15.1
06 engineering sciences	11.6	11.4	11.8	11.9	11.4
07 arts, art sciences	12.4	12.5	11.9	11.6	11.4
08 other	15.2	15.3	14.7	14.2	13.8
01–09 tertiary training	**11.9**	**10.5**	**9.9**	**9.8**	**10.5**
10 farming, animal breeding, fishing	21.8	18.4	21.3	20.4	20.7
11 industrial and craft manufacturing occ.	14.5	15.4	11.9	12.0	12.5
12 metal working occ.	14.1	15.6	15.9	15.5	14.9
13 other manufacturing occ.	19.2	20.6	19.6	19.1	18.7
14 construction occ.	21.7	22.1	21.5	20.2	19.7
15 technical occ.	14.2	10.1	10.4	10.6	10.5
16 salesmen and service occ., shipping and transport related occ.	17.7	18.3	17.4	17.5	17.4
17 organisation, administration and office occ.	15.2	15.4	15.2	15.0	15.2
18 private service occ.	18.3	18.1	17.4	17.2	17.7
19 healthcare and social occ.	14.6	13.1	12.8	12.7	12.8
20 body care, guest relation, domestic and cleaning occ.	25.9	22.8	21.8	21.1	21.2
21 other occ.	18.7	22.7	23.8	25.3	27.3
10–21 dual training	**16.9**	**16.1**	**15.8**	**15.7**	**16.1**
22 engineering occ.	16.5	16.3	17.1	17.8	18.0
23 commercial occ.	14.8	16.6	18.5	20.3	21.2
24 IT specialists, mathematicians, natural scientific occ.	15.9	16.4	16.9	17.8	18.2
25 creative-artistic occ.	15.1	15.5	15.6	16.1	16.3
26 education related and nursing occ.	15.5	14.2	14.3	14.8	14.9
27 other occ.	13.9	13.2	13.2	12.9	13.7
22–28 technical college	**16.3**	**17.7**	**18.5**	**18.4**	**17.8**
29 without any qualification	**18.5**	**20.2**	**20.1**	**20.2**	**21.4**
Total	**16.6**	**16.8**	**16.5**	**16.4**	**16.5**
Of these					
MINT tertiary training [03;06]	12.2	11.0	10.2	10.3	10.9
MINT dual training [15]	11.1	10.6	10.3	10.7	10.7
MINT technical college [22;24]	17.1	19.1	20.5	22.0	19.8
MINT (total)	**13.8**	**13.5**	**13.1**	**13.4**	**13.4**

Source: Economix based on data of the German Education Report and reports of the Federal Statistical Office (series 11.2 and 11.3)

3 Classifications and aggregations

3.1 Classification of 88 occupations

No.	Code (German classification of occupations 1992)	Name (88 occupations)
01	01	agricultural occupations
02	02	livestock keeper
03	03	administrative, consulting and technical specialists in agriculture and livestock keeping
04	05	horticultural occupations
05	06	forester, hunter
06	07	miner
07	08	mineral processing operator
08	10	stone processing operator
09	11	building materials manufacturer
10	12	ceramist
11	13	glass manufacturer
12	14	chemistry related occupations
13	15	plastics related occupations
14	16	paper manufacturer and processor
15	17	printer
16	18	wood machining occupations
17	19	metallurgical and semi-finished goods occupations
18	20	foundry related occupations
19	21	non-cutting metal former
20	22	cutting metal former
21	23	metal refining occupations
22	24	metal welding and soldering occupations
23	25	metal and plant manufacturer
24	26	metal sheet constructor, installer
25	27	mechanical engineer
26	28	vehicle manufacturer
27	29	toolmaking and mould making occupations
28	30	precision mechanic
29	31	electric and electronic technician
30	32	assembler
31	33	spinner
32	34	textile manufacturer
33	35	textile processor
34	36	textile finisher
35	37	tanner, dyer, leather processor
36	39	baker, pastry cook
37	40	butcher
38	41	cook
39	42	beverage manufacturer
40	43	food producer
41	44	building constructor
42	46	civil engineer
43	47	construction labourer

