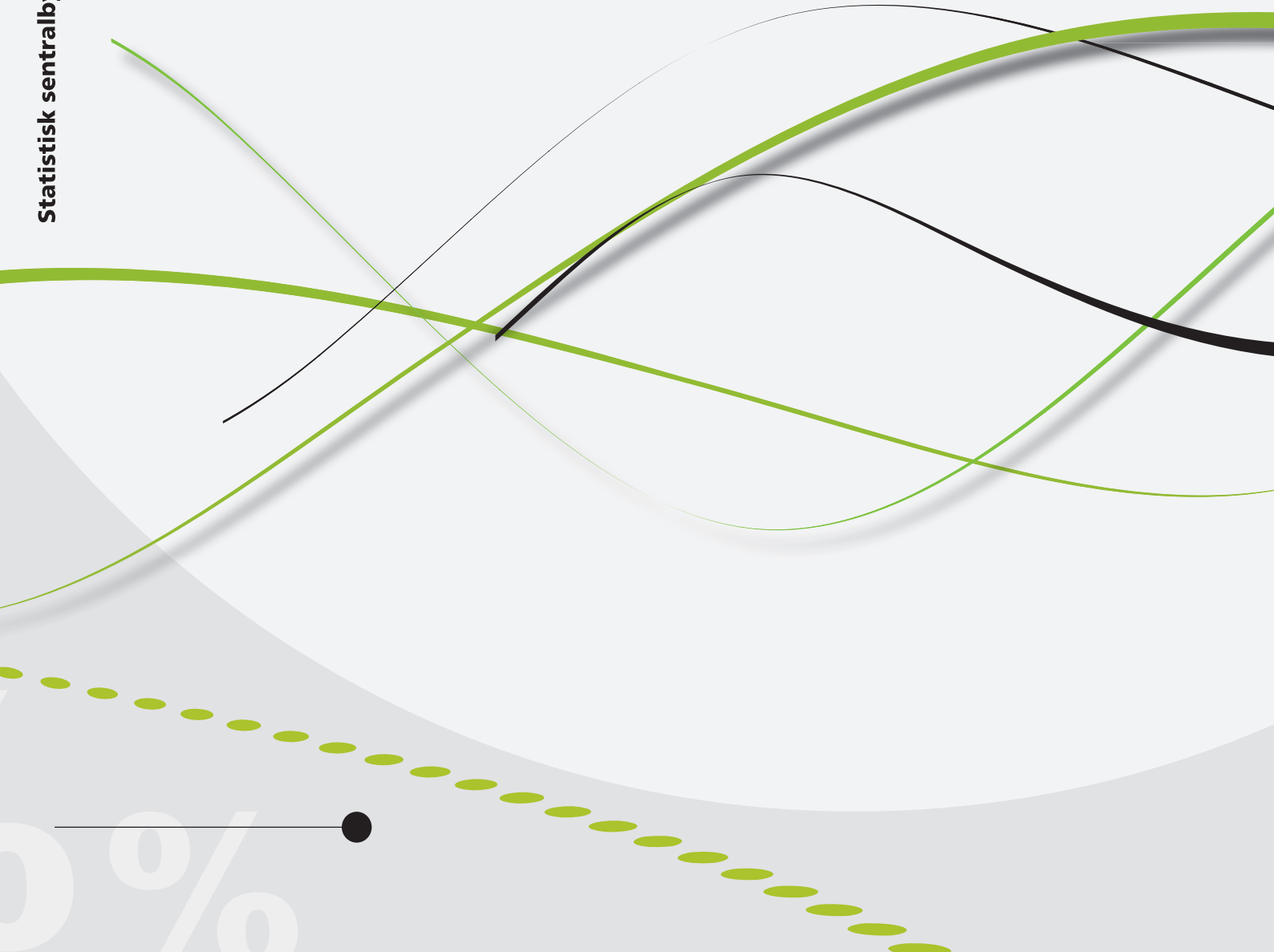


*Bjørn Dapi, Hege Marie Gjefsen, Victoria Sparrman
and Nils Martin Stølen*

Education-specific labour force and demand in Norway in times of transition



*Bjørn Dapi, Hege Marie Gjefsen, Victoria Sparrman
and Nils Martin Stølen*

**Education-specific labour force and demand in
Norway in times of transition**

In the series Reports, analyses and annotated statistical results are published from various surveys. Surveys include sample surveys, censuses and register-based surveys.

© Statistics Norway
When using material from this publication,
Statistics Norway shall be quoted as the source.

Published 15 November 2016

Print: Statistics Norway

ISBN 978-82-537-9408-2 (printed)
ISBN 978-82-537-9407-5 (electronic)
ISSN 0806-2056

Symbols in tables	Symbol
Category not applicable	.
Data not available	..
Data not yet available	...
Not for publication	:
Nil	-
Less than 0.5 of unit employed	0
Less than 0.05 of unit employed	0.0
Provisional or preliminary figure	*
Break in the homogeneity of a vertical series	—
Break in the homogeneity of a horizontal series	
Decimal punctuation mark	.

Preface¹

This report has been financed by the Ministry of Education and Research, the Ministry of Labour and Social Affairs, the Ministry of Trade, Industry and Fisheries, and the Ministry of Health and Care Services.

Statistics Norway, 15 November 2016.

¹We would like to thank Brita Bye, Ådne Cappelen, Torbjørn Eika, Håvard Hugnes, Robin Choudhury, Trude Gunnes, Lars Kirkebøen, Kjetil Telle and Jørgen Ouren for valuable discussions related to the projections.

Abstract

This report analyzes the demand for labour in Norway between 2014 and 2035, and whether this demand corresponds to the educational composition of the labour force. Labour is classified into five levels of education and 28 education groups. We illustrate possible imbalances in these educational groups in the future.

In this report we define the labour force as the number of individuals that participate in the labour market. Projections of the labour force are based on the assumption that individuals make educational choices that are similar to the observed patterns during the last five years. Demographic trends and labour force participation rates also are incorporated in the projections. However, the projections of labour force by education do not depend on developments in the Norwegian economy. For example, whether unemployment is believed to be high or low in the future and whether the outlook for future income changes, does not affect the labour force projections.

Demand for labour is defined as employment, which is determined in a macro model of the Norwegian economy. Global economic developments, fiscal policy and the petroleum industry, largely determine the demand for various goods and services in this model, which determines the firms' price-setting behavior and thus the developments in relative wages for the 5 educational levels. The composition of the 5 educational levels (i.e. the share of each of the 28 educational groups) is based on historical data in the period 1986-2012.

The industry composition in the future is crucial for the development of labour demand for the 5 different levels of education. In general we assume that the historical averages of unemployment for the 5 education levels also apply in the future.

The results indicate a large employment fall in the petroleum industry and other petroleum related activities. Firms in these industries employ many workers with upper secondary vocational education and workers with tertiary education. Consequently, it is likely that the demand for these types of workers decreases when activity is reduced. The reduction in demand for workers with upper secondary vocational education in the petroleum sector is partly offset by an increase in the demand in other industries, in particular, the growth in the construction industry. The decline in demand for labour with tertiary education from petroleum-related activities is partly offset by a higher demand for this kind of labour from other industries. The service sector is projected to grow steadily until 2035, and industries that contribute most are those that employ workers with higher education levels. Some examples are research activities, market-oriented education and health care.

The labour force with higher education also increases. In particular, projections indicate an increase in the labour force with education in economics and administration and some health programs at both bachelor and master level. Within these educational fields there are few people who will retire in the near future, but many who choose such educations. This means that the inflow of labour is higher than the outflow. Projections also show an increase in the proportion of the labour force with unknown educational background resulting from more immigrants in the population projections.

Projections of the labour force and demand for labour by education are carried out separately. However, they rely on the same assumptions regarding demographic development, and the same educational classification. It is thus possible to compare these projections and discuss possible surplus or shortage of labour within educational groups (if the projected labour force and demand show different growth rates).

A projected surplus or shortage of a particular type of labour must be interpreted with caution because labour market mechanisms or policy interventions are assumed away, and of course as they are based on a number of assumptions. Moreover, in reality both firms and workers react to perceived labour surplus and/or shortages. For example, firms may hire alternative types of labour, increase wages, and/or change the composition of the employed, which in turn can affect educational choices and consequently the composition of the labour force.

According to our projections the share of workers with upper secondary general education decreases both for the labour force and the labour demand. However, the share falls to a larger extent for the labour force, resulting in excess demand. Our projections indicate a higher growth in the labour force of workers with tertiary education, providing an oversupply. This is especially true for people with higher education in economics and management and humanities.

Earlier projections show a lack of personnel with education in healthcare and education in the future. The current projections show far lower shortages of workers with a degree in educational sciences. Demand for workers with such educational background is lower because of lower projected birth rates. Demand for workers with education in healthcare services is also slightly lower. However, if labour saving productivity growth in the Health Sector is lower than 0.5 percent per year or the quality of the provided healthcare services is to increase, a substantially higher employment in this sector is required.

Sammendrag

Denne rapporten analyserer etterspørselen etter arbeidskraft i perioden 2014 til 2035, og om etterspørselen samsvarer med utdannings sammensetning blant de som deltar i arbeidsmarkedet. Rapporten framskriver arbeidsstyrken og etterspørsel etter arbeidskraft etter fem ulike utdanningsnivåer og 28 utdanningsgrupper. Vi belyser mulige ubalanser mellom disse utdanningsgruppene framover.

Framskrivning av arbeidsstyrken baserer seg på utdanningsmønstrene vi har sett siste fem årene, den demografiske utviklingen og yrkesdeltagelsen. Arbeidsstyrken fordelt på utdanning er uavhengig av hvordan norsk økonomi utvikler seg, dvs. om arbeidsledigheten blir høy eller lav, og om utsiktene til framtidig inntekt eller lignende endrer seg.

Etterspørsel etter arbeidskraft definerer vi som sysselsettingen slik den bestemmes i en makromodell. Utviklingen i internasjonal økonomi, finanspolitikk og petroleumsvirksomheten bestemmer i stor grad etterspørselen etter ulike varer og tjenester i denne modellen, som igjen bestemmer bedriftenes prissetting, og derigjennom utviklingen i relative lønninger for de 5 utdanningsnivåene. Sammensetningen av utdanningsfelt innen hver av de 5 utdanningsnivåene er basert på den historiske utviklingen i sysselsettingen for hver utdanningsgruppe og næring i perioden 1986-2012.

Nærings sammensetningen har stor betydning for hvordan etterspørselen etter de fem utdanningsnivåene blir framover. Vi forutsetter i hovedsak at de historiske gjennomsnittene for arbeidsledighet for de 5 utdanningsnivåene videreføres i framtiden.

Resultatene tyder på at sysselsettingen går mye ned i petroleumsnæringen og i petroleum relatert virksomhet. I denne virksomheten benyttes mange personer med videregående fagutdanning og personer med lang utdanning. Denne nedgangen i etterspørsel etter videregående fagutdanning fra petroleumsvirksomheten blir motvirket av økt etterspørsel i andre næringer, og sysselsettingen øker spesielt mye i bygg og anlegg. Tjenestesektoren vokser sterkt fram til 2035, og det er de næringene som benytter personer med lang utdanning som vokser sterkest. Tjenestenæringer som vokser mye og benytter lang utdanning er forskning, markedsrettet undervisning samt helse og omsorg.

Arbeidsstyrken med lang høyere utdanning øker også. Spesielt viser framskrivningene en økning i arbeidsstyrken med utdanning innen økonomi og administrasjon og enkelte helseutdanninger på både bachelor- og masternivå. Innenfor slike utdanninger er det få personer som vil gå av med pensjon og mange som velger slike utdanninger. Det betyr at tilveksten er høyere enn avgangen. Framskrivningene viser også en økning i andelen med ukjent utdanning, som skyldes at befolkningsframskrivningene viser høy innvandring til Norge.

Framskrivning av arbeidsstyrke og etterspørsel etter arbeidskraft etter utdanning gjøres separat. Imidlertid bygger de på de samme forutsetningene for demografisk utvikling og bruker de samme grupperingene av arbeidskraft etter utdanning. Det er dermed mulig å sammenligne framskrivningene for å diskutere mulige overskudd eller underskudd av arbeidskraft innen utdanningsgrupper. Ubalanse kan dermed oppstå dersom framskrevet sysselsetting etter utdanning utvikler seg forskjellig fra framskrevet arbeidsstyrke med gitte

utdanningsforutsetninger.

Et framskrevet overskudd eller underskudd av en bestemt type arbeidskraft må tolkes med varsomhet, først og fremst fordi de bygger på en rekke forutsetninger. I virkeligheten vil også både tilbuds- og etterspørselsiden reagere på kommende ubalanser. Ved ubalanser kan arbeidsgivere måtte bruke alternative typer arbeidskraft, øke lønn eller endre sammensetningen av arbeidskraft, noe som igjen kan påvirke utdanningsmønstrer og arbeidstilbudet.

Resultatene viser at andelen med videregående utdanning i allmenne fag synker både i arbeidsstyrken og for etterspørselen etter arbeidskraft. Imidlertid synker andelen kraftigere i arbeidsstyrken, som gir en overskuddsetterpørsel. Blant de med høyere utdanning viser framskrivningene at veksten i arbeidsstyrken er høyere enn i etterspørselen, som gir et overskuddstilbud. Dette gjelder særlig for personer med høyere utdanning innen økonomi og administrasjon og humanistiske fag.

I tidligere framskrivninger har det vært vist mangel på personell med utdanning innen helse og omsorg og utdanning. Disse framskrivningene viser imidlertid noe lavere mangel på personer med utdanning innen pedagogiske fag. Etterspørsel etter personer med slike utdanninger er lavere på grunn av forventninger om lavere barnetall fremover. Etterspørselen etter personer med helseutdanninger er også noe lavere enn i tidligere beregninger. Etterspørselen etter denne gruppen vil imidlertid bli høyere dersom produktivitetsutviklingen blir lavere enn 0,5 prosent eller dersom kvaliteten på tjenestene øker.

Contents

1. Introduction	9
2. Data and classification	11
2.1. Classification by education	11
2.2. Data	13
3. A model of the Norwegian Economy (MODAG)	14
4. Projections of the Norwegian economy towards 2035	17
4.1. The Norwegian economy today	17
4.2. Assumptions for the projections	19
4.3. The starting point of the projection period	24
4.4. Macro projections of the Norwegian economy towards 2035	24
4.5. Industry projections towards 2035	27
4.6. Projected demand for labour by education level	28
4.7. Projected demand for labour by educational field	35
4.8. Results compared to the report of 2013	40
5. Modelling the labour force	43
6. Projected labour force towards 2035	45
6.1. Projected labour force by level of education	45
6.2. Projected labour force by educational field	48
7. Comparing projected labour force with projected labour demand	52
7.1. Comparison by level of education	52
7.2. Labour force and demand for labour by field of education	58
A. Appendix	67
B. Appendix	71

1 Introduction

The relatively high and persistent unemployment rates for some educational groups in Europe has increased the interest of detecting potential educational imbalances in the labour market, see [OECD \(2016\)](#). As noted in the OECD-report, Norway has a long tradition in projecting educational imbalances.

In this report, we make projections of the demand for five levels of education and compare this with the development in the labour force in the period 2013 to 2035. The five levels are further decomposed into 28 fields of education. The projections are used to discuss potential mismatch in the future labour market. Due to the economic status of the Norwegian economy, the uncertainty of making such projections is particularly large this time. The recent oil price drop has highlighted the need for an economic transition towards nonpetroleum activities and the economy is still recovering from the financial crisis.

A central question is what is defined by labour force and the demand of labour by education. The labour force is defined as persons participating in the labour market. Demand for labour is defined as employment. Labour demand and labour force are projected using separate models (MODAG and MOSART).

