Labour market forecasts by education and occupation up to 2022

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Content

1 ROA labour market forecasts

As part of the Education and Labour Market Project (POA)[1], the Research Centre for Education and the Labour Market (ROA) develops a number of research activities aimed at a better understanding of the medium-term developments in supply and demand on the Dutch labour market. These activities include analyses of the match between skills supply and demand, the development of labour market indicators for the current equilibrium between supply and demand, and labour market forecasts of supply and demand by industry, occupation, education, and region. The indicators for the current state of the labour market as well as the medium-term forecasts are gathered in an online database: the Labour Market Information System (AIS).[2] This database is updated on a yearly basis. The POA project was initiated by ROA in 1986 to increase the transparency of the labour market for youngsters in order for them to make better informed decisions on their education. The project is funded by the Ministry of Education, Culture and Science (OCW), the Ministry of Economic Affairs and Climate Policy (EZK), the Ministry of Interior and Kingdom Relations (BZK), the Ministry of Social Affairs and Employment (SZW), the Employee Insurance Agency (UWV), the Cooperation Organisation for Vocational Education, Training and the Labour Market (SBB), and employment agency Randstad Netherlands.[3]

This report describes the main features of the POA forecasting model (Chapter 2), and briefly discusses the findings from the most recent forecast for the Dutch labour market until 2022 by occupational groups and types of education (Chapter 3). Finally, the relevance of labour market information and labour market forecasts for stakeholders in the labour market is discussed (Chapter 4).

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1. http://roa.sbe.maastrichtuniversity.nl/?portfolio=poa-project-onderwijs-arbeidsmarkt-2
2. See http://roastatistics.maastrichtuniversity.nl/
3. The financing from the Ministries falls within the Coordination of Nationaal Regieorgaan Onderwijsonderzoek (NRO; file number 405-17-900).

2   The forecasting model

2.1 Model design

For its medium-term, six-year period, labour market forecasts ROA uses a flow-based approach of labour force flows to and from the labour market. The most recent forecasts until 2022 are based on labour market developments by economic sector, occupational group, and type of education between 1996 and 2016. The forecasting model itself is based on (explanatory) econometric models developed by ROA. The most important data inputs of the model include: 1) the Labour Force Survey (LFS) provided by Statistics Netherlands (CBS), 2) employment forecasts by industry sectors (by Panteia), 3) baseline forecasts from the Ministry of Education, Culture and Science (OCW) for the inflow of students in the labour market, and 4) data from ROA's School Leaver Information System (SIS).

The key advantage of this approach is that the most important processes that determine the development of supply and demand in the labour market are assessed. The ROA forecasts allow for the dynamic interplay between submarkets because the labour market is considered in its entirety.[4] As the method includes substitution between different labour market segments, it is arguably superior to a partial equilibrium analysis that solely examines labour market developments from a purely sectoral perspective.[5]

Forecasts are generated for a total of 113 occupational groups and 90 types of education, and span the entire labour market. The forecasts are also computed for 35 Dutch labour market regions on higher education aggregates due to data constraints. The forecasts in this report, as well as the other labour market data, are usually reported for an aggregate of 12 occupational classes and 22 education categories. The fully detailed forecasts are available online: http://roastatistics.maastrichtuniversity.nl/. In line with the ILO-definition of employment, the forecasting model counts all persons between the age of 15 and 74 at work for at least 1 hour per week.[6]

Figure 1 provides an overview of the forecasting model.[7] The goal of the model is to derive indicators of friction (dashed lines) from the estimates of the future demand for labour and the expected supply of labour.

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4.   CPB (2013), *Economische analyse van korte en lange termijn knelpunten op de arbeidsmarkt*, Den Haag: CPB Notitie, 31 mei 2013.
5.   Partial forecasts can be complementary because they can satisfy the need for information on specific markets. However, they do not take into account the dynamic interplay between submarkets.
6.   Bijlsma, I. S. Dijksman, D. Fouarge, A. Künn-Nelen & D. Poulissen (2015), *Veranderingen in de omvang en samenstelling van de beroepsbevolking als gevolg van de overstap op de ILO-definitie van de beroepsbevolking*, Maastricht: ROA-TR-2015/6.
7.   De methodology that was used for the forecasts will be published early 2018. The details of the methodology used in the previous edition can be found at: ROA (2016), *Methodiek arbeidsmarktprognoses en –indicatoren 2015-2020*, Universiteit Maastricht: ROA-TR-2016/4.

Demand for labour

Expansion demand is an important flow variable on the demand side of the labour market. It represents the expected employment creation in a certain occupational group or type of education. In case of job destruction this expansion demand can be negative. To compute the expansion demand by occupation and education, the model uses macroeconomic data on the expected employment growth at the level of 21 industry sectors. This data is based on estimates of the economic growth, employment, and participation rates from the Netherlands Bureau of Economic Policy Analysis (CPB). More specifically, for the most recent labour market forecasts, estimates from the CPB's Central Economic Plan (CEP) of 2017 are used.[8] The expected annual economic growth rates used for the years 2017 and 2018 are 2.1% and 1.8%, respectively. All subsequent years are assumed to have a structural growth of 1.7%.[9]

During the estimation stage of the project, two developments occurred which are likely to impact the actual demand for labour in the estimation period. First, at the end of September 2017 it was announced that an additional 2.1 billion in public funds will be invested in nursing and care homes by the next government.[10] The CPB computed that this investment will result in the creation of 40,000 full-time jobs (mainly in nursing and care). We have integrated the impact of this investment in the demand forecasts by increasing the demand for nursing and care occupations with an additional 54,000 jobs (40,000 full-time jobs multiplied by a part-time factor of 1.35 for the healthcare sector according to the AIS). This extra employment is distributed over the relevant occupational groups proportionally to the prior expansion demand in these occupations (by occupation: nurses (secondary vocational education/mbo), caretakers and specialised nurses; by education: secondary vocational training level 3 and 4 healthcare, and higher vocational training nursing and medical diagnostics).