(Table 3.1 continued)

No.	Code (German classification of occupations 1992)	Name (88 occupations)
44	48	construction finisher
45	49	interior decorator, upholsterer
46	50	wood, plastics processing occupations
47	51	painter, varnisher
48	52	product tester, shipping packer
49	53	unskilled labourer
50	54	machine and plant operator
51	55	machine setter
52	60	engineer
53	61	chemist, physicist, mathematician
54	62	technician
55	63	special technician
56	64	engineering draftsman
57	65	master craftsman
58	66	sales force
59	67	trained wholesale, retail salesman; purchase, sale specialist
60	68	sales representative
61	69	banking, insurance specialist
62	70	other sales service occupations
63	71	surface transport related occupations
64	72	waterborne and air transport
65	73	telecommunication occupations
66	74	stock and transport workers
67	75	business management, consulting and controlling occupations
68	76	political representatives, senior officials
69	77	accountant, information technology officer
70	78	office clerks
71	79	security guard
72	80	other security related occupations
73	81	lawyer, executory officer
74	82	authors, journalists and linguists
75	83	artist
76	84	medical doctors, pharmacists
77	85	other healthcare occupations
78	86	social care, welfare occupations
79	87	teacher
80	88	humanities, natural science occupations
81	89	religious professionals
82	90	body care occupations
83	91	hotel and restaurant business occupations
84	92	housekeeper, food processor
85	93	cleaning and waste disposal occupations
86	97	family members as helpers (agriculture excluded)
87	98	with not (yet) determined occupation
88	99	without specified occupation

Source: Economix, Federal Statistical Office: Klassifikation der Berufe 1992 (Classification of occupations 1992)

3.2 Aggregation of 88 occupations

88 occupations	34 occupations	13 occupations
01 agricultural occupations	01 agricultural occupations [01–05]	01 manufacturing occupations [01–51]
02 livestock keeper		
03 administrative, consulting and technical specialists in agriculture and livestock keeping		
04 horticultural occupations		
05 forester, hunter		
06 miner	02 miner, building materials manufacturers [06–09]	
07 mineral processing operator		
08 stone processing operator		
09 building materials manufacturer		
10 ceramist	03 ceramists and glass manufacturers [10–11]	
11 glass manufacturer		
12 chemistry related occupations	04 chemistry and plastics related occ. [12–13]	
13 plastics related occupations		
14 paper manufacturer and processor	05 paper and print related occ. [14–15]	
15 printer		
16 wood machining occupations	06 wood occupations [16;46]	
17 metallurgical and semi-finished goods occupations	07 metal extractors and manufacturers [17–22]	
18 foundry related occupations		
19 non-cutting metal former		
20 cutting metal former		
21 metal refining occupations		
22 metal welding and soldering occupations		
23 metal and plant manufacturer	08 plant operators, installer [23–24]	
24 metal sheet constructor, installer		
25 mechanical engineer	09 mechanical engineers and precision mechanics [25–28]	
26 vehicle manufacturer		
27 toolmaking and mould making occupations		
28 precision mechanic		
29 electric and electronic technician	10 electric and electronic technician [29]	
30 assembler	11 assembler [30]	
31 spinner	12 textile and leather occ. [31–35]	
32 textile manufacturer		
33 textile processor		
34 textile finisher		
35 tanner, dyer, leather processor		
36 baker, pastry cook	13 food related occ. [36–40]	
37 butcher		
38 cook		
39 beverage manufacturer		
40 food producer		
41 building constructor	14 building [41–45;47]	
42 civil engineer		
43 construction labourer		
44 construction finisher		
45 interior decorator, upholsterer		
46 wood, plastics processing occupations	06 wood occupations [16;46]	

(Table 3.2 continued)