Mismatch between the projected labour force and demand arises if there are substantial differences in projected growth rates. As discussed by [Ahamad and Blaug \(1973\)](#) and [Psacharopoulos \(1991\)](#) there are concerns with giving projections of potential mismatch in the labour market. However, the past can suggest a path for the future development in the labour market. The projections can thus serve as a benchmark for the discussion of future imbalances in the labour market.

We project the development of the labour force given that the individual choices in education are the same as in the recent past, namely the last five years. Also observed trends in demography and the observed labour force participation are taken into account. The labour force by education is projected using a microsimulation model (MOSART). One example of an educational choice is that most 16 year-olds continue to upper secondary from compulsory education. The probability to continue in upper secondary education is the same in the model as what is observed for the recent years. Age-, gender- and education-specific enrolment and completion rates in all educational activities are assumed to stay stable.

Labour demand is projected using a detailed model of the entire Norwegian economy (MODAG). Demand for labour is the employment as suggested by the macroeconomic model.

The outcome of the model relies on future developments of main macroeconomic drivers, such as development in the petroleum industry, international economy and public sector. Changes over time in one industry can affect factor prices and thus labour demand in other industries. In addition to the fact that aggregate public spending is given outside the model this is also the case for the educational composition in this sector. Both these assumptions contribute to the educational composition in the future. The unemployment rate for each of the five educational levels relates to the development in the aggregate unemployment rate. The disaggregated unemployment rates are adjusted so that unemployment in the future corresponds to the historical unemployment level

for each skill group, with one exception. The unemployment rate for upper secondary education in general studies is assumed to be somewhat higher in the future compared to the historical level for this group. The assumption relies on a hypothesis that the need for upper secondary education in general studies will be considerably lower in the future due to increased specialization. Conditional on the assumptions, the model projects demand for labour at five levels of education based on the development in 20 different industries. The development in these levels is further decomposed to 28 different fields of education.

The Norwegian industry structure in 2035 will differ from the recent past. The petroleum industry and the manufacturing industry are expected to grow at a lower rate than the average for the Norwegian economy. This leads to lower demand in particular for workers with education in engineering and science. In contrast, service industries are expected to grow at a higher rate. Service industries hire workers with both short and long tertiary education and with primary and secondary lower education. The changes in industry composition compared to earlier analysis lowers the demand for secondary vocational education and increases demand for tertiary education.

Trends in demand of labour for the 28 fields of education are based on the time period 1986 to 2012 and the development in educational levels from the macro model. Using a long time period reduces the impact of business cycles fluctuations on the estimated trends compared to using a shorter time period, as both years at the top and bottom of the business cycle are included. Hence, the estimated trends for secondary vocational training directed towards manufacturing and crafts is lower than in earlier projections and thus projected demand is lower. The combination of less steep trends and a lower predicted growth in the level of vocational education results in considerable lower growth in demand for the manufacturing and crafts education field compared to our previous report.

The projections show a substantial increase in the share of the total labour force from people with higher education. The main mechanism is an increase in the propensity to take higher education over time. Many of the persons currently in education take higher education, while relatively few of those retiring from the labour market did. The projections show large increases in labour force share for certain groups: Higher education in economics and administration, humanities and arts, social sciences, and certain other health studies.

A major factor of uncertainty in the projections is how migration will develop in the future. Projections of persons with immigrant background are based on the patterns for earlier migrants, but there are considerable uncertainties about both the magnitude of migration in the future, and the skills of those who migrate.

It should be noted that there is no mechanism ensuring that labour force will match demand in the two models. Thus, combining the projections from the two models gives an indication of educational levels and fields where we may expect labour shortages or surpluses absent any other changes, or alternatively, where substantial future adjustments of some kind are required.

For those with education at lower secondary level or unknown education, the projections show a relative decline in both labour force and labour demand, yielding a balance between the two. For upper secondary education in gen-

eral studies, both the labour force and labour demand decreases relative to the labour force. The labour force with upper secondary education decrease at a higher pace than the demand, resulting in projections of excess demand.

For tertiary education, the labour force increases faster than the demand, and the projections thus show an excess supply. The projections show relatively large imbalances for humanities and arts and economics and administration, with excess in labour force. For education in nursing and care-giving and education, the demand is projected to increase at a higher pace than the labour force, creating excess demand. This suggests that some adjustment will be necessary to balance labour force and demand for these groups. For example, increased wages may attract more job-searchers or firms may hire more labour from the education groups that are relatively less expensive and close substitutes.

The remaining of this report is organized as follows. Classification by education is presented in Section 2. The model used when projecting demand for labour by education, MODAG, is described in Section 3, as well as the underlying assumptions for projecting demand for labour by education. Projections of demand for labour by education are presented in Section 4. Section 5 presents the model projecting labour force, MOSART, and Section 6 presents projections of the labour force. Section 7 discusses the combined results for the labour force and the demand for labour.

2 Data and classification

2.1 Classification by education

Labour force and demand are aggregated by educational background in these projections, not by occupation. There are good reasons for aggregating by education. Information about educational background is readily available from administrative registers. Educational traits do rarely change after a certain age, and could therefore be considered as a fixed characteristic. Moreover, there are examples of employees performing the same tasks, but have different occupations if working in different industries.

There are five main levels of education in our classification, including unreported education. The levels are in accordance with the design of the Norwegian educational system, and correspond closely with international standards for education (ISCED2011). The highest three levels are each divided into fields, yielding a total of 28 educational groups.

Some educational groups are aggregated when comparing labour demand and labour force. Groups that are presented together share the same labour market opportunities, and discussing them together gives a more appropriate image of the expected situation at the labour market.

The numbers in Table 1 are taken from the National Accounts. Distribution by field is defined from the administrative educational registers.

A large educational group in the data is the one consisting of persons whose highest completed level of education is lower secondary education and unknown education. Some of the individuals in this category have completed parts of upper secondary education, but not completed a three- or four years

Table 1: Classification by education. In 1000 persons. National Accounts and administrative educational registers.

	2012
Lower secondary and unreported education	589
Upper secondary education	1142
General programs	290
Economics and administration	130
Electronics, mechanics work and machinery	231
Building and construction	113
Other fields of science, technique and crafts	156
Nursing and care giving	109
Other fields, upper secondary education	113
Short tertiary education	694
Humanities and arts	43
Education	152
Social sciences, business and law	41
Economics and administration	124
Engineering	68
Other fields of science	70
Nursing and care giving	80
Other fields of health and social services	81
Other short tertiary education	36
Long tertiary education	259
Humanities and arts	27
Education	9
Social sciences	25
Law	19
Economics and administration	39
Graduate engineering	34
Other fields of science	54
Medicine	22
Dental studies	4
Other long tertiary education	27
Total	2711

program.

Upper secondary level education is divided into two broader categories: General programs, who qualify for further studies, and vocational programs. The latter category does generally not qualify for further studies, and are associated with more students transitioning to work after completion. Some of the categories of vocational education include several educational programs. Electronics, machinery and mechanics work is traditionally the largest vocational group, and include today students from the program for electricity and electronics, as well as technical and industrial production. Building and construction and design, arts and crafts correspond to the study programs with the same names. Health and care giving corresponds to programs within health-care, childhood and youth development. The last vocational group at upper secondary level, other fields, consists of education within agriculture, fishing and forestry, restaurant and food processing, as well as programs within transportation.

Upper secondary level also includes post-secondary, non-tertiary education. Educations at post secondary, non-tertiary level are aggregated together with upper secondary education within the same field. Post-secondary, non-tertiary education is defined as a separate level in ISCED2011, but are aggregated together with upper secondary education in the projections of the labour force and demand of labour. The main reason for such a choice is the composition of persons with education at post-secondary, non-tertiary level. There are only few observations of persons of higher ages with these educations. It

is therefore challenging to conclude about demand and the labour force in the future, as we only have observed them for a short time span.

Short tertiary education is equivalent to education at bachelor's level. To be assigned this level of education, it is necessary to have completed two subsequent years of tertiary education. The number of programs at tertiary level is large, and the programs are aggregated into broader fields of study. The largest groups at short tertiary level are degrees within the field of education, predominantly teachers and kindergarten teachers, economics and administration, nursing and caregiving and other health studies.

Long tertiary education includes education at master's level and ph.D. level. Also long tertiary education is dominated by economics and administration, in addition to engineering and other fields of science and technology.

The educational background of the immigrant population is to some extent different from the rest of the population. There are more people with education at compulsory level, but there is also a higher share of the immigrant population with education at master's level than what is the case for the rest of the population. About 24% of the immigrants still have unreported education after the 2011/2012 survey. For a further discussion of the distribution of education for the migrant population, see [Steinkellner and Holseter \(2013\)](#).

2.2 Data

The models use the past trends to make projections about demand and the labour force in the future. Knowledge about past trends are based on a wide array of register data. Both information about the educational register (Utdanningsregisteret) and Labour Force Sample Survey is essential to determine past trends. We also use the most recent demographic projections and the Annual National Accounts with base year 2013 and preliminary figures until the first quarter in 2016.

The demographic projections are published every two years, and this report uses the 2016 projection as documented in [Tønnessen et al. \(2016\)](#). Different from the last projections is a lower fertility rate, which reduces the number of children. Additionally, the 2016-projections suggest higher migration in the long term than the 2014 projections.

The final version of the national accounts for year t is based on detailed annual statistics and methods for compilation of annual national accounts. It is published 21 months after the end of the year, i.e. in August/September the year after.

The first version of the annual accounts is compiled by adding up the four quarters of the ordinary quarterly national accounts (QNA) and is published 45-50 days after the end of the year. This preliminary version is revised in May and in August/September in the same year. These two versions are also based on the methods and accounting system of the QNA, but annual statistics and other information available at the time are also utilised.

It is important to note that the National Accounts register total employment independent of the workers' residence. This means that there is a gap between employment in the registers and the National Accounts.

3 A model of the Norwegian Economy (MODAG)

In this report, we will characterize labour demand as the employment level. In the projection period the employment level is predicted, given the assumptions incorporated in the macroeconomic model. Hence, it should be noted that labour demand does not refer to the labour demand function.

Our results rely on the macroeconomic model MODAG. This model is developed by Statistics Norway to depict the Norwegian economy. In the short run, the production level in the model is determined by aggregate demand similar to the traditional Keynesian framework for an open economy with inflation targeting. In the long run, also the supply side contributes to the predicted production level. The labour market is characterised by large wage setters that bargain over wages (see [Layard et al. \(2005\)](#)). Products are normally assumed to be imperfect substitutes, hence the Norwegian product prices can differ from prices set by foreign competitors. Foreign prices are taken into account by Norwegian producers in their price setting in line with theories of monopolistic competition. Therefore, Norwegian prices on exports and home market are set as a mark-up on the firms' variable costs. The mark-ups usually increase if prices of competing goods produced abroad increase. Foreign prices also affect the firms' costs through imported intermediate consumption. Changes in demand can hence lead to adjustments in product prices, the production level and/or the production process. The production process is mainly driven by technological progress and substitution within the production factors. Since labour is one type of input in the production process, demand for labour depends on all these factors.

The model MODAG is used for forecasting and policy analysis. In this section, a short description of the model is outlined. We will focus on the labour market and only outline some of the main features of the other parts of the model. The model can be separated into three main markets, the financial market, the product market and the labour market, which are determined simultaneously. [Boug and Dyvi \(2008\)](#) present the most recent version in Norwegian. [Haraldsen et al. \(2015\)](#) provides a documentation of the most recent version of the model, which includes a heterogeneous labour with five educational levels: lower secondary, secondary general, secondary vocational, short and long tertiary education.

The Norwegian National Accounts provide the conceptual framework and the empirical basis of MODAG. Population forecast is important for determining the population age and gender composition in the projection period. The model contains a large number of final uses (consumption, investment, and exports) of products, and these products have different prices depending on whether they are home produced or imported and on destination (exports or home market). MODAG includes 38 products and 20 industries. Specifically, MODAG balances all products in terms of supply and demand equations. The input-output structure and the National Account-based relationships are supplemented with econometric equations describing how the agents tend to respond to various factors. The advantage of this type of model is that a balanced growth path can only be achieved by a balanced growth path in all industries, or high growth in some industries and low growth in others.

The main structure is that prices along with interest rates, exchange rates

and wages determine demand from households and firms as well as foreign demand. Interest rates increase with a higher core inflation rate and with a lower unemployment rate in line with flexible inflation targeting, introduced in Norway in March 2001. Government expenditures are exogenous and assumptions for its future development are required. These assumptions, however, are more credible if the fiscal policy rule introduced in March 2001 is adhered to.

The volume of exports for each product depends on a world market demand indicator and the cost competitiveness represented by the Norwegian export price divided by the foreign competitors' price in a common currency. Thus exports are in general demand driven. According to the Armington-approach ([Armington \(1969\)](#)) demand from export markets and relative prices are important determinants of the demand for Norwegian products abroad. This approach specifies that products traded internationally are differentiated by country of origin and not treated as homogenous. Import of each product is in general an imperfect substitute for the corresponding Norwegian product. The change in import share from the base year for each product is a function of the ratio between the home price and the import price. The detailed input-output structure captures variations in import shares by use in the base year of the model. An increase in domestic use will lead to more imports for a given import share. Some imports are considered as non-competitive in the sense that there is really no corresponding Norwegian production. In these cases imports are basically determined directly from the demand.

The labour market is strongly affected by the product market as production volume and prices affect wages and employment. Therefore, industry composition is important in determining demand for different levels and fields of education. For instance, the long-run growth of the service sector has been higher than the average in Norway, as in many other western countries. This sector mainly demands persons with bachelor or master degree, and in particular persons with engineering background and economics and administration, short and long tertiary degree. Given that this historical path will continue, the demand for labour with bachelor and master degrees will be high also towards the end of the projection horizon. An advantage of using a disaggregated production structure in MODAG is that it can account for heterogeneity between production processes; some are labour-intensive, while others employ relatively little labour. The long-run growth in the many distinct variables will in sum determine the industry structure in Norway.

The macroeconomic model includes industry-specific employment for five educational levels. This is used to investigate the educational composition of labour. Workers from these educational levels are partly substitutes within each industry and the employment shares within each industry depend on relative wages and factors related to technological change such as capital stocks and deterministic trends as explained in [Haraldsen et al. \(2015\)](#). The main mechanism is that the demand for labour from each educational level is determined by the production level, relative wages, the ratio between capital stock and production, and a deterministic time trend.

The deterministic time trend reflects the assumption that the growth in demand for labour with tertiary education is higher than for labour with shorter level of education. This is consistent with the hypothesis of skill biased tech-

nological change (SBTC), which suggests that technological innovation favours employment of skilled labour. It should be noted that this deterministic trend is imposed in absence of observable variables that capture the close link between technological change and the skill composition of labour. Haraldsen et al. (2015) document that the estimated trend coefficients are strongly significant in most industries. Hence, demand for labour with tertiary and medium length of education increases in line with technological change while relative demand decreases for labour with primary or upper secondary education, general programs, referred to as short education for simplicity.

In line with institutional aspects of Norwegian wage formation, the model distinguishes between three main sectors when modeling wage formation: manufacturing, market oriented service activities and public sector. The sector exposed to international competition is the manufacturing sector and it negotiates first. Then the wage settlement in this sector is the wage norm for the following negotiations in the other sectors. The manufacturing sector adjusts the wage towards an equilibrium wage share, and the other sectors consider the manufacturing wage development as a norm, see Gjelsvik et al. (2015). The wage growths for the various industries within each of these three sectors are modelled to grow at the same pace.

MODAG incorporates economic relations for all parts of the labour market, ie. wages, labour demand and supply. However, the supply side of MODAG is highly aggregated and mainly determined by demographic variables and variables that capture labour market pressure. Labour supply increases when after tax wages increase, while demand for labour falls if wage costs increase. In this report, the labour supply from MODAG is only used to balance the projections in the labour market and the presented labour supply stems from MOSART.