Second, at the end of the estimation stage of the project, the new Dutch government formation following the 2017 elections was finished. Following the announced government budgets, the CPB published updated outlooks that incorporated the effects of the Coalition Agreement of Rutte III.[11] The updated short-term growth prospects are more favourable; a 3.3% growth in 2017, and 2.5% in 2018. This is also the case for the medium-term forecasts; on average 2% growth per year during the period 2018-2021. These new outlooks are not incorporate in the ROA-forecasts. However, we expect the consequences of this to be relatively small. The updated economic growth outlook expects an employment growth rate of 1% during the period 2018-2021, which is also the annual employment growth rate that is assumed in this report due to the aforementioned growth adjustment in the healthcare sector.

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8. CPB (2017), *Central Economic Plan 2017*, Den Haag.
9. The forecasts discussed in Chapter 3 do not take into account possible substantial changes in government spending that could be initiated by the Dutch government that was formed in the fall of 2017. An update of the forecasts will be published in 2018.
10. https://www.nrc.nl/nieuws/2017/09/23/geef-21-miljard-euro-maar-eens-netjes-uit-13097319-a1574518
11. CPB (2018), *Macro Economic Outlook (MEV) 2018*, Den Haag; CPB (2018), *Actualisatie middellangetermijnverkenning 2018-2021* (verwerking Regeerakkoord), Den Haag.

Figure 1
Schematic overview of the forecasting model
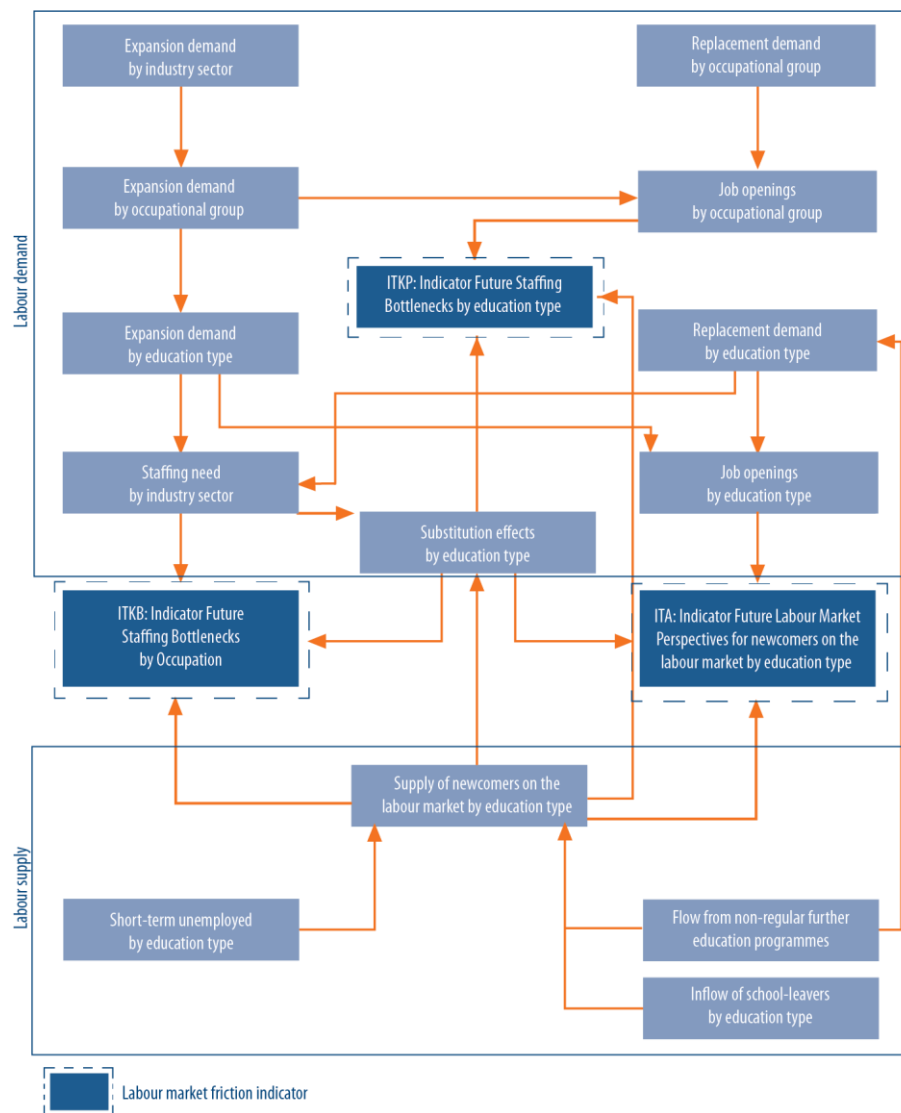
Expansion and substitution demand

The macroeconomic estimates of the CPB are differentiated for 21 industry sectors.[12] The forecasts pertain to the number of workers and jobs, as well as to the added value and capital investments by sector. These are used in the ROA models to estimate the expansion demand by occupation. In order to differentiate the estimates

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12. The sectoral delineation we use is based on the classification of the European Union (Nomenclature statistique des activités économiques dans la Communauté Européenne, NACE). The differentiation by industry sector was computed by research company Panteia.

by sector, a PRISMA-M distribution model is used which accounts for intersectoral relationships. The estimates also distinguish between SMEs and large corporations, and are predominantly based on the macroeconomic framework of CPB.[13] Furthermore, these projections are harmonised and made compatible with the sector forecasts of the Employee Insurance Agency (UWV) so as to ensure a high degree of consistency and comparability between ROA and UWV data.[14]

Starting from the projected expansion demand in the various industry sectors, the expected shifts in the occupational structure within these sectors are predicted first.[15] The possibility that certain occupational groups could grow faster than others, for example, as a result of technological change or an increasing internationalisation of certain sectors, is accounted for. Apart from the shifts in the size and structure of employment in the last 20 years, a number of additional explanatory variables (such as value-added and investment) are included in the so-called 'occupation model' of expansion demand in order to forecast the expansion demand by occupation.[16]

Next, the implications are determined of the predicted growth of the various occupational groups for the expansion demand by education type. This process explicitly takes into account shifts in the educational composition within occupational groups.[17] The expansion demand by education type refers to the number of employees with a specific educational background that employers would like to hire in order to increase their output. However, the actual growth in the number of workers per education type will usually deviate from the predicted growth due to the interaction between the demand and the supply side of the labour market and, subsequently, the resulting substitution processes: if the current supply of specific education degrees falls short of employers' demand, employers will seek to fill their vacancies by hiring persons with a related degree. These substitution processes are explicitly modelled.[18] The employment projections by occupation and education make intensive use of the LFS of Statistic Netherlands (years 1996-2016).