88 occupations	34 occupations	13 occupations
47 painter, varnisher	14 building [41–45;47]	
48 product tester, shipping packer	15 product tester, shipping packer [48]	
49 unskilled labourer	16 unskilled labourer [49]	
50 machine and plant operator	17 machine operators [50–51]	
51 machine setter		
52 engineer	18 engineers, natural scientists [52–53]	02 technical occupations [52;54–57]
53 chemist, physicist, mathematician		03 scientists [53;80]
54 technician	19 technicians [54–56]	02 technical occupations [52;54–57]
55 special technician		
56 engineering draftsman		
57 master craftsman	20 master craftsmen [57]	
58 sales force	21 salesmen [58–60;62]	04 salesmen, commercial and financial professionals [58–62]
59 trained wholesale, retail salesman; purchase, sale specialist		
60 sales representative		
61 banking, insurance specialist	22 banking, insurance specialist [61]	
62 other sales service occupations	21 salesmen [58–60;62]	
63 surface transport related occupations	23 transport related occ. [63–66]	05 transport related occupations [63–66]
64 waterborne and air transport		
65 telecommunication occupations		
66 stock and transport workers		
67 business management, consulting and controlling occupations	24 managers, senior officials [67–68]	06 managers, senior officials [67–68]
68 political representatives, senior officials		
69 accountant, information technology officer	25 accountant, information technology officer [69]	07 administrative and office occupations [69–70]
70 office clerks	26 office clerks [70]	
71 security guard	27 security occupations [71–72]	08 legal and security related occupations [71–73]
72 other security related occupations		
73 lawyer, executory officer	28 lawyer, executory officer [73]	
74 authors, journalists and linguists	29 artists, journalists [74–75]	09 artists, journalists [74–75]
75 artist		
76 medical doctors, pharmacists	30 health occupations [76–77]	10 health occupations [76–77]
77 other healthcare occupations		
78 social care, welfare occupations	31 teacher, social care occ. [78–79;81]	11 teacher, social care occ. [78–79;81]
79 teacher		
80 humanities, natural science occupations	32 humanities, natural science occ. [80]	03 scientists [53;80]
81 religious professionals	31 teacher, social care occ. [78–79;81]	11 teacher, social care occ. [78–79;81]
82 body care occupations	33 personal service occ. [82–85]	12 personal service occ. [82–85]
83 hotel and restaurant business occupations		
84 housekeeper, food processor		
85 cleaning and waste disposal occupations		
86 family members as helpers (agriculture excluded)	34 workers without specified occupation [86–88]	13 workers without specified occupation [86–88]
87 with not (yet) determined occupation		
88 without specified occupation		

Source: Economix

3.3 Classification of 44 sectors

No.	Code (VGR classification of sectors 2008)	Name (44 sectors)
1	01–03	agriculture, forestry, fishing and aquaculture
2	05–09	mining, extraction of rock and ores
3	10–12	food and beverages
4	13–15	textiles, wearing apparel, leather products
5	16	wood, cork, straw
6	17,18	paper products and printing
7	19–21	refined petroleum, chemical, pharmaceutical products
8	22–23	rubber, plastic, glass, ceramic products
9	24–25	metal production and metal working
10	26–27	electrical equipment, electronic and optical products
11	28	mechanical engineering
12	29–30	vehicle manufacturing
13	31–33	furniture, other manufacturing, repair
14	35	energy supply
15	36–39	water supply, waste management services
16	41–43	construction
17	46	wholesale trade
18	45,47	retail trade
19	49–52	transport, warehousing
20	53	postal and courier activities
21	55–56	accommodation, hotels and restaurants
22	58–60	publishing, motion picture, broadcasting
23	61	telecommunications
24	62–63	IT, information services
25	64–66	financial services, insurance, financial intermediaries
26	68	real estate
27	69–70	accounting, management consulting
28	71	architecture, engineering; technical testing and analysis
29	72	research and development
30	73–75	other scientific and technical services
31	77	renting and leasing of goods
32	78	employment agencies
33	79	travel agencies, tour operators, reservation services
34	80–82	other business service providers
35	84 ,99	public administration; social security
36	85	education
37	86	healthcare
38	88,87	social work, nursing homes
39	90,91,92	arts, culture, gambling and betting
40	93	sports, entertainment, recreation
41	94	interest groups
42	95	repair of consumer goods
43	96	other personal services
44	97,98	personal domestic services