Aggregate unemployment is determined residually. There are two relationships between real wage and unemployment:

(i) The wage setting, where real wages will be higher when unemployment is low.

(ii) The demand for labour, where higher real wages decrease demand for labour, which in isolation increases unemployment.

These two relationships jointly determine unemployment so that the real wage implied by the wage setting is consistent with the price setting and the demand for labour, cf. Layard et al. (2005). If the unemployment rate is lower than this level, real wages will be higher and firms will reduce the demand for labour. The level of unemployment will increase until there is correspondence between the real wage rate implied by wage setting and the real wage rate consistent with the firms' price setting and demand for labour. The disaggregated unemployment rate for each educational level is related to the aggregate unemployment rate. In the projection, each education specific unemployment is a constant share of the aggregate unemployment. This is based on a historical relationship.

The demand for labour towards the end of the projection period can be interpreted as a result of structural rather than cyclical factors. The long run model characteristics are in line with standard neoclassical economic theory. However, the dynamic adjustments towards the long run are largely estimated to fit the data and it takes some time before the effects of exogenous shocks vanish

and economic developments follow in line with long term relations. Wage- and price-rigidities lead to Keynesian effects, which means that demand shocks lead to increased/decreased production effects in the short and medium run. It also takes time before relative prices adjust to balance changes in demand and supply. This will lead to standard multiplier and quantity adjustments in addition to price adjustments.

4 Projections of the Norwegian economy towards 2035

MODAG relies on a number of assumptions on economic mechanisms that are determined outside the model.

Norway is a small open economy where natural resources such as oil, natural gas and fishing are the basis of large industries. The development in prices of these goods on the world market is thus important for the economic situation. In order to evaluate the effects of recent changes in the economy, the model is updated with a number of assumptions regarding the development in the world economy, Norwegian policy, the development of the petroleum sector and other economic variables that are not projected by the model. For example, government purchases account for about 14 percent of GDP, and hence the assumptions about fiscal policy are important for the model's projection of the Norwegian economy.

The role of these assumptions can further be illustrated by considering the interplay between developments in the oil price and other economic variables in the model. Changes in the oil price affect the profitability of petroleum production and consequently the level of activity in the petroleum industry. This has repercussions in other industries that compete for the same factors of productions (e.g. labour, capital). The outcome of the model is an allocation of labour and capital across industries, which is sensitive to changes in the oil price. So the oil price can be regarded as determined abroad, independent of the Norwegian economy. Consequently, we need to make assumptions about the future development of the oil price and incorporate this into the model. These assumptions are formed by historical developments and beliefs about the future.

We distinguish between the nearest future (ie. 2016-2020) and the long run (ie. 2021-2035) in our prognosis period. The reason for this separation is that the Norwegian economy has historically grown faster during a recovery and slower in a boom compared to the long term growth pattern. Hence, imposing a long-term growth in key economic variables throughout the whole projection period will result in a more extended recession/boom than what one would expect from historical cyclical patterns. We therefore incorporate a detailed forecast of the Norwegian economy for the next four years, which is based on our quarterly economic survey from the 2nd quarter in 2016 ([Statistics Norway \(2016\)](#)).

4.1 The Norwegian economy today

At the time of writing, the Norwegian economy is in a moderate cyclical downturn. The main cause is the economic slowdown in the petroleum sector. This sector has shown reduced activity since the end of 2013 and in particular lower real investments. Activity in the petroleum sector was even further reduced as a

consequence of the fall in oil prices starting in the summer of 2014. Correspondingly, unemployment has increased from 3.6 percent in 2014 to 4.8 percent in August 2016.

Demand from the petroleum industry, including the industry's labour costs, accounted for over 13 per cent of mainland GDP in 2013. Almost all industries supply intermediary goods to firms in the petroleum industry, but some substantially more than others. Due to the fact that these firms represent a far greater share of the economy in some regions than in the country as a whole, certain geographic regions in Norway have been affected more than others by the recession.

There are many reasons why the decline in oil prices has not resulted in an even more pronounced downturn. This is partly due to the fiscal rule. The government's scope for manoeuvre in the short-term is almost not affected by the oil price fall, unlike the experience of other oil-exporting countries. However, fiscal policy has not stimulated the economy as much as the expansionary monetary policy, including the sharp depreciation of the krone. The oil price affects the krone exchange rate directly, and reduced interest rates have also contributed to the depreciation. Despite this, exports of traditional goods dipped by over 5 per cent in the first quarter of 2016, after a clear rise in 2015. Most of the decline can be attributed to a sharp fall in exports of refined products, following a corresponding increase in these exports through 2015. This is not a consequence of developments either in the global economy or in competitiveness, but a consequence of a corresponding change in imports of refined products. That said, Norwegian traditional exports have also been negatively affected by the low oil price. This is because demand for goods and services demanded by the petroleum industry has also fallen globally.

The global fall in demand for products associated with petroleum extraction in the wake of the collapse of the oil price is probably a large part of the explanation. It is reflected in a pronounced fall in exports of engineering products. The imports of our trading partners also appear to have moved on a weak trend. The improvement in competitiveness has also served to curb imports, thereby stimulating Norwegian production. Improved cost-competitiveness may also have facilitated the financing of some investment projects and spurred interest in investing. It will take time before the effects of improved competitiveness on export volumes are exhausted.

The interest rates that households now face have followed the fall in the money market rates. A typical mortgage has an average interest rate around 2.5 percent. Low interest rates and the belief that interest rates will remain low in the future have stimulated the housing market. In consequence, the cyclical downturn has not yet been an impediment to a high rise in house prices for the country as whole. The marked price inflation has prompted a clear rise in housing investment through 2015 and into 2016.

Household real disposable income increased by 2.7 per cent in 2015. Despite the decline in interest rates and high house price inflation, household consumption has increased fairly moderately through 2015 and so far this year. Households' behaviour is perhaps best understood within the current economic context, which is that of a moderate recession. Increased uncertainty about own income developments due to the relatively high unemployment is a factor that

has probably prompted the increase in saving from 2014 to 2015.

The wage settlements for manufacturing is estimated to result in only 2.4 percent this year. Wage growth for this year in manufacturing continues to provide the norm for other settlements. As a result of this and temporary high inflation in 2016 real wage growth will be negative in 2016.

4.2 Assumptions for the projections

Our projections of the oil price are closely related to our beliefs on future developments of supply and demand of oil in the global market. We expect demand for oil to be high in the long run even though alternative fuel resources are becoming increasingly more available. This is because these alternatives are less mobile factors of production than oil. With better technology, which becomes available in the very long run, demand for oil may become more sensitive to alternative energy resources. Yet, we expect the high demand for oil to not give rise to higher oil prices because it will be partly offset by a relatively high oil supply. The crude oil price (Brent Blend) is expected to be approximately 50 USD per barrel in 2017 and increase to about 63 USD per barrel in 2020. Over the long run, the oil price is assumed to increase annually by 2 per cent, following the inflation rate. This means that by 2035, the end of our projection period, we expect the nominal crude oil price to be approximately 86 USD. This is still lower than the nominal price levels of 2011 to 2013, which were about 110 USD per barrel.

As mentioned earlier, developments in oil price have a direct impact on the Norwegian petroleum extraction industry. A lasting low oil price, compared to the price before the summer 2014, will lead to major adjustments in the development of new capacity offshore. The size of these adjustments is difficult to quantify as lower oil prices may initiate research and development activities providing new solutions and opportunities. However, in the long term petroleum production declines when oil prices decrease because fewer resources can be profitably extracted at lower prices. In addition, fewer profitable resources are likely to be discovered because exploration activities are discouraged at lower prices. According to Petroleum Directorate, petroleum production is going to be reduced by approximately 1 percent per year in our projection period. We have based our projections on a similar reduction and also that this will lead to reduced investments. Petroleum investments are reduced with 2 percent per year. The projections are therefore based on the petroleum production becoming somewhat more efficient in the projection period than in the recent years.

International economic growth has been low since the financial crisis. Therefore it is assumed that the inflation rate in the Euro area will continue to be quite low in the nearest years and then, increase from 1 per cent to 1.4 per cent, which is somewhat lower than the inflation target of the European Central Bank, equal to roughly 2 per cent annually. The growth of world markets prices for manufactured goods are assumed to be particularly low, approximately half a percent. The money market interest rate in the Euro area - an important policy instrument for stimulating investment and economic growth - is assumed to increase from the currently very low level to 3 per cent towards the end of the projection period.

Figure 1: Growth in exports markets, in per cent.

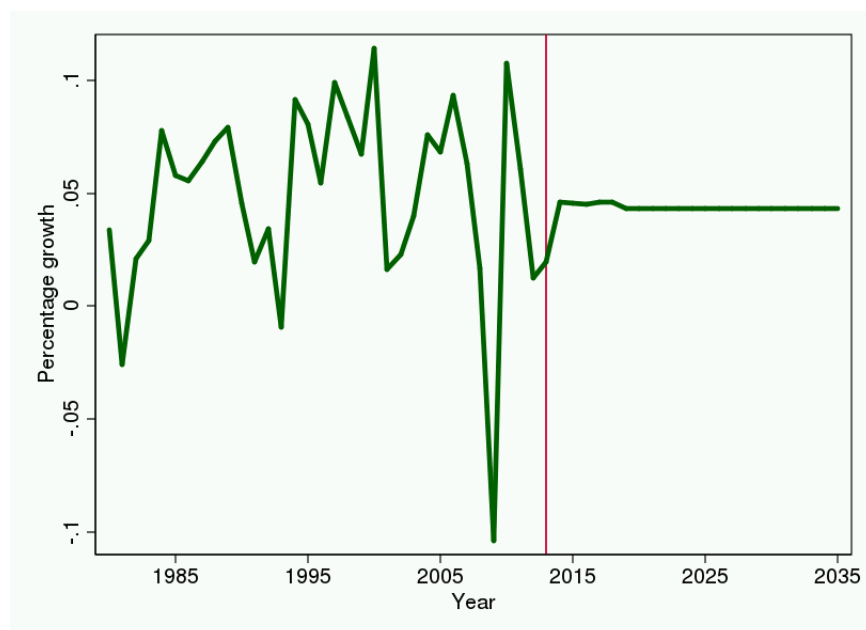
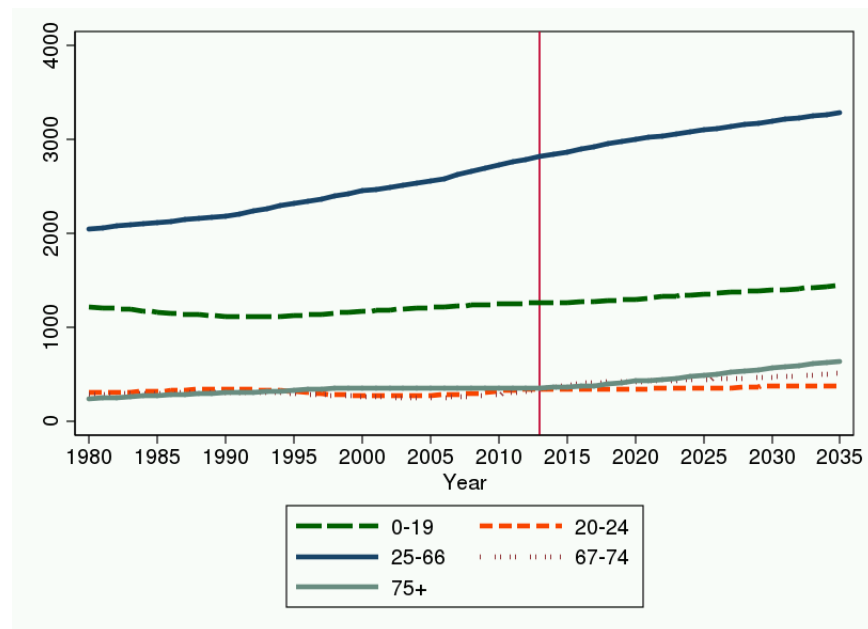


Figure 1 shows the historical and projected average growth rates of imports for Norway's trading partners. Norwegian exports depend on demand from the largest trading partners, especially Sweden, Germany and Great Britain. The current growth in export markets is relatively low reflecting poor growth in the OECD economies and in Europe in particular. However, import by Norway's trading partners is expected to grow by barely 4.5 per cent in the next few years as well as in the long run.

Assumptions about the future demographic composition, in particular the size of the elderly cohorts, have implications for the development of the health care sector and public spending in the Norwegian economy. The number of elderly people largely determines pensions and government transfers as well as spending on social care. Government expenditure on education is another element that is closely related to demographic development because it depends on the number of young people. Figure (2) presents the main features of the most recent population forecast by Statistics Norway. The ageing of the Norwegian population takes place in particular after 2020 when the population of 75 years and older increases markedly. The number of young people (0-19 years) and the number of potential students (20-24 years) are relatively stable. In contrast, the population most represented in the workforce (25-66 years) increases relatively more. This reflects that the high migration Norway has experienced in the recent years, is forecasted to continue but at a lower growth rate in the future.

Fiscal policy is specified in accordance with the fiscal policy rule that was introduced in Norway in March 2001 *St.meld. (2001)*. Further it is assumed a nominal return on the government pension fund of 5.5 per cent annually implying a real return of 3.5 per cent using international consumer price inflation (CPI) as deflator. The structural petroleum adjusted deficit is currently less than this return, and the adjusted deficit is assumed to follow the rule over time, albeit

Figure 2: Population based on register data 1980-2013 and forecasted 2014-2035. In thousands.

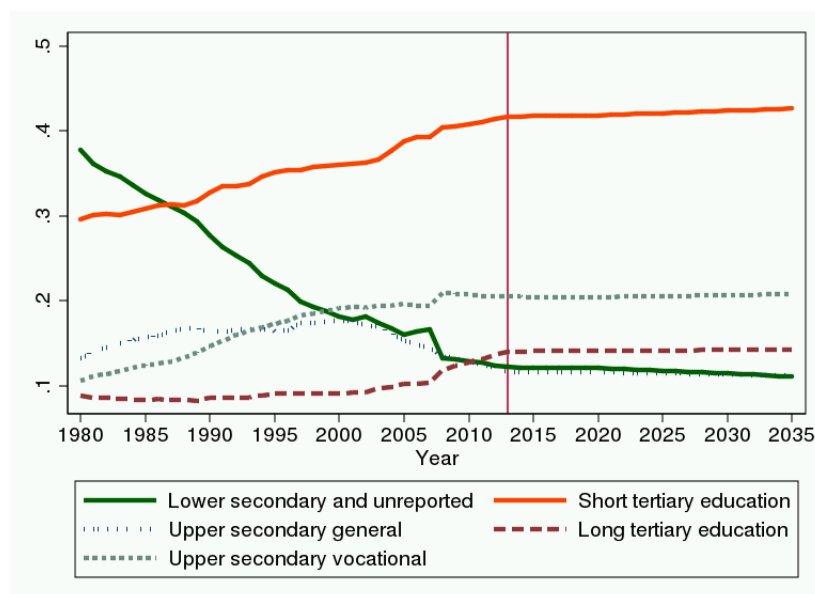


not every year. Public consumption is assumed to grow by approximately 2 per cent annually during our prognosis period. Public investment in infrastructures increases by 2 percent from 2020 to 2035, in other words as a constant share of mainland GDP. Public investment in research and development is assumed to grow slightly faster at 2.5 per cent annually. Total investment in the public sector is also affected by purchases of new fighter aircrafts during the period 2015-2024, amounting to more than 60 billion kroner during these years. From 2020 to 2025 military investments in aircrafts are 12 billion kroner annually.