Replacement demand and job openings

The labour market is also characterized by replacement demand resulting from, for example, (early) retirement, outflow due to disability, temporary withdrawal from the labour market and occupation mobility. In order to determine the replacement requirement, the labour force outflow is calculated using expected participation rates across different age cohorts. These are based on the most recent CPB-forecasts of

13. T. Kwaak (2006), *PRISMA-M: een bedrijfstakkenmodel voor de middellange termijn*, Zoetermeer: EIM.
14. UWV (2017), UWV Arbeidsmarktprognose 2017-2018: https://www.uwv.nl/overuwv/Images/uwv-arbeidsmarktprognose-2017-2018.pdf
15. This is done by using allocation matrices of occupation by industry sector for the period 1996-2016.
16. F. Cörvers & A. Dupuy (2010), Estimating employment dynamics across occupations and sectors of industry, *Journal of Macroeconomics*, 32: 17-27.
17. A. Dupuy (2006), *Measuring Skill-upgrading in the Dutch Labor Market*, ROA-W-2006/3E, Maastricht: ROA.
18. F. Cörvers & H. Heijke (2004), *Forecasting the labour market by occupation and education: Some key issues*, ROA-W-2004/4, Maastricht: ROA.

the gross participation rate by age, gender and education level.[19] The forecasting model also incorporates skills-upgrading into the replacement demand.[20] This upgrading process is estimated from the data. However, when the outflow of a worker in a certain occupation with a certain educational background does not actually lead to demand for another worker, no replacement demand occurs. This will be the case when employment is shrinking. Thus, only part of the labour market outflow actually creates replacement demand.

The replacement demand is computed separately for occupational groups and education types. These are not necessarily equal. The mobility between occupational groups influences the replacement demand per occupational group, but has no effect on the replacement demand per education type because the mobility between occupational groups has no direct consequences for the educational structure of employment, although they can overlap. Conversely, completing further education leads to inflow into another (usually higher) education type, and outflow out of the old one. Replacement demand will then be generated for the old education type, though it will not affect the occupational structure.

Estimates of the outflow patterns by occupation and education are based on the LFS, of which only data for the most recent 10 years are used. In case of an employment increase, the expansion and replacement demand determine the number of job openings for new entrants to the labour market. In case of a decline in employment, new job openings only consist of replacement demand.

Supply of labour

The mid-term equilibrium in the labour market is determined by the total demand for labour, and the supply of labour. The labour supply consists of the future labour force inflow of school-leavers and of workers who switch between education types because they complete additional or further education programmes during the forecasting period. The labour supply also includes the short-term and frictional unemployed at the start of the forecasting period. Based on available evidence, the assumption is made that the long-term unemployed (defined as those who have been looking for a job for longer than one year) are no longer serious competitors for school-leavers.[21]

The inflow projections for school-leavers are based on the 2017 baseline forecasts of the Ministry of Education, Culture and Science (OCW).[22] These are forecasts for the expected inflow of workers from the initial education system into the labour market by

19. Euwals, R., M. de Graaf-Zijl & A. den Ouden (2014), *Arbeidsaanbod tot 2060*, Den Haag: CPB Achtergronddocument, 3 juli 2014.
20. For a justification, see chapter 4 in ROA (2015), *De arbeidsmarkt naar opleiding en beroep tot 2020*, Maastricht: ROA-R-2015/6.
21. The CPB concludes that the unemployment duration is negatively correlated with the relevance of the group for determining the labour market equilibrium (M. de Graaf-Zijl, A. van der Horst & D. van Vuuren, 2015, *Langdurige werkloosheid. Afwachten en hervormen.* CPB Policy Brief 2015/11).
22. https://www.rijksoverheid.nl/documenten/rapporten/2017/09/19/referentieraming-2017

broad fields of study. These are refined and supplemented by ROA with projections of the inflow into the post-initial education system on the basis of administrative data (Education Matrix), the LFS of Statistic Netherlands, and ROA's School-leavers Information System (SIS).

2.2 Labour market friction indicators

Friction indicator for new inflow into the labour market

The expected labour supply is confronted with the expected labour demand for each type of education to quantify the future labour market perspectives of the prospective labour force. The resulting *Indicator Future Labour Market Perspectives* (ITA) is the ratio of the labour supply and labour demand, and it denotes the expected discrepancy between supply and demand for each type of education for the next six years. If the labour supply is smaller than or equal to the labour demand, the ITA is smaller than or equal to 1.00 and the labour market prospect is classified as 'good'. If the value of the ITA is smaller than or equal to 0.85, the labour market perspective is classified as 'very good'.[23] When the ITA has a value between 1.00 and 1.05 – and the excess supply is not much larger than what can arguably be regarded as friction – the labour market prospect is 'fair'. Larger values of the ITA correspond with a 'poor' labour market prospect, and a value greater than 1.15 is regarded as 'bad'.[24]

It is critical to correctly interpret this friction indicator. Oversupply of labour with a specific educational background does not necessarily mean that graduates will become unemployed, and an undersupply does not automatically imply there will be unfilled job vacancies. This is because such conditions could prompt employers to modify their job requirements so that they might ultimately hire people with a different educational background than the ones they initially seek to hire. School-leavers for which supply exceeds demand will see their labour market position deteriorate, as they will more often be forced to work below their level of education or outside their field of study, and will more frequently have to settle for lower wages and/or part-time positions when they would rather work full-time.[25] Conversely, a situation of undersupply will likely improve labour market perspectives of the new labour force inflow since they will experience less pressure to accept lower wages or jobs below