Source: Economix, Federal Statistical Office: Wirtschaftszweige der VGR 2008 (national accounts classification of sectors 2008)

3.4 Aggregation of 44 sectors

44 sectors	34 sectors	10 sectors
01 agriculture, forestry, fishing and aquaculture	01 agriculture, forestry, fishing and aquaculture [1]	01 agriculture, forestry, fishing and aquaculture [1]
02 mining, extraction of rock and ores	02 basic industry [2;6–9]	02 energy, water and recycling [2;14;15]
03 food and beverages	03 consumer industry [3–5;13]	03 manufacturing [3–13]
04 textiles, wearing apparel, leather products		
05 wood, cork, straw		
06 paper products and printing	02 basic industry [2;6–9]	
07 refined petroleum, chemical, pharmaceutical products		
08 rubber, plastic, glass, ceramic products		
09 metal production and metal working		
10 electrical equipment, electronic and optical products	04 capital goods industry [10–12]	
11 mechanical engineering		
12 vehicle manufacturing		
13 furniture, other manufacturing, repair	03 consumer industry [3–5;13]	
14 energy supply	05 energy and water supply [14,15]	02 energy, water and recycling [2;14;15]
15 water supply, waste management services		
16 construction	06 construction [16]	04 construction [16]
17 wholesale trade	07 wholesale trade [17]	05 trade and transport [17–20;23]
18 retail trade	08 retail trade [18]	
19 transport, warehousing	09 transport, warehousing [19]	
20 postal and courier activities	10 postal and courier activities [20]	
21 accommodation, hotels and restaurants	11 accommodation, hotels and restaurants [21]	08 personal services [21;22;26;33;39;40;42–44]
22 publishing, motion picture, broadcasting	12 publishing, motion picture, broadcasting [22]	
23 telecommunications	13 telecommunications [23]	05 trade and transport [17–20;23]
24 IT, information services	14 IT, information services [24]	07 business services [24;27–30;32;34;41]
25 financial services, insurance, financial intermediaries	15 financial services, insurance, financial intermediaries [25]	06 financial services [25;31]
26 real estate	16 real estate [26]	08 personal services [21;22;26;33;39;40;42–44]
27 accounting, management consulting	17 accounting, management consulting [27]	07 business services [24;27–30;32;34;41]
28 architecture, engineering; technical testing and analysis	18 architecture, engineering; technical testing and analysis [28]	
29 research and development	19 research and development [29]	
30 other scientific and technical services	20 other scientific and technical services [30]	
31 renting and leasing of goods	21 renting and leasing of goods [31]	06 financial services [25;31]

(Table 3.4 continued)

44 sectors	34 sectors	10 sectors
32 employment agencies	22 employment agencies [32]	07 business services [24;27–30;32;34;41]
33 travel agencies, tour operators, reservation services	23 travel agencies, tour operators, reservation services [33]	08 personal services [21;22;26;33;39;40;42–44]
34 other business service providers	24 other business service providers [34]	07 business services [24;27–30;32;34;41]
35 public administration; social security	25 public administration; social security [35]	09 public administration; social security [35]
36 education	26 education [36]	10 social services [36–38]
37 healthcare	27 healthcare [37]	
38 social work, nursing homes	28 social work, nursing homes [38]	
39 arts, culture, gambling and betting	29 arts, culture, gambling and betting [39]	08 personal services [21;22;26;33;39;40;42–44]
40 sports, entertainment, recreation	30 sports, entertainment, recreation [40]	
41 interest groups	31 interest groups [41]	07 business services [24;27–30;32;34;41]
42 repair of consumer goods	32 repair of computers, personal and household goods [42]	08 personal services [21;22;26;33;39;40;42–44]
43 other personal services	33 other personal services [43]	
44 personal domestic services	34 personal domestic services [44]	