In addition to assumptions about aggregate public spending the skill composition needs in the public sector are also given outside the model. This affects the aggregate skill composition of the employed labour force to a lesser extent than the skill composition in the private sector which is an outcome of the model. Figure (3) shows the employment share of each education level in the public sector. The projections are based on the assumption that public sector also in the future decreases the employment share of lower secondary and upper secondary general education. Consequently, the employment share of workers with higher education increases somewhat, especially for those with short tertiary education. The skill composition is more stable in the projections compared to the history in particular for those with lower educational level. This is because we assume that the public sector to a large extent already has specialized many production processes leaving little scope for additional specialization.

To account for increased activity in the health care sector, public employment grows with slightly over 1 per cent and somewhat faster for local government than for central government. Labour productivity in the public sector is assumed to grow by 0.5 per cent after 2020. These assumptions are based on unchanged quality of the health care services. If the quality should be higher,

Figure 3: Public employment share by level of education.



then both employment or/and productivity has to be higher. Tax rates are increased slightly in order to cover expenses related to social transfers, which are mainly driven by demographic trends. This productivity growth ensures that the current quality of health care services is preserved in the long run while at the same time fiscal policy rule is adhered to.

An important assumption regarding the labour market is the development of the education specific unemployment rates. The aggregate unemployment rate is endogenous in the model, whereas the unemployment rates for each of the five skill groups are assumed to follow the aggregate unemployment rate. The education specific unemployment rates are adjusted so that the level in the future corresponds to the historical level of unemployment for each skill group, with one exception. The unemployment rate for upper secondary general education is assumed to be somewhat higher in the future compared to the historical level for this group. This relies on an assumption that the need for this type of education will be considerably lower in the future due to increased qualification/specialization in work life.

Table 2 provides a concise summary of assumptions regarding important variables in the model MODAG. They are categorized as variables that are potential policy instruments makers and as variables that fall outside the influence of policy makers.

Table 2: Assumptions incorporated in the macroeconomic model MODAG

Variable	Assumption
Potential policy instruments.	
Army defence expenditure	High military investments till 2022. (fighter air jets)
General government investment	Grows with approx. 2% after 2020.
General government consumption	Approx. 2% growth.
Pension benefits	Between 1.5 and 2 % growth in real terms.
Other benefits	Low growth in real terms. Follows population forecast.
Use of the Government pension fund global	Follows the budgetary rule (approx. 3.5%).
Other variables.	
Demographics	Middle alternative from SSB forecasts (2016)
Money market rate, Euro level	From very low to 3% towards 2035.
Consumer price index, Euro-area	Yearly growth, from 1% to approx. 1.4% in 2035.
Export markets indicator	Approx. 4.4%.
Unemployment by education	Proportional to aggregate unemployment.
Petroleum sector	63 USD per barrel in 2022.
	Price follows inflation rate after 2020.
	Production of Norwegian petroleum falls at 1% yearly.

4.3 The starting point of the projection period

Before we turn to the projections, we present some technical details about how the model is adjusted to accommodate preliminary figures from national accounts, the figures from a recent projection by Statistics Norway (Statistics Norway, 2016) and the transmission towards long term growth of exogenous variables.

At the starting point, i.e. 2014 and 2015, we have preliminary values for all of the exogenous variables in the model while the values for education specific variables end in 2013. For the period 2016 to 2019, we use the projections by Statistics Norway in [Statistics Norway \(2016\)](#). We use the preliminary values and the projections as guidance for how the exogenous variables should develop.

When MODAG with five levels of education is used mechanically to simulate the endogenous variables in both these periods, i.e. 2014 to 2015 and 2016 to 2019, there is a difference between the predicted values for the endogenous variables on the one hand and the preliminary values of the same variables from national accounts or the values from the projection in [Statistics Norway \(2016\)](#) on the other hand. In the current projections, we adjusted the path to be in line with the preliminary figures from national accounts and the figures from [Statistics Norway \(2016\)](#).

From 2020 and towards the end of the projection period, we feed the model with the long run growth in the exogenous variables. However, there is no strict rule for how the difference between the simulated values and the last observations of the economic survey should be prolonged. If there is a structural break, then the difference should be held constant throughout the projection period to account for the permanent shift. On the other hand, if there are fluctuations causing a temporary deviation between model simulation and value in 2020, then the error term should return to zero in the projection period.

Some of the error terms are adjusted gradually towards zero between 2013 and 2020 before they are set equal to zero in the rest of the projection period. Other error terms are held constant throughout the whole projection period. This means that temporary deviations at the end of the observed period do not affect our long term projections.

4.4 Macro projections of the Norwegian economy towards 2035

Projections of the Norwegian economy are based on the assumptions outlined in the previous section. In addition, the medium to long run growth in central economic variables are important for industry developments. Here we consider macroeconomic variables for the Norwegian economy in the nearest future (2016-2020) and the long run (2021-2035). We start by describing the projections for investment, government expenditure, household consumption and output level (GDP). In the end we turn to the labour market projections to 2035.

Table (3) summarizes the projections from 2014 to 2035. The nearest future is affected by cyclical fluctuations and we expect GDP growth to pick up from the 2017 onwards. Several factors contribute to this development. Firstly, the construction sector will provide an ongoing positive impulse owed to rela-

Table 3: Macroeconomic projections, average growth in percent when not otherwise stated

	2010-2013	2014-2020	2021-2027	2028-2035
Demand and output				
Consumption in households etc.	2.8	1.9	2.8	2
General government consumption	1.2	2.1	1.9	1.8
Gross fixed investment	7	0.6	0.8	0.7
Extraction and transp. via pipel	15.3	-5.7	-2.5	-2.9
Mainland Norway	4.9	2.5	1.5	1.2
Industries	2.1	0.9	2.5	0.9
Housing	11	3.4	0.8	1
General government	3.6	3.9	0.9	2
Demand from Mainland Norway	2.8	2.1	2.3	1.8
Stockbuilding	0.7	0.1	0	0
Exports	-0.7	2.2	1.5	1.9
Crude oil and natural gas	-3.7	0.7	-1.3	-0.9
Traditional goods	0.5	3.5	3	2.9
Imports	3.9	2.2	3	2.4
Traditional goods	3.1	2.4	3.3	2.7
Gross domestic product	1.5	1.6	1.5	1.5
Mainland Norway	2.6	1.6	2.1	2
Manufacturing	2.3	0	0.7	1.1
Labour market				
Total hours worked, Mainland	1.3	1	1	1.1
Employed persons	1.5	0.9	1	1.1
Labour force	1.3	1.2	1	0.7
Participation rate (level)	71.6	71.5	72.8	73.8
Unemployed rate (level)	3.4	4.4	4	3.7
Prices and wages				
Wages per standard man-year	4.4	2.3	3.7	3.1
Consumer price index (CPI)	1.4	2	2.1	2.3
CPI-ATE	1.4	2	2.1	2.3
Export prices, traditional goods	2	3	2.6	2.5
Import prices, traditional goods	1.8	2	2.1	2.3
Housing prices	6.2	5	2.1	2
Income, interest rates and exchange rate				
Household real income	4.1	1.7	2.9	1.9
Household saving ratio (level)	6.1	8.2	8.2	8.7
Money market rate (level)	2.3	1	0.9	2.4
Lending rate, credit loans(level)	3.7	2.7	3.5	4.8
Real after-tax lending rate(level)	1.1	0	0.6	1.4
Importweighted krone exchange rate	-0.5	1.2	0.2	0.3
NOK per euro (level)	7.8	9.1	9	9.1
Current account				
Current balance (bill. NOK)	-327.6	-258.8	-181.9	-421.2
Current balance (per cent of GDP)	-11.5	-7.7	-4	-6.8
International indicators				
Exports markets indicator	3.1	4.6	4.4	4.4
Consumer price index, euro-area	2.2	0.8	1.9	2
Money market rate, euro(level)	0.7	0.1	0.9	2.4
Crude oil price NOK (level)	598.8	435.3	559.7	657.2

tively high demand in the housing sector. Secondly, the negative development in the petroleum industry is expected to become less pronounced in the nearest future as the oil price stabilizes. Thirdly, internationally exposed industries

benefit from a relatively weak currency and increasing demand from our trade partners. However, it should be noted that international prices of industrial goods are expected to grow only moderately and less than prices of services. Fourthly, relatively low and stable interest rates reflect a lower opportunity cost of borrowing and consequently contribute to higher investment and household consumption. And finally, an expansionary fiscal policy with somewhat higher growth in real transfers to households and with greater corporate tax relief will further contribute to the cyclical upturn from 2017.

The long run development in the Norwegian economy is closely affected by the relatively smaller role that the petroleum sector is expected to have. Relatively low oil prices (compared to the past) give a negative effect on investments. Consequently, mainland investments are expected to increase more than total investments because of the decline in petroleum investments. Similarly export of traditional goods is projected to grow at a higher rate than total exports. Further, total GDP is expected to grow less than GDP in the mainland economy due to the decline in petroleum extraction. Average growth in GDP is 1.5 per cent over the period while it is 2 per cent for mainland GDP. This also explains why imports are projected to grow at a moderate, but higher than in the past, rate.

An important element of aggregate demand that is very sensitive to developments in the labour market is household consumption. Household consumption grows in line with growth in households' real disposable income. The households savings ratio is therefore expected to follow a steady path in the projection period. Higher average growth in consumption relative to mainland GDP is partly due to increased pension payments and demographic changes but also because of slightly lower taxes. The room for fiscal stimulus according to the fiscal policy rule is partly used for higher military expenditures on investments and growth in public consumption related to the ageing of the population.

Now we turn to the economic projections that regard the Norwegian labour market. The labour participation rate fell during the years of the financial crisis and has not yet fully recovered. The labour participation is expected to be reduced by one percentage point in 2016 to 71 per cent over the next two years and then increase slowly to 74 per cent by 2030.

There are at least two arguments for a somewhat higher participation rate in the future. First, labour force participation is higher for those with a tertiary education compared to those with primary or secondary education. Since the number of tertiary educated persons increases while the number of persons with less education decreases in our projections, the average participation rate is expected to increase as well. Secondly, higher real wages lead to higher labour supply in particular in terms of hours per employee. On the other hand, labour participation rates for some immigrant groups are quite low and this will lower aggregate participation rates. An ageing population will do the same, although participation rates for those 62 years and older has been increasing for some time and this counteracts some of the ageing effect.

Supply of labour and employment follow each other quite closely in the projection period. Both employment and supply of labour are expected to increase by approximately one percent the next four years. In the recovery years 2017 to 2019, the employment growth is just above the growth in supply of labour. However, averaging over the years 2014 to 2020 (as in Table (3)) conceals

some important business cycle fluctuations. For example, employment growth has declined so far in 2016, and the average growth for employment in 2016 is expected to be close to zero. Then, the average growth in employment will be approximately 1 percent each year over the period.

Corresponding to growth in supply of labour and employment unemployment is expected to increase this year to an average of 4.7 percent, up from 4.4 percent last year. Unemployment is then expected to slowly decrease in line with the improvement of Norwegian and international business cycles. The average unemployment rate for the years 2028 to 2035 is projected to be 3.7 percent, which corresponds to the equilibrium Norwegian unemployment rate estimated by [Nymoen and Sparrman \(2014\)](#).

The growth in yearly wages of 2.7 percent in 2015 was the lowest in two decades, and the wage settlement of 2016 is expected to provide even lower wage growth. Growth in yearly wages is expected to increase in 2017, but to stay well under 4 percent for the rest of the period. Inflation is expected to be low and stable over the period, and the growth of the consumer price index seems to stay around 2 percent from 2017 onwards. The average growth in nominal wages and consumer prices implies that real consumer wages grow with under 2 percent annually on average.

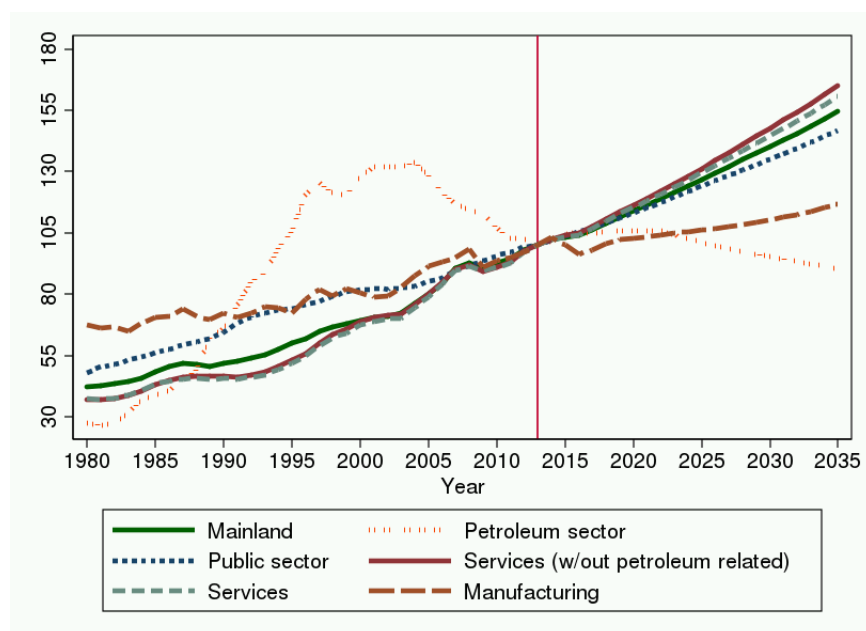
The small decline in the GDP mainland growth rate goes in line with lower growth in labour supply due to demographic factors and lower immigration. The growth rate in labour productivity (approximated by the growth rate in mainland GDP minus the growth rate in total number of hours worked), shows that the baseline scenario projects a fairly stable productivity growth of approximately 1 percent annually in the long run.

4.5 Industry projections towards 2035

Industry developments are important in determining demand for labour with different levels and fields of education. Higher growth in one part of the economy can increase employment for the relevant industries and change the composition of skill level. This further leads to changes in relative wages and changes in employment in other industries. Thus, the expected growth of key macroeconomic variables will affect the labour demanded by different industries.

Figure (4) shows the development of value added for some industry aggregates relative to the volume in 2013. In line with our earlier discussion on the negative developments in the petroleum industry, figure (4) shows a fall in the value added in our projection time window. The output in manufacturing, which is closely related to the development in the petroleum industry, grows over the years at a fairly constant rate, but at a slower pace than total value added in Mainland Norway. Output in both market oriented services and public sector services are expected to increase considerably. Value added in market oriented services shows a higher growth rate when we exclude services that are closely related to the petroleum sector. The increase in the public sector value added is mainly driven by demographic factors leading to higher demand for social services such as health and social care for elderly people. This is a fairly standard feature of all projections of the structure of production in Norway. It should be noted that in our projections the growth rate of public spending does

Figure 4: Projections of gross products. Volumes are indexed relative to the volume in 2013.



only account for increase in demographic changes. Hence, if the standard of public services increases this will increase public spending.