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23. The boundaries of the ITA are based on a statistical analysis of the spread of the labour market condition of the different types of education. See M. Wieling, A. de Grip en E. Willems (1990), *Een systematische kwalitatieve typering van arbeidsmarktinformatie*, ROA-W-1990/8, Maastricht: ROA. For an analysis of the significance of the ITA, see also A. Dupuy (2009), *An evaluation of the forecast of the indicator of the labour market gap*, ROA-TR-2009/3, Maastricht: ROA.
24. ROA frequently evaluates the quality of its forecasts. With regards to replacement demand, see for example R. Montizaan (2009), *Evaluatie vervangingsvraagprognoses naar opleiding en beroep*, ROA-TR-2009/1, Maastricht: ROA. This evaluation shows that the previous forecasts were able to correctly predict the ITA-characterization (out of five options) for over 40% of the education types, while for approximately 80% of the education types a correct or neighbouring characterization was given. See A. Dupuy (2009), *An evaluation of the forecast of the indicator of the labour market gap*, ROA-TR-2009/3, Maastricht: ROA; D. Bertrand-Cloodt (2010), *Evaluatie uitbreidingsvraag en indicator toekomstig arbeidsmarktperspectief (ITA) tot 2008*, ROA-TR-2010/6, Maastricht: ROA.
25. M. Wieling & L. Borghans (2001), Discrepancies between supply and demand and adjustment processes in the labour market, *Labour*, 15: 33-56.

their level of education. On the one hand, graduates from educational programmes that are displaced by those with an excess-supply will face a smaller number of job openings as a result of substitution. On the other hand, additional job openings will likely be created for graduates from educational programmes that are closely related to those that are in undersupply. In case of frictions, these substitution effects are therefore especially important for the labour market prospects of graduates from these educational programmes.

Friction indicator for employers

The confrontation of supply and demand for each type of education also gives an indication of potential future bottlenecks in staffing. In case of employment growth, the required number of additional workers needed with a specific educational background is equal to the sum of the expansion and replacement demand. When the employment for the education type is shrinking, however, the required number of additional workers is computed in a different way than the number of job openings for new entrants on the labour market. This is because, from the viewpoint of employers, there is a possibility to cut the outflow of existing personnel (negative expansion demand per education type) when bottlenecks appear. Employers will mainly use this option when they are confronted with a tight labour market for workers with a certain type of education. An indication of the expected staffing difficulties for employers is given by the *Indicator Future Staffing Bottlenecks* (ITKP).

Labour market friction by occupation

The central focus of this report is the relationship between educational attainment and work in the labour market, i.e., the matching of employers' demand for workers with specific educational backgrounds and the supply of workers with these backgrounds. In addition to friction indicators by type of education, insight is provided into the implications of the supply and demand ratios for the potential staffing bottlenecks by occupational group. The *Indicator Future Staffing Bottlenecks by Occupation* (ITKB) reflects this expected labour market friction by occupation. More specifically, it represents the chance that the desired educational composition of the personnel structure within a certain occupational group in the labour market can actually be realised given the predicted supply and demand dynamics of the underlying education types. The ITKB takes into account the expected supply of student labour, which is relevant in the Dutch economy as many youngsters hold a small part-time job.[26] Failure to take this into account would overestimate staffing bottlenecks in occupations that employ a lot of students and have a high degree of staff rotation (such as, for example, shelf stackers).

Information on the staffing bottlenecks by occupational group can be relevant for a variety of stakeholders. Firstly, an understanding of these bottlenecks informs the

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26. CBS (2017). Ruim vier op de tien scholieren werken. https://www.cbs.nl/nl-nl/nieuws/2017/13/ruim-vier-op-de-tien-scholieren-werken; I. Bijlsma, S. Dijksman, D. Fouarge, A. Künn-Nelen & D. Poulissen (2015), *Veranderingen in de omvang en samenstelling van de beroepsbevolking als gevolg van de overstap op de ILO-definitie van de beroepsbevolking*, Maastricht: ROA-TR-2015/6.

recruitment and personnel departments of employers. Secondly, it can guide (long-term) unemployed people who are looking for a job or a different type of work environment towards opportunities in the labour market. Closely related to this last use are the (re-)training programmes that usually focus on a certain occupational group. Insight into the staffing bottlenecks by occupation could inform the way in which these training programmes are set up.

The total expected demand during the forecasting period for a certain occupation is related to the way in which employers would like to structure their labour demand for a specific occupation by educational background, as well as to the supply and demand ratios for the types of education that are relevant to that occupation. This gives an indication of the difficulties employers will face during their hiring process. When a certain occupation requires skills and expertise primarily possessed by people with educational backgrounds that are expected to suffer from substantial shortages, employers will face challenges in finding personnel that meets their job requirements. These bottlenecks will be especially pronounced when the required professional expertise is very specific and lacks available alternatives. Conversely, when the required competencies are more general, employers can usually hire people with a different educational background as there is more room for substitution.

2.3 Classification of occupations and education programmes

As mentioned, the LFS is an important data source for the ROA-forecasts because it is the only extensive dataset in the Netherlands that measures both the occupation and educational background of workers, and has a long time dimension. Statistics Netherlands redesigned the LFS in 2013. This involved a different measurement and recoding of occupations (towards the ISCO-08 classification) and educational backgrounds (towards the ISCED-1997 classification). Together with Statistics Netherlands, ROA has derived an occupational classification from the 4-digit ISCO-08 that is relevant to the Dutch labour market.[27] This classification distinguishes 113 occupational groups that can be aggregated into 12 occupational classes (groups of occupations in a similar domain).[28]

In addition, ROA has derived an educational classification from the ISCED-1997.[29] The educational classification distinguishes between 90 types of education programmes across all fields and levels. They can be aggregated into 22 educational categories.[30]

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27. ROA/CBS (2015), *Beroepenindeling ROA-CBS 2014 (BRC 2014)*, Maastricht: ROA-TR-2015/5.
28. To be precise, the forecasting model contains 114 occupational groups. This includes the category 'other occupations', occupations that are unknown, or could net be coded by CBS. Including other occupations, they group into 13 occupational classes.
29. ROA (2016), *ROA opleidingsindeling 2015*, Maastricht: ROA-TR-2016/3.
30. There are 96 education types distinguished. This includes the categories 'other types of education' for each level of education. These are educational backgrounds that are unknown or could net be coded by CBS. By including the categories 'other types of education' 29 education categories are obtained.