Source: Economix

3.5 Classification of 29 formal training categories

No.	University programme code (Federal Statistical Office)	Name (29 formal training categories)
1	1–24, 25, 83, 96	humanities and cultural studies, sports
2	26–38, 68, 71, 80, 81, 84–86, 91, 92	law, economics and social sciences
3	39–47	mathematics, natural sciences*
4	48–49, 50, 89, 90	human medicine, veterinary medicine
5	51–55, 88, 93, 94	agricultural science, forestry and nutrition science
6	56–67, 69, 70, 87	engineering sciences*
7	72–77, 82	arts, art sciences
8	98, 78, 79, 95	other
9	99	not stated
No.	**Formal qualification law/crafts code**	
10	1–6	farming, animal breeding, fishing
11	7–18	industrial and craft manufacturing occ.
12	19–30, 32	metal working occ.
13	31, 33–37, 39–43, 53, 54	other manufacturing occ.
14	44–51	construction occ.
15	60–65	technical occ.*
16	52, 66–70, 71–74	salesmen and service occ., shipping and transport related occ.
* = MINT- qualifications		

(Table 3.5 continued)

No.	University programme code (Federal Statistical Office)	Name (29 formal training categories)
17	75–78	organisation, administration and office occ.
18	79–83	private service occ.
19	84–89	healthcare and social occ.
20	90–93	body care, guest relation, domestic and cleaning occ.
21	97–99	other occ.
No.	**Fields of vocational education/ university degree code 2003 ("Mikrozensus")**	
22	56–67, 69, 70, 87, 51–55, 88, 93, 94	engineering occ.*
23	26–38. 68, 71, 80, 81, 84–86	commercial occ.
24	39–47	IT specialists, mathematicians, natural scientific occ.*
25	72–77, 82	creative-artistic occ.
26	1–24, 25, 48–50, 83, 89–92, 96	education related and nursing occ.
27	98, 78, 89, 95	other occ.
28	99	not stated
29		without any qualification
* = MINT- qualifications		

Source: Economix, Federal Statistical Office: Studierende an Hochschulen – Fächersystematik 2011 (Classification of university programs 2011), Berufsbildungsgesetz (German formal qualification law), Handwerksordnung (German crafts code), Federal Statistical Office: Hauptfachrichtung des beruflichen Ausbildungs- bzw. Hochschul-/ Fachhochschulabschlusses 2003 (Fields of vocational education resp. fields of university/university of applied science degrees)

3.6 Aggregation of 29 formal training categories

29 formal training categories	3 formal training categories
01 humanities and cultural studies, sports	tertiary training [01–09]
02 law, economics and social sciences	
03 mathematics, natural sciences*	
04 human medicine, veterinary medicine	
05 agricultural science, forestry and nutrition science	
06 engineering sciences*	
07 arts, art sciences	
08 other	
09 not stated	
10 farming, animal breeding, fishing	dual training [10–21]
11 industrial and craft manufacturing occ.	
12 metal working occ.	
13 other manufacturing occ.	
14 construction occ.	
15 technical occ.*	
16 salesmen and service occ., shipping and transport related occ.	
17 organisation, administration and office occ.	
* = MINT-qualifications	

(Table 3.6 continued)

29 formal training categories	3 formal training categories
18 private service occ.	
19 healthcare and social occ.	
20 body care, guest relation, domestic and cleaning occ.	
21 other occ.	
22 engineering occ.*	technical college [22–28]
23 commercial occ.	
24 IT specialists, mathematicians, natural scientific occ.*	
25 creative-artistic occ.	
26 education related and nursing occ.	
27 other occ.	
28 not stated	
29 without any qualification, not stated	without any qualification, not stated [29]
* = MINT-qualifications	

Source: Economix

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Abbreviations

GDP	Gross domestic product
BMAS	German Ministry for Labour and Social Affairs (Bundesministerium für Arbeit und Soziales)
CE	Cambridge Econometrics
ERC	Economix Research & Consulting
IAO	Fraunhofer-Institut für Arbeitswirtschaft und Organisation Stuttgart
IER	Warwick Institute for Employment Research
ISF	Institut für Sozialwissenschaftliche Forschung e. V. München
MINT-Qualification	Formal qualification in mathematics, natural science, informatics and technical science
ROA	Research Centre for Education and the Labour Market Maastricht
NA	National accounts