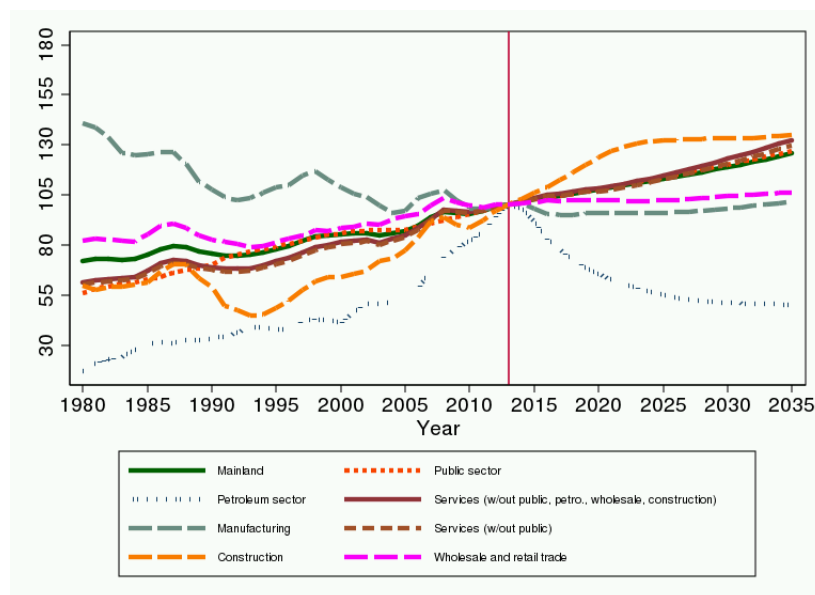
Figure (5) shows the employment development in several industry groups relative to the volume in 2013. By comparing this figure with figure (4) illustrate the close connection between the output growth and the employment growth. So, employment is projected to fall in the petroleum sector throughout the projection period. In contrast employment in the services sector grows. It should be noted that this development is not driven by the exogenous assumptions regarding the public sector; in fact employment growth in the public sector follows (or rather is assumed to follow) employment growth in the Mainland economy. The construction sector is an example that contributes to the high employment growth in services.

4.6 Projected demand for labour by education level

In this section, we present employment projections by five educational levels towards 2035. The model is simulated over the period 2013 to 2035. The development in levels are closely linked to the development in industry structure in the previous section. The main results of this section are that the historical trends of demand for different levels of education will continue also in the future.

As mentioned in Section 3, aggregate unemployment is determined residually in the aggregated model. The relationship between aggregate unemployment and education specific unemployment rates are based on the historical relationship with one exception. We assume that the unemployment rate for workers with non-specific educational background (i.e. workers with upper secondary education general programs will be higher in the projection period than

Figure 5: Projections of employment by industries. Volumes are indexed relative to the volume in 2013.



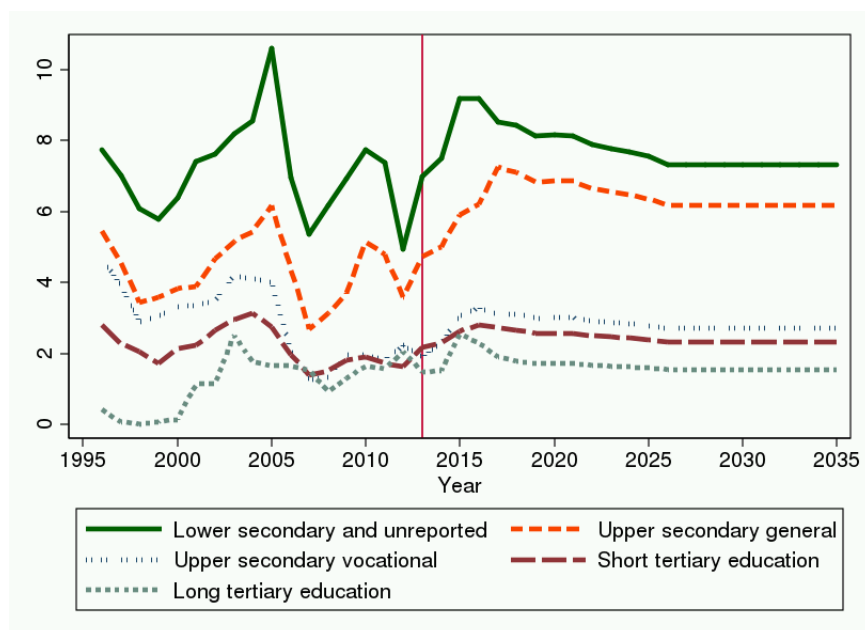
it has been historically due to relatively fewer job opportunities for this type of labour in the future. Indications for this development are the reduction in the number of jobs without formal education requirements and increased qualification/certification requirements in work life. For example, currently there are strict rules for how the cleaning of hospitals should be performed and the requirements are likely to increase with new knowledge. The cleaning industry is also developed to meet new requirements, e.g. to be more environmental friendly and perform the tasks more economically. To achieve the knowledge, formal educational background is required. Similar examples are found in other fields of work life. The education specific unemployment rates, displayed in Figure 6, show that both historically and in the projection period workers with shorter education have relatively higher unemployment rates.

Labour force survey (LFS) figures show that unemployment rate has increased in 2014, 2015 and to some extent so far this year. In line with this development education specific unemployment rates are expected to increase in this period. The aggregated unemployment rate is expected to decrease in the coming years in line with the expected upturn of the Norwegian economy and then stabilize around 3.7 percentage points (see table 2). In line with this development the education specific unemployment rates will stabilize too.

The model of wage formation in Norway is quite centralized. Hourly wages are determined in each of the three main sectors of the economy; manufacturing, market oriented service activities and public services.² The wage

²The estimated error correction coefficient for the upper secondary vocational education group, employed in public services, is numerically very small (i.e. -0.0001) and imprecisely estimated. This does not apply to the other education groups. Among workers employed in public services, those with upper secondary educational background are close substitutes to those with short tertiary education. Therefore we assume that the error term coefficient for workers with upper secondary educational background is the same as that of workers with short tertiary ed-

Figure 6: The unemployment rates by educational group.



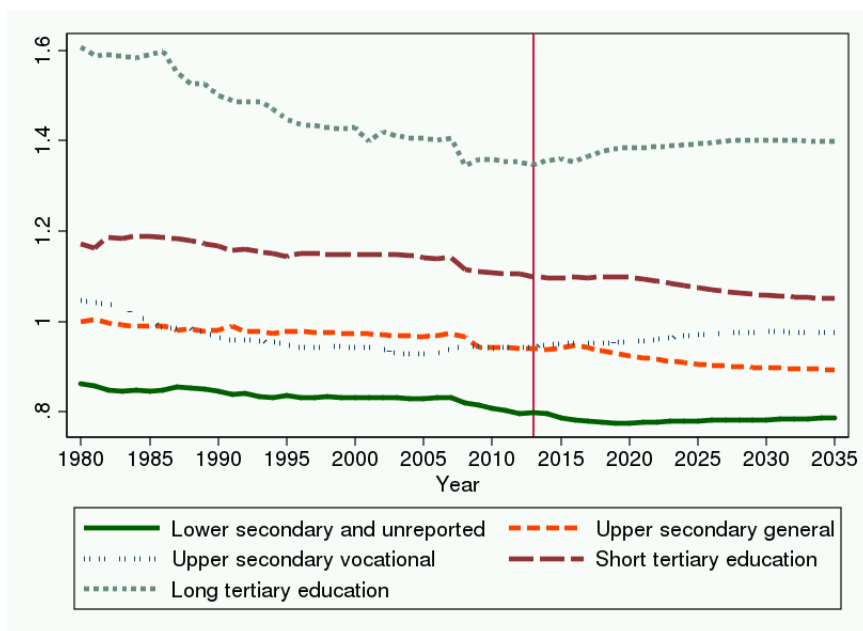
formation depends on both on the aggregated and education specific unemployment rates.

The centralized wage setting has contributed to relatively stable and to some extent even decreasing wage differentials in past decades, see figure 7 that shows the education-specific wage rates relative to average wage rate. Relative wages for workers with long education background decreased even more in 2008 due to the financial crisis. In addition, figure 7 shows that relative wages will increase somewhat for persons with long levels of education in line with the expected upturn of the economy and corresponding to a decrease in unemployment in the next decade. The wage premium will then stabilise at a level which is similar to the level observed prior to the financial crisis.

Relative wages of persons with upper secondary general education is decreasing, which is in line with the assumption of somewhat increased unemployment for this group. The lower relative wages and higher unemployment rate is also in line with the trend of decreased demand for non-specific educational background. Relative wages for vocational education increase and demand decreases for this type of workers. Wages of workers with short education are constant. This will lead to substitution effects between medium and short education. The estimation results in Haraldsen et al. (2015) show that with the exception of some industries (manufacturing of consumption goods, financial intermediation and electricity) changes in wages of labour with short education will have a larger effect on the demand for labour with vocational upper secondary education than on the demand for labour with tertiary education. The projected development in wages will therefore contribute to the development in the composition of employment described below. This is partly due to the

education (i.e. -0.17). Haraldsen et al. (2015) provides an overview on the estimated coefficients of the wage relations.

Figure 7: Hourly wage rates by educational group relative to the average hourly wage rate.



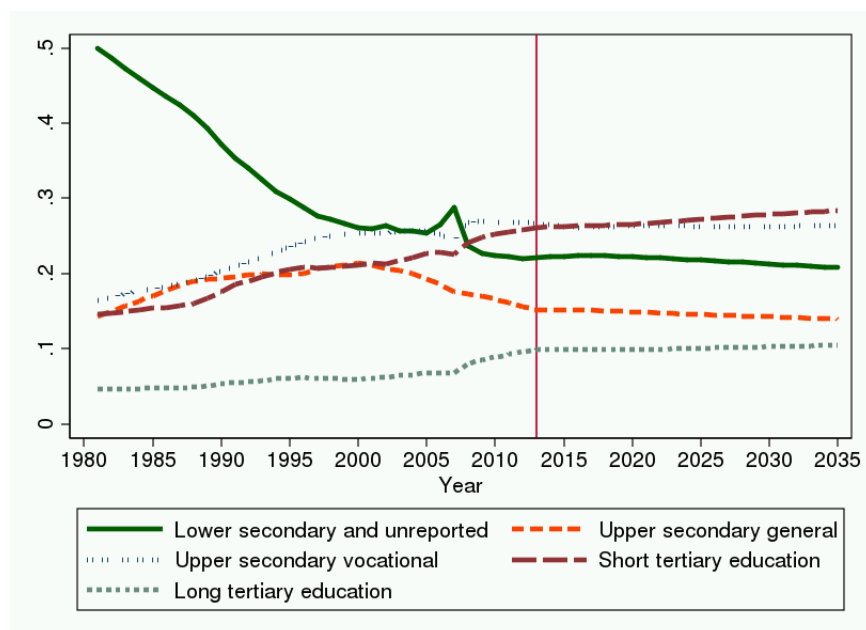
fact that substitution possibilities between labour with short and vocational upper secondary education are quite high in some industries, for example in construction. Labour with vocational upper secondary education and labour with tertiary education are complements in manufacturing of consumption goods.

Figure 8 displays the projected employment aggregated across all industries in the economy for each of the five educational levels relative to aggregate employment. It indicates that there have been large changes in the composition of the labour force during the last decades. The historical development suggests the presence of skill-biased technological change (i.e. that demand for labour with tertiary education grows faster than demand for labour with shorter level of education). In our estimations this development is represented by a trend. Haraldsen et al. (2015) document that the estimated trend coefficients are strongly significant in most industries. It should be noted that this deterministic trend is imposed in absence of observable variables that capture this close link between technological change and the skill composition of labour.

In the projections, technological progress are expected to increase demand for high skilled workers throughout the whole period. Hence, demand for labour with tertiary and medium length of education increases in line with technological change while relative demand for labour with primary or upper secondary education, general programs decreases.

It should also be noted that immigration affects the composition of employment both in the historical period and in the projections. Figure 8 shows that the negative trend in employment share of persons with lower secondary and unreported education that was very strong from the late 1980s came to a halt by the early 2000s. After 2004, Norway has experienced a rise in the immigration flow. A large part of the immigrants were registered with secondary

Figure 8: Employment by level of education relative to total employment.



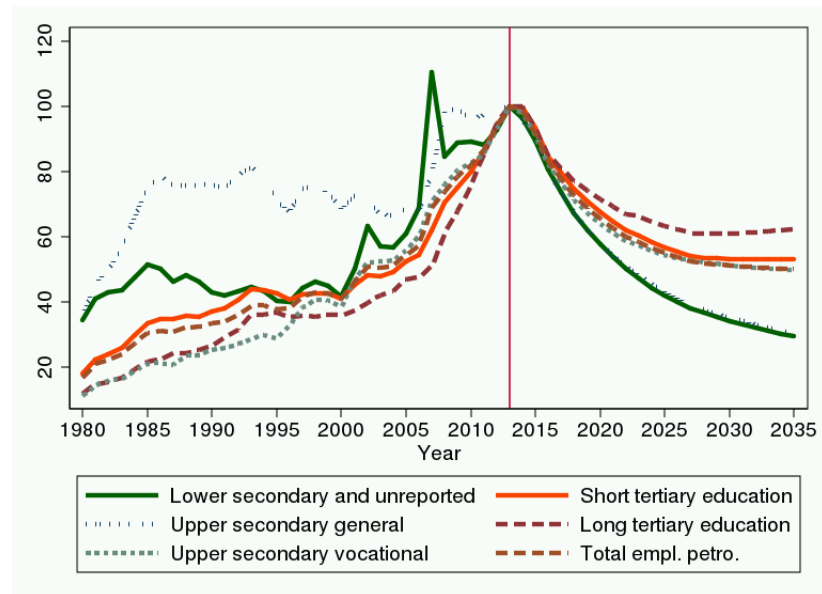
education or with unreported education background. Therefore, the increase in 2005-2006 reflects the considerable labour immigration into Norway from new EU-members in Eastern Europe. SSB carried out a survey in 2011 to improve our understanding of the skill composition of the immigrant labour force. Although the survey contributed to a reduction in the number of immigrants with lower secondary and unknown education, these numbers are still high. In addition, the number of immigrants with unknown education background who have arrived after 2011 (i.e. after the survey was carried out) is also high. The projected demand for labour (see Section 4.7) also shows that the share with unknown educational background is increasing in the projection period, while share of workers with lower secondary educational background is decreasing.

The growth in employment of persons with upper secondary education, general programs, ended around year 2000. Since then employment of this level has been fairly stable and is projected to decrease in the entire projection period. This corresponds well with increased qualification/certification requirements in work life.

As a consequence of qualification/certification requirements the share of employees with vocational education has increased. However, the growth has been more moderate during the most recent decade. In the projections, employment of vocational education is expected to continue, but the petroleum industry, which employs many persons with vocational education, will dampen the development. The spillover effects on the manufacturing industry, which uses many workers with vocational background will also contribute to a moderate growth in employment at this level.

Employees with short tertiary education are projected to comprise the largest group in the future. The share of workers with long tertiary education continues to increase, and both the number and the share of the workforce with ter-

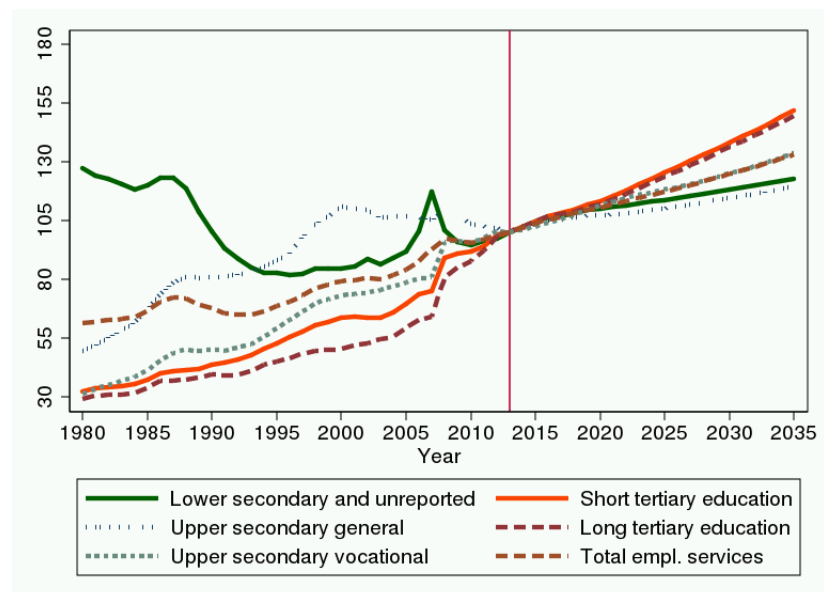
Figure 9: Projections of educational level in the petroleum sector. Volumes are indexed relative to the values in 2013.



tertiary education corresponding to a Master degree will increase in the projection period. Changes in industry structure with increasing employment in service industries contributes to this development. For example, since both market oriented services and public sector mainly employ persons with long tertiary education, the demand for these groups are expected to be high in the projection period. Furthermore, changes within industries where technological change seems to favour employment of those with tertiary education will contribute to higher employment of persons with long tertiary education.