Important to note is that redesigning of the LFS has led to breaks in certain time series. By developing and testing alternative methods, ROA has made significant efforts to adequately integrate these structural breaks into the different parts of the forecasting model.

3 Forecasts by education and occupation

3.1 Future labour market prospects by education

The labour market prospects by education – captured by the *Indicator Future Labour Market Perspectives* (ITA) – are determined by the equilibrium between the supply of labour (short term unemployed and expected labour market inflow) and the demand for labour (expected job openings and substitution demand).[31] As mentioned, if supply and demand for a particular education are equal, the ITA has a value of 1. The labour market prospects are then considered good because there is someone with the appropriate degree for every job opening. If the demand for graduates with a certain educational background exceeds the supply, the ITA is smaller than 1 and the graduates are not expected to face many difficulties in finding a job. An education type with an ITA greater than 1 indicates that the supply of graduates exceeds the demand. This is indicative of relatively weak labour market prospects and larger difficulties for students to obtaining a job.

Table 1 shows the expected labour market prospects for youngsters who enter the labour market between 2017 and 2022 by level, and broad fields of education. More detailed forecasts, including the supply and demand components, are reported in the online AIS. A distinction is made between lower level secondary vocational education (mbo level 2 and 3), higher level secondary vocational education (mbo 4), higher vocational education (hbo) and university (wo). The table shows that, averaged over all educations levels and fields, the labour market prospects until 2022 are good. However, there are large differences between the various education types and education levels. In general, the labour market prospects of graduates become more favourable when their education level gets higher.

Secondary vocational education

The prospects of graduates with secondary vocational education (mbo) degrees are reasonable for the mbo 2/3 level and good for the mbo 4 level. Graduates with an mbo 2/3 level degree in construction and infrastructure, technical installation, and other technical fields have good prospects. In other fields, but especially economical fields, fewer graduates with an mbo 2/3 level degree are expected to face good labour market prospects. With the exception of media and design, and transport and logistics, all mbo 4 level graduates with a degree in technical studies have labour market prospects that are good or very good. As a result, 67% of graduates with an mbo 4 technical degree have (very) good labour market prospects. Moreover, the favourable forecasts for mbo technique are the result of both a large replacement demand and a higher than average expansion demand for most underlying education types.

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31. The estimates for supply and demand are reported and discussed in ROA (2017), *De arbeidsmarkt naar opleiding en beroep tot 2022*. Maastricht: ROA-R-2017/10.

Poor prospects are expected for mbo 2/3 graduates in health and welfare. The forecasts show that the expected inflow of graduates into the labour market exceeds the expected demand, but this is mostly true for fields such as hair dressers and beauticians or social care, but less so for healthcare where the oversupply of graduates in the labour market is small. For the mbo 4 graduates in the fields of healthcare and welfare, prospects are also weak. But again this masks a large variation at the more detailed level: prospects are good for healthcare fields but bad for social care fields.

Higher vocational education

There are also substantial differences between the labour market prospects for graduates from higher vocational education. Graduates from four out of the seven education categories at this education level are expected to have good prospects on the labour market. These are graduates with a degree in education, engineering, healthcare and agricultural and nature sciences. Three other categories have only weak prospects (language and culture, economics, and behavioural and social sciences).

Graduates with an hbo degree in engineering are expected to face a relatively large number of job openings as a result of a rather high replacement demand and low inflow of graduates. This translates into favourable prospects for all education types within this category, and even very good prospects for graduates of hbo mechanical engineering, chemistry, construction and civil engineering. Good prospects are also expected for graduates from hbo agricultural sciences within the category hbo agricultural and nature sciences, which is mainly due to the low inflow of graduates from these studies into the labour market.

The prospects for graduates with an hbo degree in language and culture studies are less favourable and are only good for hbo degrees in art, albeit the jobs for graduates from this field are often small and poorly paid.[32] Moreover, the graduates with an hbo degree in art more often work in jobs without favourable career prospects.[33] Graduates from hbo communication science and hbo journalism both experience a high inflow of graduates compared to the replacement and expansion demand. The ITAs for the education types comprising hbo economics are either weak or bad, and are only considered fair for hbo accountancy and finance. This is also the result of a relatively small demand for graduates with this degree compared to the considerable forecasted inflow of graduates. The same conclusion applies to hbo behavioural and social sciences.

The labour market prospects are good for all graduates with a degree in hbo healthcare, and this is true regardless of the underlying education type. The best

32. Allen, J., Belfi, B., Mommers, A. (2017), *Van startende kunstenaar tot gevorderde: de loopbaanontwikkelingen van kunstenaars in de eerste vijf jaren na afstuderen*, Maastricht: ROA-R-2017/6.
33. ROA (2017), *Schoolverlaters tussen onderwijs en arbeidsmarkt 2016*, Maastricht: ROA-R-2017/7.

outlook is predicted for hbo graduates of nursing and medical diagnostics, who will experience a relatively large replacement and expansion demand, as well as a labour market inflow that cannot keep up with this demand.