Figures (9) and (10) show the projected employment growth by education level for two industry groups, the petroleum sector and the services sector. These two industry groups have very different employment developments. While employment in the Petroleum sector falls, employment in the Services sector grows steadily. Still, both industries show similar developments in the skill composition. Employment growth for those with low education is lower than for those with high education.

Figure 10: Projections of educational level in services. Volumes are indexed relative to the values in 2013.



4.7 Projected demand for labour by educational field

In this section, the five educational levels are further disaggregated into 28 educational fields (see Section 2 for a complete list). The 28 fields correspond to the Norwegian education standard (NUS2000) and several educational programs are covered by several fields.

In the previous section, MODAG was used to project industry-specific employment by level of education, accounting for changes in industrial structure that may affect demand for labour. The employment projections at the industry and educational level from MODAG are then used to project the employment for the 28 educational fields by using a sub-model, or projection procedure. Employment in each industry is disaggregated on various educational fields using micro data for employment from the Norwegian employer-employee registers. We project employment shares of the educational fields relative to employment of the educational group in each industry.

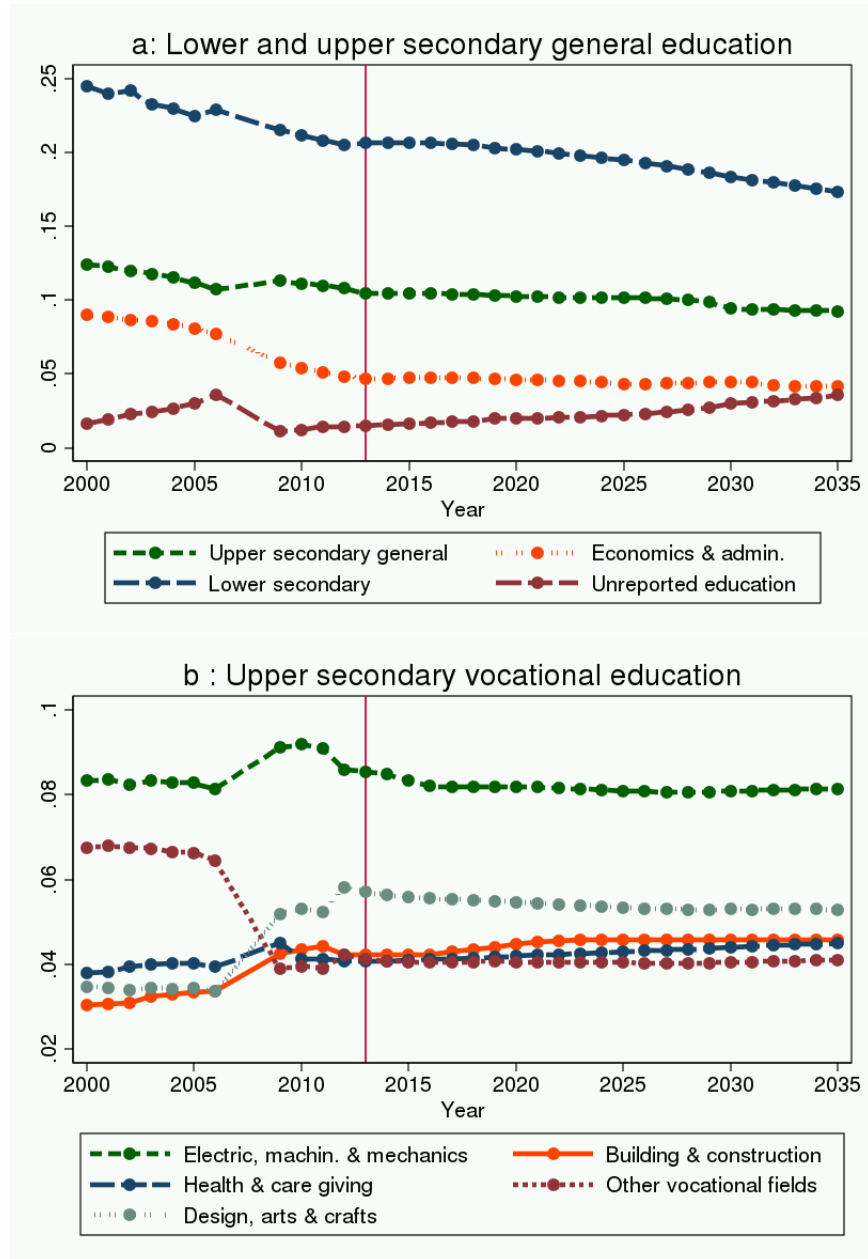
Data from 1986 to 2006 and 2009 to 2012 (Administrative registers), are used for projecting these employment shares. Employment by educational fields are projected for the next twenty three years by extrapolating the historical employment trends for 25 of the 28 fields in each industry.³ The education fields "Other fields, upper secondary education", "Other tertiary education, lower degree", and "Other tertiary education, higher degree" are three exceptions. The results are based on a yearly employment growth of 1 percent for these fields from 2012 to the end of the projection period. The reason for not relying on the estimated time trends for these fields is that they have experienced large compositional changes throughout the years. For example, the number of workers with education from abroad has increased since the mid-2000s and initially there have been challenges with correct educational classification for these workers. Consequently, they are overrepresented in the three educational fields mentioned above. Such compositional changes can bias the estimated employment trends and reduce the credibility of the projections.

The employment shares are calculated for the 28 educational fields in each industry and are coupled with the projected employment by educational levels and industry, the projections derived from MODAG. The projections are based on historical employment shares of educational field and a number of changes (e.g. political changes) might cause the actual development to be different from the projections.

Figure 11a displays the number of workers with lower secondary education, secondary general education with focus on Economics and administration, secondary general education and unreported education. Employment of the first group is declining relative to the development in employment in general. The employment rate for secondary general education and Economics and administration are fairly stable or declining somewhat in the projections. It is explained quite thoroughly in the previous section that this development corresponds well with increased qualification/certification requirements. The employment share of persons with unreported education is increasing throughout

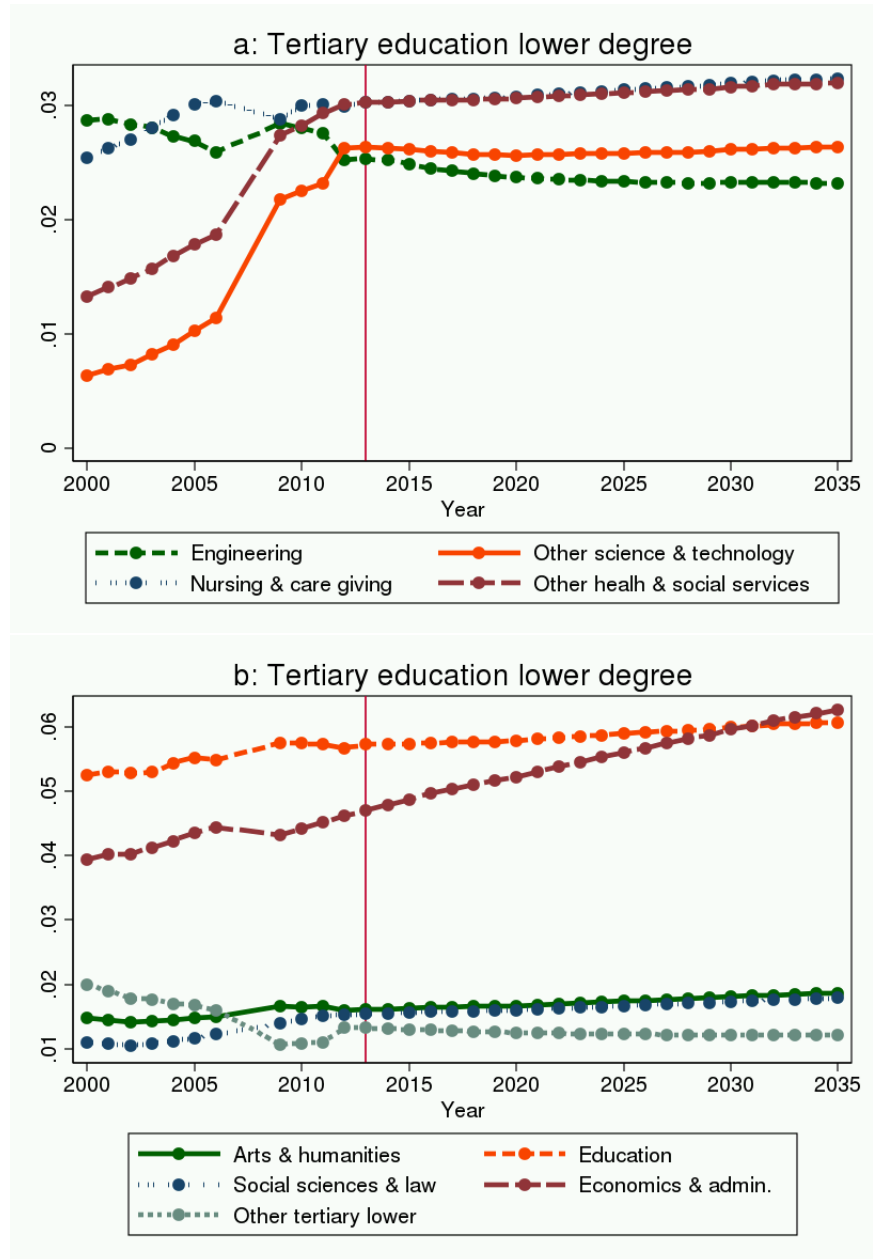
³Technically linear trends are estimated while including a step dummy for the years 1986 to 2006. This takes into account that the composition of the educational fields may have changed between the two periods.

Figure 11: Number of employed workers with lower and upper secondary education relative to overall employment.



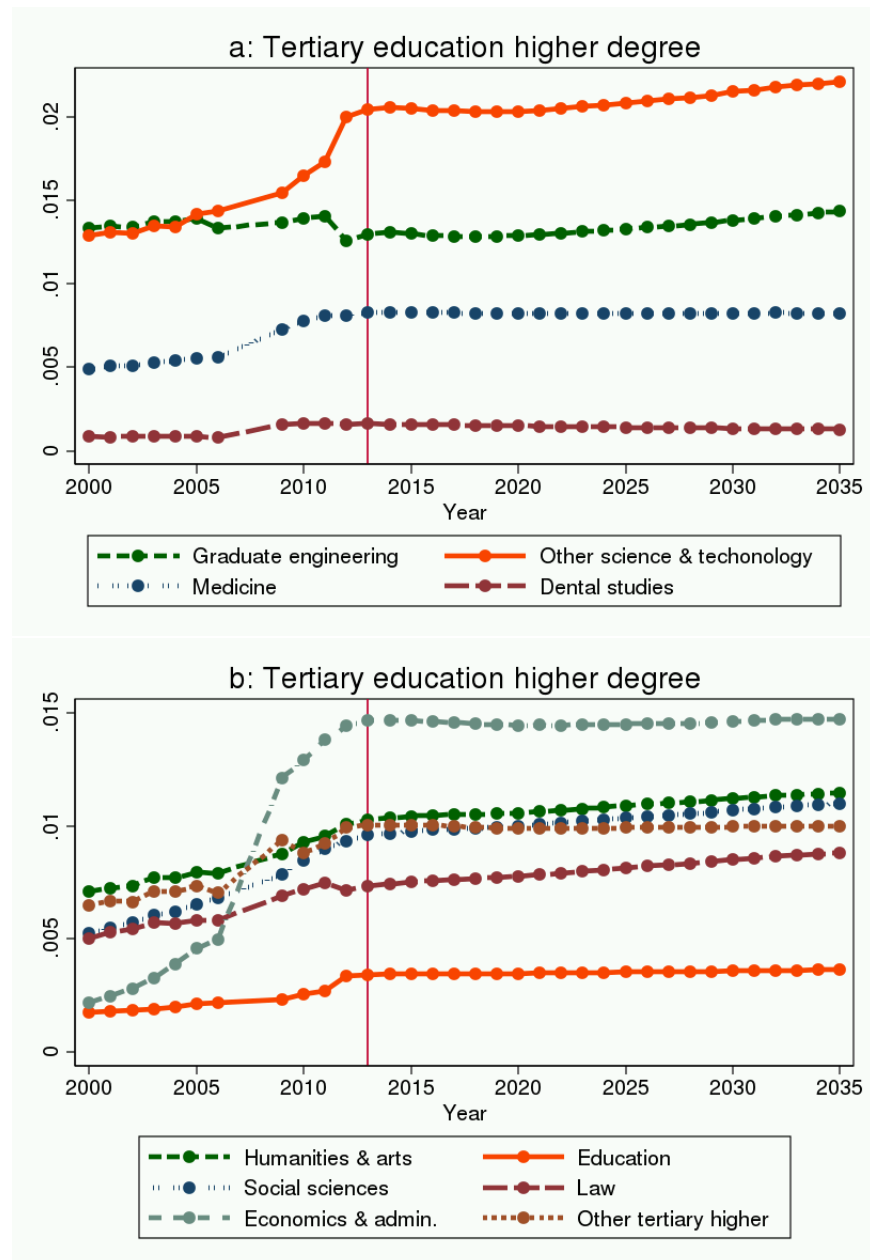
Note: There is a break in the time series for the years 2007 and 2008.

Figure 12: Number of employed workers with tertiary education, lower degree, relative to overall employment.



Note: There is a break in the time series for the years 2007 and 2008.

Figure 13: Number of employed workers with tertiary education, higher degree, relative to overall employment.



Note: There is a break in the time series for the years 2007 and 2008.

the period. This is because we lack information of the educational background of immigrants which is also explained in the previous section. This is also the reason why the demand for persons with lower secondary education and unreported education put together, as in the previous section, is constant and not falling in the projection period.

Figure 11b displays observed and projected employment of workers with upper secondary education vocational programs. Electric, machine and mechanic is by far the largest educational field within this category. This group is a near substitute to design, arts and craft that has a decreasing trend in the projection period. The demand for these groups grows somewhat lower than suggested by only investigating the first group.

The initial input that is used to calculate the share of workers with education health and care giving is chosen so that the quality of services provided by this sector is constant. The average growth rate of employment in health and care giving is between 1.8 and 2.7 percent annually. Increased demand for workers in the health sector corresponds well with the fact that the share of elderly increases in the population. The output from the model shows that the demand for health and care giving at upper secondary educational level increases steadily over the entire period but only with a rate between 1.1 and 1.5 percent annually. The reason is that the growth from MODAG accounts for substitution and complementarity towards other levels of education. Hence, the resulting growth for this educational field is lower than a partial analysis would suggest. This implies that employment should increase more than the initial analysis to ensure sufficient number of workers within this field. It can also be argued that the input to this model should be higher. First because persons demand higher quality and second because only accounting for demographic changes implicitly requires that private health and care giving has to increase. This is due to the fact that otherwise fewer individuals have to take care of more elderly persons. It is therefore safe to say, that these projections are at the lower bound for what will be demanded in the future.

The expected development of the groups of workers with tertiary education, lower degree, relative to the aggregate development in employment are presented in Figure 12a and Figure 12b. The figures show that also at this level there is a high demand for persons with health related educational background. Both the demand for nursing and care giving and other health and social care services increase. The input growth used to calculate the employment share for this field is about 1.7 percent annually. As discussed in the previous paragraph this is probably the minimum employment required to account for the number of elderly in the population. The output growth from the model for this group corresponds well with the given input growth because the growth rate in tertiary short education also increases in the projection period.