Table 1

Future labour market prospects by education (ITA) for school-leavers, and the share of supply with bad, weak, fair, and (very) good labour market prospects, 2017-2022

	ITA	Qualification labour market prospects	Labour market prospects by education type			
			Bad prospects (%)	Weak prospects (%)	Fair prospects (%)	(very) good prospects (%)
mbo 2/3 agriculture	1.14	weak	0	100	0	0
mbo 2/3 economics	1.12	weak	36.1	13.5	46.6	3.7
mbo 2/3 engineering	1.01	fair	0	14.6	36.7	48.7
mbo 2/3 care and welfare	1.10	weak	30.0	0	70.0	0
mbo 4 agriculture	0.99	good	0	0	0	100
mbo 4 economics	1.11	weak	21.8	75.1	3.1	0
mbo 4 engineering	0.97	good	9.8	22.9	0	67.3
mbo 4 care and welfare	1.08	weak	26.3	0	16.2	57.5
hbo education	0.90	good	0	0	0	100
hbo language and culture	1.08	weak	24.6	10.9	0	64.5
hbo economics	1.13	weak	41.2	49.3	9.6	0
hbo engineering	0.87	good	0	0	0	100
hbo agriculture and nature	1.00	good	0	0	63.0	37.0
hbo healthcare	0.97	good	0	0	0	100
hbo behavioural and social sciences	1.06	weak	0	30.8	69.2	0
wo education	0.99	good	0	0	0	100
wo language and culture	1.05	fair	21.7	0	78.3	0
wo economics and law	1.04	fair	9.1	13.2	39.5	38.2
wo engineering	0.85	very good	0	0	0	100
wo agriculture and nature	1.02	fair	0	0	68.8	31.2
wo medicine	0.96	good	0	41.0	0	59.0
wo behavioural and social sciences	0.96	good	0	0	0	100
Total (incl. other, bo, vmbo and havo/vwo)	0.99	good	9.9	13.6	29.5	47.0

* The education categories contain underlying education types. The percentages show the share of underlying education types, weighted by number of workers for which the labour market prospects are bad, weak, fair, and (very) good.
Source: ROA (AIS)

University graduates

The labour market prospects for graduates with a university degree (wo) are good, with the exception of graduates with degrees in language and culture, and economics and law. Good prospects are expected for all education types within science (technical fields), with computer science graduates even enjoying very good prospects as a result of substantial replacement and expansion demand combined with a limited inflow of computer scientists. Similar good prospects hold for graduates in architecture, civil engineering, mechanical engineering and electrical engineering.

Just like at the hbo-level, a strong replacement and expansion demand is expected for most graduates with a university degree in medical sciences, especially for graduates in (veterinary) medicine or dentistry. In general, (very) good labour market prospects are expected for 59% of medical science graduates. The prospects for graduates of behavioural and social sciences are good as a result of considerable replacement demand, although the jobs in question are more often part-time compared to other university graduates. Finally, the labour market outlook for university economic and law graduates is expected to be fair, as (very) good prospects are only estimated for approximately 38% of these graduates (mainly graduates in quantitative economics).

3.2 Future labour market prospects by occupation

The balance between supply and demand that determines the labour market outlook by education also determines the prospects by occupational group. When employers want to fill vacancies for a certain occupation, they are dependent on the available supply of graduates with an educational background that matches the required knowledge and expertise for that occupation. It is thus the expected supply of graduates that determines the extent to which employers will face difficulties in hiring suitable staff in the coming years. This implies that bottlenecks will pose more of a problem if they relate to occupations that require quite specific expertise. This is because employers are then unable to draw from the supply of graduates with closely related backgrounds as substitutes. The forecast model takes this into account.

The *Indicator Future Staffing Bottlenecks by Occupation* (ITKB) gives the probability that the demand for a certain occupational group can be met in terms of educational composition given the supply and demand ratios for the different education types.[34] Table 2 shows the ITKB for 12 occupational classes (that groups occupations in a similar field of expertise) for the period 2017-2022. The remaining columns display the share of the demand for which employers are expected to have (almost) no, some, or (very) large bottlenecks. These are based on the bottleneck qualifications of the occupational groups that constitute an occupational class. The table shows that we can expect large staffing bottlenecks for pedagogical, ICT, and technical occupations during the next six years. For the pedagogical occupations, (very) large

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34. The forecasts also account for the expected supply of students who are looking for a student job.

bottlenecks are expected for 70% of the total demand for workers, and this is true for almost all underlying occupational groups. Even more staffing difficulties are projected for ICT occupations, where 87% of the demand is expected to encounter (very) large bottlenecks, particularly with respect to software and application developers.

Table 2
Future Staffing Bottlenecks by Occupation (ITKB) for employers, and the share of demand with no, almost no, some and (very) large bottlenecks (by ITKB-qualification), 2017-2022

	ITKB	ITKB-qualification	Bottlenecks by occupational class*			
			None	Almost none	Some	(Very) large
Pedagogical occupations	0.838	large	7.5	23.0	0	69.5
Creative and linguistic occupations	0.872	some	0	12.1	12.0	75.8
Commercial occupations	0.923	none	20.6	64.7	14.7	0
Business and administrative occupations	0.898	almost none	18.7	25.2	28.2	27.9
Managers	0.864	large	0	16.9	27.4	55.8
Public order, security and judicial occupations	0.879	some	6.2	22.1	38.1	33.6
Technical occupations	0.839	large	4.4	6.0	23.7	65.9
ICT occupations	0.824	large	0	0	12.7	87.3
Agriculture occupations	0.940	none	52.6	47.4	0	0
Care and welfare occupations	0.876	some	19.8	22.5	20.8	36.8
Service occupations	0.930	none	76.8	18.5	0	4.6
Transport and logistics occupations	0.921	almost none	40.1	45.1	0	14.8
Total			21.0	25.4	16.5	37.1

* The occupational classes contain underlying occupational groups. The percentages show the share of the underlying occupational groups, weighted by number of workers, for which no, almost no, some, and (very) large bottlenecks are expected.
Source: ROA (AIS)

Significant staffing bottlenecks are also predicted for technical occupations, especially for electricians, (electrical and civil) engineers and architects. Despite the substantial growth in the expected inflow of technically schooled and ICT graduates, the employment prospects for technical occupations remain good. One explanation for this is that part of the inflow 'leaks' into other, non-technical occupations.[35] This is likely a result of the increasing demand for workers with a solid understanding of

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35. ROA (2017), *Schoolverlaters tussen onderwijs en arbeidsmarkt 2016,* Maastricht, ROA-R-2017/7.

technology and technique, and problem-solving abilities.[36] Another reason for the favourable outlook for technical occupations is that part of the technical education programmes could be considered less 'hard' and therefore less able to qualitatively match the demand of employers in the technical sector.

In contrast, (almost) no staffing bottlenecks are expected for commercial occupations, business and administrative occupations, agricultural occupations, service occupations, and transport and logistics occupations. Within the business and administrative occupations, bottlenecks are only predicted for workers with a university degree and not for vocational-educated workers (probably because vocational-educated workers mostly perform routine tasks that can be automated). Because all occupations in the agricultural sector are projected to shrink, none of them are expected to experience staffing bottlenecks until 2022.

Hardly any personnel bottlenecks are foreseen for creative and linguistic occupations. However, the relatively large replacement demand for artists, graphic designers, and product designers implies that some bottlenecks are to be expected for creative staff. For occupations such as photographers, interior designers, and journalists, employers are expected to find sufficient staff.

For public order, security and judicial occupations there is an expected shortfall in supply for 34% of the labour demand. However, this mostly concerns the highly-educated within these occupations (e.g., government officials and lawyers). Some staffing difficulties are also expected for care and welfare occupations. This is mostly driven by the high demand in healthcare occupations, for example for doctors, physiotherapists, and psychologists, but also, at the intermediate vocational education, for nursing occupations, large staffing bottlenecks are expected. This is not the case for social care occupations for which hardly any bottlenecks are expected.

Finally, approximately half of management recruiting is projected to face substantial staffing bottlenecks. Important to note here is that managers are spread across a very diverse group of professions and educational backgrounds. Part of the bottlenecks can be explained by the fact that a considerable percentage of managers work in sectors that are projected to experience significant staffing difficulties, such as education, ICT and healthcare.

3.3 Automation and bottlenecks

The scientific literature[37] and policy discussions[38] greatly emphasize the role of automation and robotization as an explanation for changes in the employment structure: jobs that mainly involve routine tasks (such as bank clerks and secretaries)

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36. Fouarge, D. (2017), *Veranderingen in werk en vaardigheden*, Oratie, Maastricht University.
37. Frey, C. & Osborne, M. (2017), The future of employment: how susceptible are jobs to computerisation?, *Technological Forecasting and Social Change*, 114, 254-280.
38. SER (2016), *Mens en technologie: Samen aan het werk*, SER: Den Haag.

come under pressure as a result of new technologies that can perform such tasks in a more costs effectively. The question is then to what extent the forecasting model adequately picks up this process. While the risk of automation of occupations is not explicitly part of the ROA forecasting model, we do find a negative correlation between the expansion demand in occupations and the automation risk in those occupations.[39] Figure 2 illustrates the relationship between the expected staffing bottlenecks by occupation and the automation risk. The size of the circles is proportional to the number of workers in each occupation. The figure clearly shows a negative relationship: the staffing bottlenecks by occupation become smaller when the risk of automation becomes greater. Furthermore, using the Dutch Skills Survey we find that there are more bottlenecks in occupations that require performing tasks with a higher degree of complexity.

Figure 2
Relationship between expected staffing bottlenecks and risk of automation by occupation
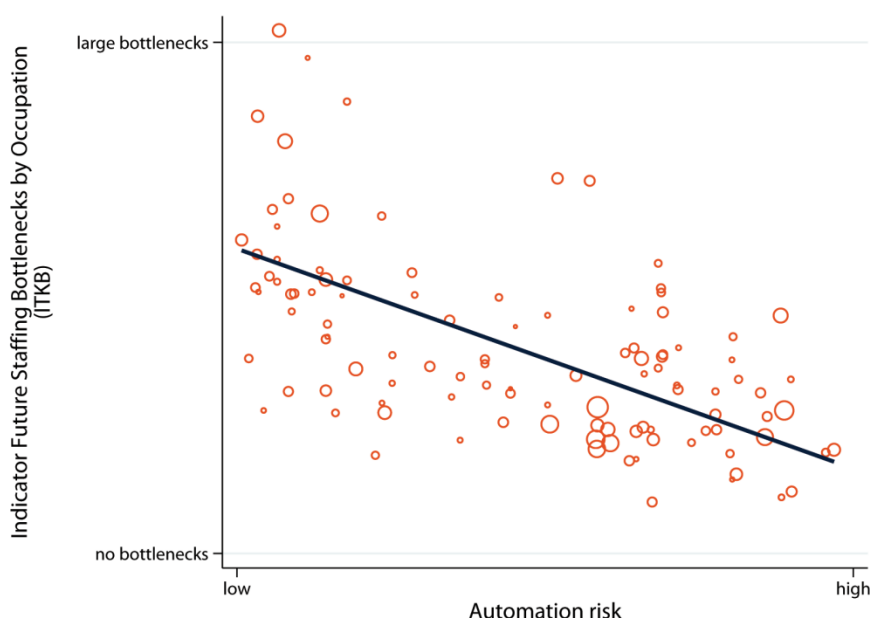
Source: ROA (AIS), Deloitte

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39. The automation risk we refer to is from: Deloitte (2014), *De impact van automatisering op de Nederlandse arbeidsmarkt. Een gedegen verkenning op basis van Data Analytics*, Deloitte.