Persons that have studied Education constitute the largest share in the group with lower tertiary education for most of the projection period. The share is almost constant from 2013 to 2035. This is in line with the new population projections suggesting a constant share of persons in school age. The group of workers with a degree in Economics and administration is projected to increase, and this is the second largest group at this level. Demand for workers with education in Social sciences and law also increases in the projection period. En-

gineers and other fields of science and technology are close substitutes in the production process. Other fields of science and technology will increase while Engineering shows a small declining share in the projection period. This might be due to shortages of Engineers in the historical data. The demand for this type of labour should also be judged against the longer education level for the same groups. The groups of workers with bachelor degrees in Arts and humanities or Other tertiary lower educations constitutes the smallest groups within this category.

The group of workers with education corresponding to a Master degree or more, are displayed in Figures 13a and 13b. In 2013, workers with Other science and technology constituted the largest group and it has increased rapidly under the period with very high oil prices. At the same time graduate engineering increased less. This can, as we previously explained, be due to shortages in labour supply. The share of demand for these educations are projected to be constant also in the future. Economics and administration has increased rapidly. Also social sciences are going to have a marginal increase as a share of the total employment in 2035. The aggregated share of demand for persons with master degrees in the field of Education is assumed to be constant in the projection period. The demand share for dentists is assumed to be constant as a share of total employment. The share of workers with education in Medicine has increased from 0.5 percent of all employed workers in 2000 to 0.75 percent in 2013. In spite of the aging of the population, the projections show that demand for this group is constant over the period.

4.8 Results compared to the report of 2013

Compared to the results in the 2013-report (Cappelen et al. (2013)), there are some important differences. First, the industry composition is projected to change more as the petroleum sector is expected to further shrink. This also has an effect on the manufacturing industry which grows slower. At the same time domestic demand grows faster resulting in a positive impulse to the construction sector and services. This yields lower demand for labour with vocational upper secondary education and a somewhat reduced demand for labour with tertiary education, but even higher demand for those with short education level. Table 4 summarizes the projections made in this report to those made in 2012, see Cappelen et al. (2013). In this table, deviations in employment in 2012 and 2030 are shown together with projected employment levels in this report.

Relative wages of vocational education is now increasing while they were decreasing in the previous report. This decreases the demand of vocational education and prevent demand for workers with primary or secondary lower education to fall in the projection period. At the same time relative wages of short tertiary education decreases in this report compared to our previous projections in 2013. This is probably due to an increase in labour supply. Since the two levels secondary vocational education and short tertiary education are substitutes in the production processes, the demand for vocational educated workers are even lower in this report. In the previous report, relative wages for this group were stable throughout the projection period. The difference also increases demand for short tertiary education in this report compared to the previous report.

The approach on calculating each educational field in this report builds on the method presented in [Bjørnstad et al. \(2010\)](#), which matched data with industry-specific employment to educational field. The same approach was also used in [Cappelen et al. \(2013\)](#) using the years 2009 to 2010. However, both previous reports used a short time period to estimate the employment trends. Short time periods can lead to very steep trends in demand for various fields of education. This might be due to business cycles, for example where the demand for one type of educational field increases with the cycle. The experience of the two previous reports was that the trends had to be adjusted mechanically afterwards. Our method, with a longer time span, shows that most trends decline with the extended data period. The trends in this report are therefore mostly derived by using the historical pattern. The difference is particularly clear for the demand for electric, machine and mechanic of labour which was increasing steeply in the previous report. The steep trend in these years is visible in [figure 11b](#). Since we use a longer time span to detect the trend, our projections show a more moderate growth than before.

Persons with higher education in the field of Education are also lower in this report due to the new population forecasts with lower birth rates.

Finally, the focus in this report has been on relative development in employment for each educational field, while the previous reports have focused on levels of employment. In general, all figures will show a less steep development in most variables, since the economy is growing and all variables have a underlying trend.

Table 4: Employment level and employment deviations between the current analysis and the 2013-report. In 1000 persons.

	Level in this study		Deviation from 2013-report*	
	2012	2030	2012	2030
Primary and unreported education	589	680	-14	164
Upper secondary education	1142	1285	-33	-167
General programs	290	300	-13	3
Economics and administration	130	142	-12	10
Electronics, mechanics work and machinery	231	258	-18	-68
Building and construction	113	146	-9	-42
Other fields of science, technique and crafts	156	169	12	-34
Nursing and care giving	109	140	5	-10
Other fields, upper secondary education	113	129	2	-26
Tertiary education, lower degree	694	893	16	-64
Humanities and arts	43	58	-4	0
Education	152	191	-2	-27
Social sciences, business and law	41	55	0	-3
Economics and administration	124	190	-1	21
Engineering	68	74	-5	0
Other fields of science	70	83	9	-7
Nursing and care giving	80	102	-6	-42
Other fields of health and social services	81	101	21	8
Other tertiary education, lower degree	36	39	4	-15
Tertiary education, higher degree	259	330	21	12
Humanities and arts	27	36	1	4
Education	9	11	3	4
Social sciences	25	34	1	0
Law	19	27	-1	-1
Economics and administration	39	47	3	-4
Graduate engineering	34	44	-2	-3
Other fields of science	54	69	9	13
Medicine	22	26	3	-3
Dental studies	4	4	2	1
Other tertiary education, higher degree	27	32	2	1
Total	2711	3221	16	-24

* Positive figures means that this report projects a higher number than the 2013-report.

5 Modelling the labour force

To simulate the labour force by education in the future, we use the dynamic micro-simulation model MOSART. The model simulates the life course of the Norwegian population, and is used for projections of education, the labour force and pension expenditures. The model is further described in [Fredriksen \(1998\)](#). The MOSART model simulates events through the life course of all individuals registered in Norway. Most relevant here is that it simulates educational events so that new people entering the population are assigned educational characteristics. Also labour market entry and exit are simulated, allowing for complete projections of population and the labour force by education.

To make projections about the future, the life course events of those who are not yet born or are future migrants to Norway need to be taken into account. The MOSART model uses the population projections to simulate the life course events also for the projected population in the future.

Assigning educational characteristics to those in the future population who have not yet completed their education is done by simulating educational transitions. Individuals are simulated to make a series of transitions: Start, choice of level and field of education, completing the ongoing educational activity and, conditional on not completing, continue in education the next year. For each year, all individuals have the possibility to make this series of transitions and their educational characteristics are updated upon completion. For a more in-depth description of the events and the simulation, see [Gjefsen \(2013\)](#).

The data show that there are cases of persons having their educational background updated even if not registered in education. Many of the migrants in the data are not registered with any education for the first years after arrival. Migrants who have education at upper secondary or tertiary level from their home country can choose to report their education, and if having it approved, it is registered. To improve the data for migrants with unreported education, there was a survey in 2011, which has succeeded in improving the data quality substantially. 24% of the immigrant population are still registered without any educational information.

Also for the Norwegian-born who take education abroad, registration might be a problem if not being supported by the Norwegian State Educational Loan Fund (Statens Lekasse). In addition, there are cases of persons who complete the final requirements for graduating after having left an educational activity. To account for these educational transitions, there is a possibility to have educational background updated without being enrolled in any educational activity.

Educational choices made by the immigrant population distinguish themselves to some extent from the choices made by non-migrants. The transition probability is therefore estimated separately according to migration background, see [Gjefsen et al. \(2014\)](#) for an overview.

Educational transitions are simulated for each year, and the simulated population thus can have their educational characteristics updated also at higher ages. Register data show that most educational choices are made before age 30, but individuals still move in and out of education, and in some cases complete an educational activity after the early thirties.

To simulate the events in MOSART, probabilities to make the transitions

need to be estimated. For educational transitions, the probabilities are based on the observed transitions between 2009 and 2014 from register data on educational activities and completion. The estimated probabilities depend on individual characteristics and earlier educational history.

The length of the estimation period matters for the projections. There are fluctuations over time in the probability to make the transitions, and if relying on a single year, the projections are sensitive to these fluctuations. If using a too long time span, however, and trends in the transition probabilities, the estimated probabilities might not reflect the relevant situation. To take both these concerns into account, the last five years are used to estimate transition probabilities. The projections in Cappelen et al. (2013) and Gjefsen et al. (2014) are also based on the observed transition probabilities during the last five years.

Labour force participation differs according to educational background. Observed participation rates for each age and educational background is used in the simulation to assign labour market status for each year, and are aggregated to make projections of the labour force.

When making projections about the future, some assumptions need to be made. The projections are based on the population forecasts. There are thus implicit assumptions about fertility, mortality and migration. When making projections for labour force in the medium run, migration is the most relevant aspect of the population projections. It takes at least 16 years from birth to entering the labour market, and most people exit the labour market before death. Migration, on the other hand, might strongly influence the pattern of educational characteristics of the population. The results for labour force by education hinges on the assumptions for migration in the population forecasts.

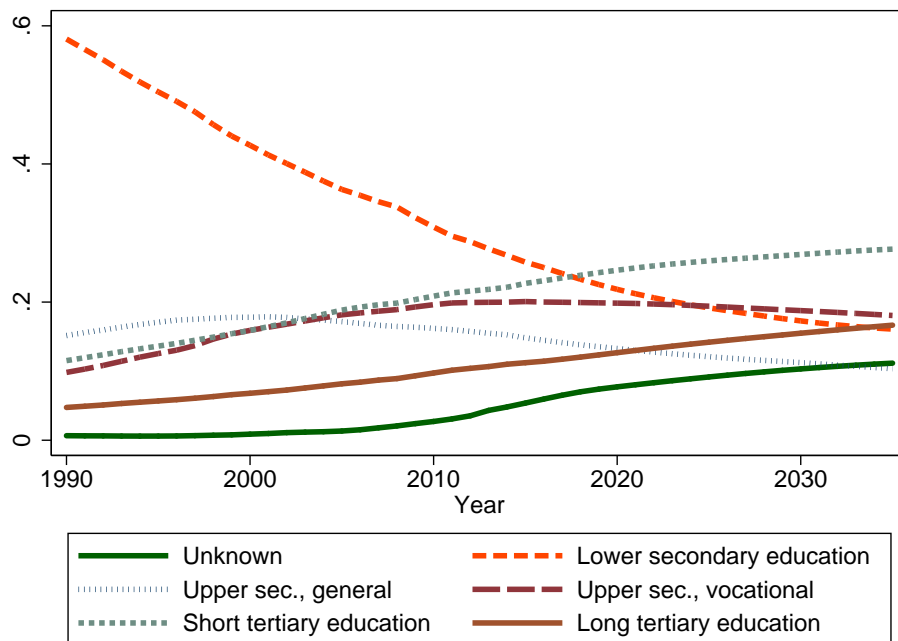
The model only projects residents in Norway. Hence, those who come to Norway for short stays are not included in the projections of the labour force. Both migrants living in Norway and expected migration in the future are included in the projections.

Probabilities to make educational transitions is assumed to remain the same as the mean between 2009 and 2014, conditional on the educational and individual characteristics in the population. Over the last decades, there have been strong trends in favor of starting in higher education. A relevant question is therefore if constant educational propensities are reasonable to assume. There are some reasons for such an assumption to be made. Realized educational transitions are a combination of the behaviour of the individuals making the choices and the institutions offering places in education. To disentangle the two is challenging. Any trends in observed educational transitions could therefore not be interpreted as trends in behavior. Moreover, educational enrolment varies over the business cycle, and using an average over several years makes it possible to make projections that are neutral to business cycle conditions.

Labour force participation is assumed to remain constant for a given age and educational background in the model, but can differ over the business cycle. The MOSART model attempts to project labour force for a business cycle neutral situation. The situation in the year to which the labour force is calibrated is thus important for the projections.

The MOSART model thus projects the number of persons who are expected to be at the labour market under the assumption that the participation rate do

Figure 14: Relative labour force by highest completed level of education.



not change for a given education, gender and age. There are no feedback mechanisms on the size and composition of the labour force from e.g. wage changes. Compared to the theoretical concept of the labour force, it is somewhat different. The part of the population participating at the labour market do so independently of institutional factors and demand for labour.

6 Projected labour force towards 2035

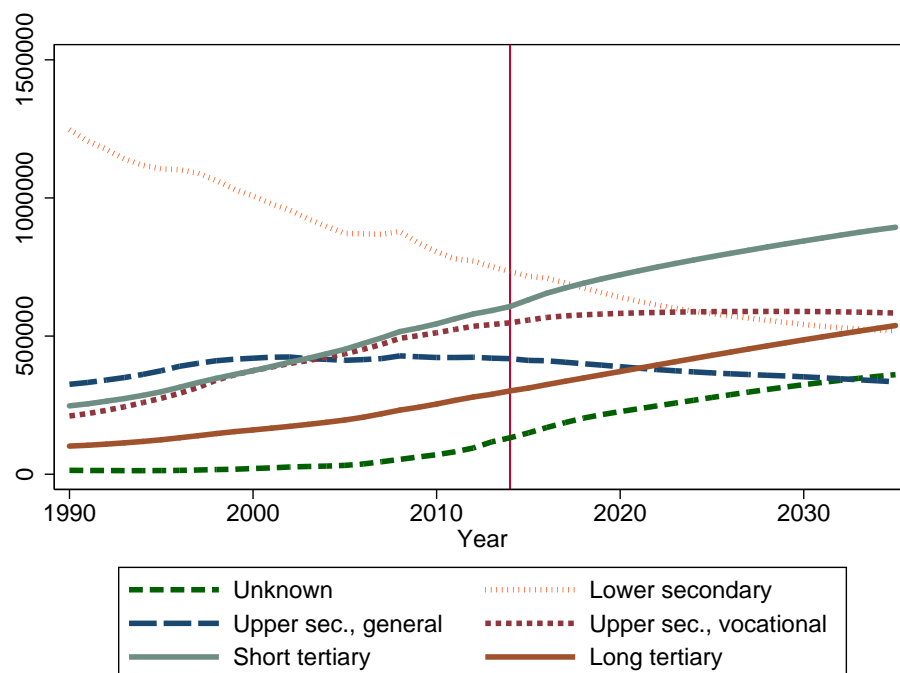
6.1 Projected labour force by level of education

Figures 14 and 15 show projected number of persons between 16 and 74 by level of education from the present towards 2035. The population projections makes projections of increasing population from today to 2035. Under constant employment probabilities for given education, the labour force will also increase.

The group for lower secondary education is projected to decline towards 2035, both in terms of number of persons and the share of total labour force. The share with lower secondary education is reduced from 25 percent in 2014 to 15 percent in 2035.

There has been a decline in the share with no more than compulsory education over the last decades, and under the assumption of constant educational propensities, it will continue to diminish. Older persons, with a larger share with primary and lower secondary education, are gradually replaced by younger cohorts, who in general have a higher education level. Moreover, those with low education have in general lower participation rates at the labour market than those with higher education.

Figure 15: Labour force by highest completed level of education. 1,000 persons.



Due to immigrant flows, the number of persons with unknown education is expected to increase. Some of those who migrate to Norway and have no reported education do in fact have higher education from the source country, but do not register.

The number of persons in the labour force with upper secondary education has increased during the last decades, but the projections show a slight decline from today towards 2035. High probabilities for persons with education at upper secondary level to start in higher education gives an outflow from upper secondary level education for those who complete an education at tertiary level.

Both for short and long tertiary education, the labour force is projected to increase. Towards 2035, the group with short tertiary education, i.e., bachelor's degree, is projected to approach the group with upper secondary education in magnitude. The large expansion in tertiary education during the 1990s lead to more than doubling the size of the labour force with these educations. When keeping educational propensities constant, the replacement of the older cohorts with the younger cohorts makes for a further increase in the labour force with short tertiary education as the highest.