4 Relevance of labour market information

4.1 Use of labour market information by stakeholders

The idea behind the labour market forecasts and the publication of these forecasts is that a more transparent labour market leads to better-informed choices. It is hard to define precisely what that means. However, at the micro level this could result in fewer graduates being unemployed or regretting their decision for a particular field of study. At the macro level it could result in an improved allocation of supply and demand.[40]

The labour market information developed as part of POA is relevant for numerous target groups. One important target group consist of youngsters and job seekers who are in the process of choosing an education or further education programme. The analyses in POA enables them to base their choice on the medium-term labour market prospects of various study programmes and occupations. A number of websites (www.studiekeuze123.nl) and information guides (www.keuzegids.org) help to bring this information to this target group. This informative role is further taken on by various independent organisations in the field of education, such as the Cooperation Organisation for Vocational Education, Training and the Labour Market (SBB) (www.kansopwerk.nl), which use data generated within POA in their dissemination of information. Research shows that youngsters benefit from transparent labour market information (see below).

Labour market forecasts are also relevant for employers, labour market mediators, and policy makers. Employers can, for instance, adapt their recruitment strategy or terms of employment as a result of a predicted imbalance between supply and demand, while labour market mediators and related organisations can use the information to adjust their integration and training programmes (organisations such as employment agency Randstad, and the Employee Insurance Agency (UWV) use the POA-forecasts in their mediation activities). Policy makers can use POA-forecasts to design policies to ensure that expected personnel shortages in, for example, the technical or education sector are reduced. Furthermore, since 2016, the Commissie Doelmatigheid Hoger Onderwijs (CDHO), which is responsible for the accreditation of new study programmes in higher education, uses the POA-forecasts in their efficacy evaluations to avoid that fields that are in excess-supply start up new education programmes.

Finally, the forecasts are meant to inform labour market policy in a broad sense. This can entail, for example, target group policies, measures aimed at increasing labour market participation, and measures specifically targeted at the bottom of the labour market. POA is therefore an important and relevant project that not only serves the public interest, but also informs the entire field of the education and the occupation

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40. Fouarge, D. (2017). Veranderingen in werk en vaardigheden. Oratie, Maastricht University.

spectrum.[41] The project also enjoys international recognition, and ROA frequently informs foreign delegations about the forecasting model and its applications.[42]

4.2 Labour market transparency and field-of-study choice

Many factors play a role in the educational and occupational choices of youngsters. For instance, preferences for specific fields or the expected match between academic aptitudes and the aptitudes required to fulfil a study programme matter.[43] These expectations themselves are a function of the social context (such as the influence of parents and friends) and earlier experiences.[44] Furthermore, according to the human capital theory, the choice for a particular education can be regarded in the same way as any other form of investment: a trade-off between the costs (time and money invested) and benefits (job and wage prospects) of an education.[45]

Evidently, the choice for a particular field of study is not always the result of a rational assessment by youngsters of what they believe they can achieve with it later on. Nevertheless, scientific literature typically finds that youngsters do react to information about the labour market prospects of educations, and that this influences their choice of study.[46] More specifically, the literature suggests that youngsters who receive such information: 1) have higher expectations regarding the benefits of education; 2) have more intention to stay in school; 3) more often follow further, additional education programmes; 4) opt for fields of education with favourable jobs and wage prospects. The literature, however, is rather scant, and the size of the effects of labour market information on the choice of study varies significantly across studies.

In a POA-related study of graduates of Dutch secondary vocational education (mbo) ROA finds that the labour market prospects of an education are clearly not the primary consideration of youngsters in their decision making process for a particular study. Instead, they give most weight to what they enjoy doing and what they are

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41. For an overview of the target groups and the use of POA, see: Fouarge, D. (2015), *Project Onderwijs-Arbeidsmarkt: Gebruik van arbeidsmarktinformatie en impact*, ROA, Maastricht: ROA-TR-2015/4.

42. As part of an international consortium led by Cambridge Econometrics, ROA collaborates with international partners to create the Cedefop 'skills supply and demand forecast'. In addition, in 2016 ROA organised a workshop about labour market forecasts intended for delegations of former Eastern European countries on behalf of the European Training Foundation. In the same year ROA also instructed the Analysis Division at the Danish Ministry of Higher Education and Science on the methodological process behind the prognoses. In 2017 ROA acted as an expert during the Paris-held international Skills Forecast Workshop (organised by France Stratégie), as well as during the seminar on Skills Forecasting in the South Mediterranean Area (organised by UNESCO).

43. Arcidiacono, P., Hotz, V. J., & Kang, S. (2012). Modeling college major choices using elicited measures of expectations and counterfactuals. Journal of Econometrics, 166(1), 3-16.

44. Joensen, J. S., & Nielsen, H. S. (2017). Spillovers in education choice. Journal of Public Economics. Forthcoming.

45. Wiswall, M., & Zafar, B. (2014). Determinants of college major choice: Identification using an information experiment. Review of Economic Studies, 82(2), 791-824.

46. See for a review: Fouarge, D., A. Künn-Nelen & A. Mommers (2016), *Studiekeuze en arbeidsmarkt: literatuurstudie*, Maastricht: ROA-R-2016/3.

good at.[47] Nevertheless, the study shows a positive correlation between the extent to which mbo-graduates weigh future career prospects in their decision making process and their actual labour market outcomes in terms of employment, wages, job satisfaction, and working at their level of education and in their field of study. Moreover, mbo-graduates who gave (a lot of) consideration to career prospects are less likely to regret their educational choices later on.

That same study also investigated the trade-off between preferences, competencies and labour market prospects. This was done by conducting a choice experiment (vignette study) in which youngsters had to choose between two mbo-programmes. The resulting analyses suggest, first of all, that youngsters do take the expected labour market prospects of study programmes into account during their decision making process. Secondly, the choice experiment showed that negative signals (irrespective of whether they referred to bad employment opportunities or to a mis-match with the individuals' interests) have more impact on not choosing for a specific field of study than positive signals have on choosing for a field. Finally, the results suggest that prospective students would be willing to opt for a field of study that is not the first match with their preferences if the labour market prospects for that field are comparatively more favourable than those of the field that best matches with their preferences.

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47   Fouarge, D., Künn, A., Punt, D. (2017), *De rol van arbeidsmarktinformatie in de opleidingskeuze van mbo'ers*, Maastricht: ROA-R-2017/9.