Compared to those with short tertiary education, long tertiary education is a relatively small group, but it increases rapidly. The same mechanism is at work for this group. In addition, when more people complete a short tertiary education, more people have the necessary prerequisites for entering education at master's level, and thus have a higher probability to attain education at long tertiary level.

Figure 16: Projections of the labour force with education at unknown, lower and upper secondary general level. Relative to total labour force

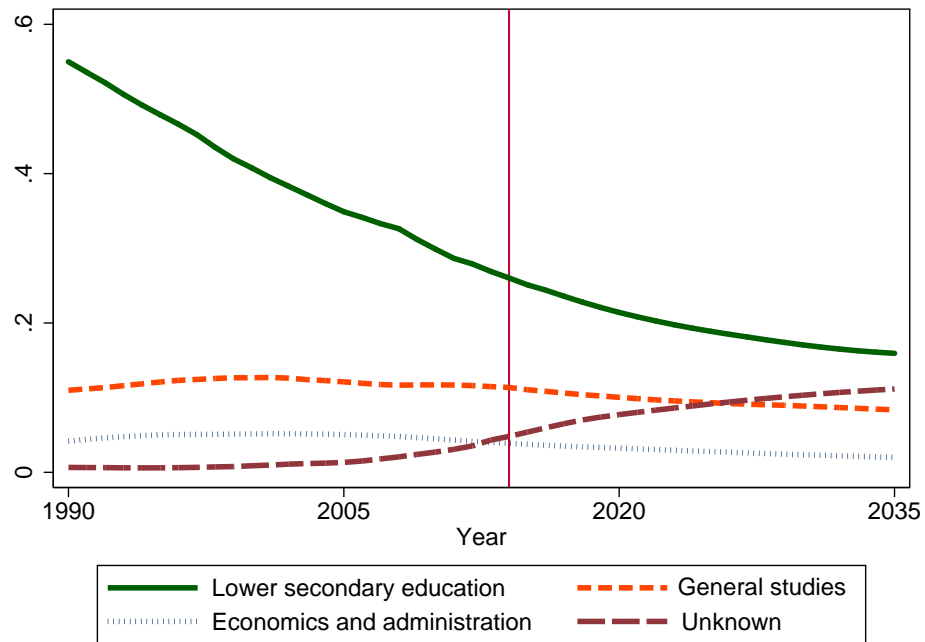


Figure 17: Projections of the labour force with education at upper secondary vocational level. Relative to total labour force

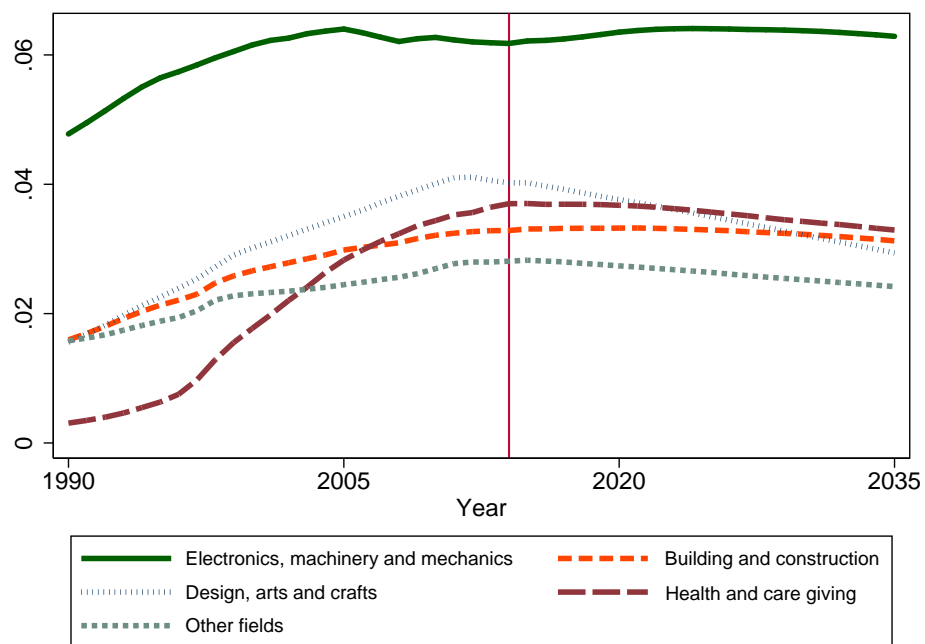
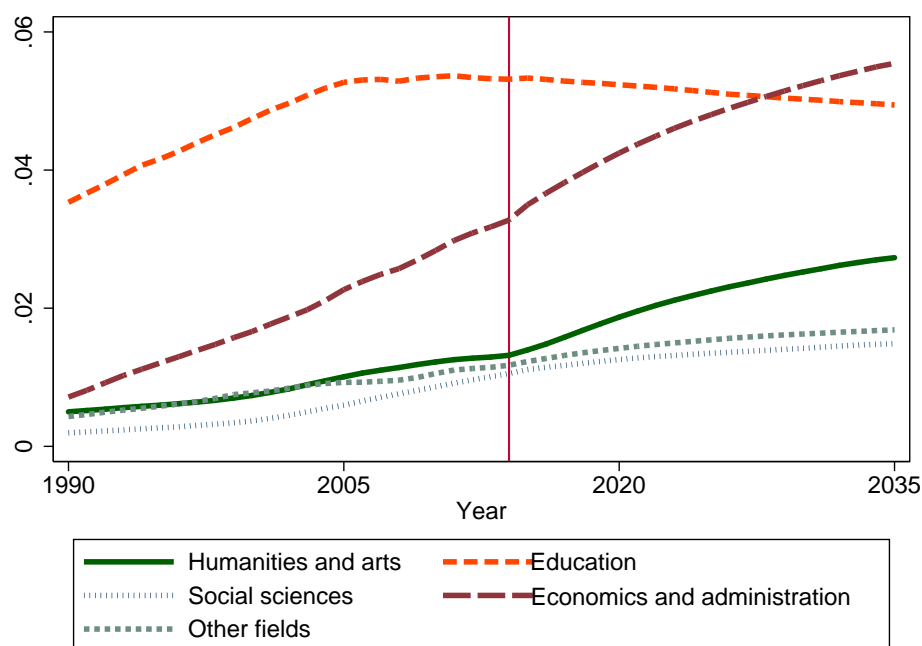


Figure 18: Projections of the labour force with short tertiary education, first group. Relative to total labour force



6.2 Projected labour force by educational field

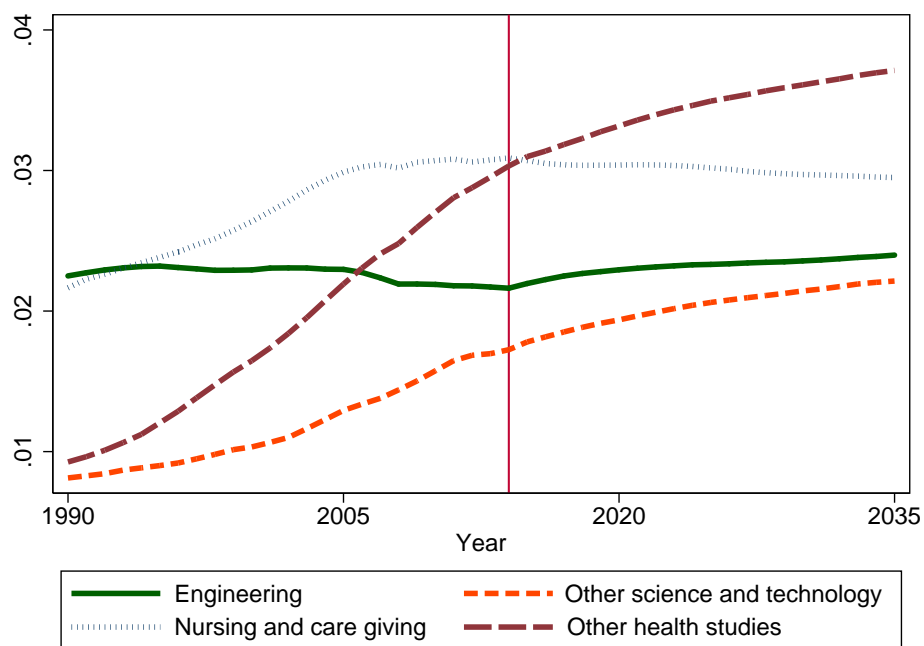
Figure 16 and 17 show the projections of labour force with education at upper secondary level or lower. As discussed earlier, we project a slight decline in the number of persons with general studies upper secondary level education. For economics and administration, the labour force with this field of education has decreased since 2010, and are projected to continue to diminish.

The largest vocational group is electronics, mechanics works and machinery. The labour force with such educational background is projected to increase towards 2035 in absolute numbers, but as a share of the total labour force, it is projected to stay the same throughout the period. For building and construction, we project a slight decrease in the share of the labour force, as we also do for health and care giving and other fields of study. For design, arts and crafts, a stronger decrease in the share of labour force is projected.

At short tertiary level, the projections show growth in the labour force for all educational fields, as seen in Figure 18 and 19. However, there are differences in how strong growth we project. The groups that are projected with the strongest growth are humanities and arts, social sciences, economics and administration, other health studies, and the residual category, other studies. Also the group of persons with education in science and technology different from engineering increases.

These categories all share an important characteristic: Much of the expansion in the educational system has been within these fields of study. There are relatively few in the older cohorts with such educational background, but many in the younger cohorts. This means that as we simulate the labour force in the

Figure 19: Projections of the labour force with short tertiary education, second group. Relative to total labour force



future, there are few people with these educations who move out of the labour force, and due to high propensities to choose these educations, a large inflow of new candidates into the labour market.

For studies in education and nursing and care giving, on the other hand, the age distribution is different. Of those in the older cohorts with higher education, a substantial part has education within these fields. To experience growth, the inflow needs to more than replace those who exit the labour market, so when relatively many persons within a group leave the labour market, the projections shows a lower growth in the labour force. For education within engineering, the age composition is similar to that of education and nursing and care giving. Projections show a small increase in the projected labour force of engineers compared to the rest of the labour force. For other fields of science and technology, the age structure has more in common with that of humanities and arts and social sciences. Hence, the projected growth in relative labour force is relatively strong.

Figure 20 and 21 show the projections for labour force with long tertiary education. We project labour force to increase for all groups at long tertiary level. The growth in labour force relative to total labour force increases for all educational fields at long tertiary level, except from dental studies and other fields.

Some groups show especially large increases in the share of the labour force. That is especially the case for humanities and arts, social sciences and economics and administration. The share with long tertiary education within the field of education increases from a very low level to a much higher one, and

Figure 20: Projections of the labour force with long tertiary education, first group. Relative to total labour force

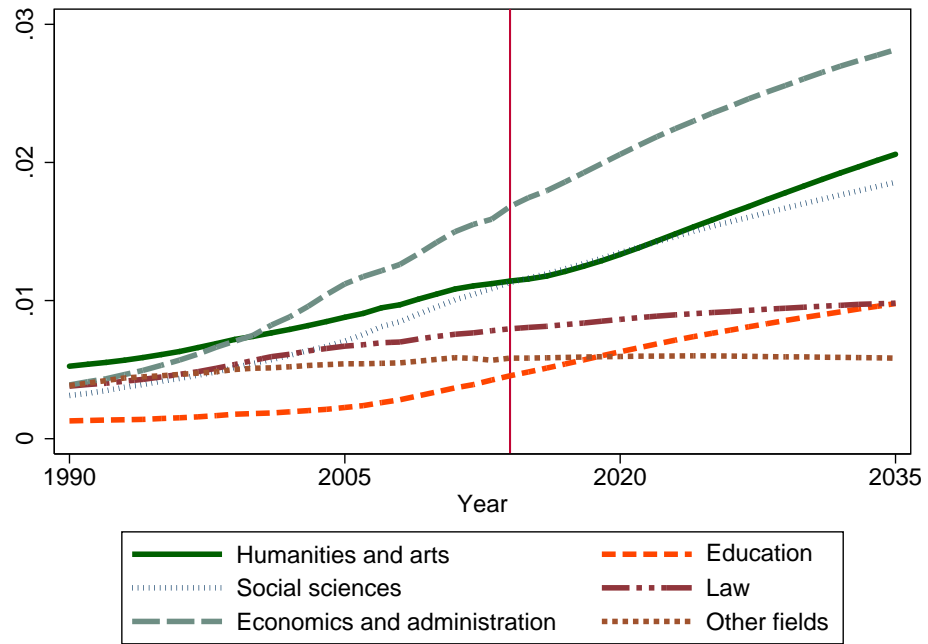
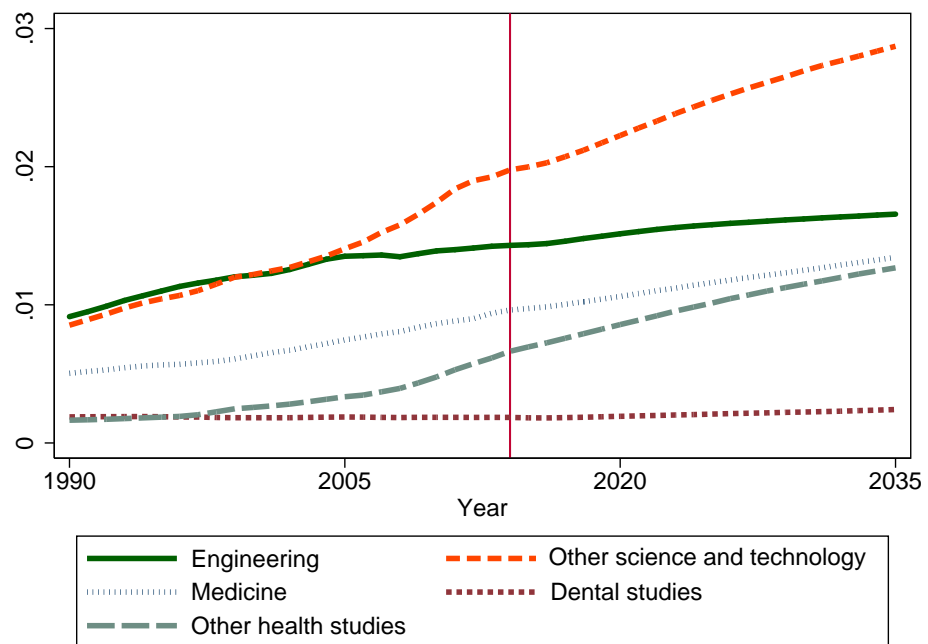


Figure 21: Projections of the labour force with long tertiary education, second group. Relative to total labour force



the increase measured in percent is therefore large. For law, the increase is relatively small, and for other fields of study, the share of labour force is projected to remain constant.

We project no large increase in the relative share of the labour force for dentists. For engineering and medicine, the model projects a relatively small and stable increase towards 2035, and relatively large increases for other science and technology and health studies at this level except from medicine and dental studies.

The age composition of the educational groups that drive the results at short tertiary level is also a relevant factor at this level. There are more people with higher ages within law, medicine and engineering than for humanities, social sciences, education and health studies. The projected growth in labour force for the latter groups is therefore higher.

7 Comparing projected labour force with projected labour demand

Employment and labour force are projected from separate models. Both models are based on the current Norwegian population and on the same demographic projections. Importantly, although the data sources are different (register data on the resident population for the labour force, National accounts for the demand), the classification of educations is the same in the two models. This enables the projections to be compared, which is a basis for discussing possible future mismatches in the labour market.

Projected mismatches can be either a surplus, i.e. a larger projected labour force than demand, or a shortage, i.e. a smaller projected labour force than demand.

While the projections for employment and labour force by education are disjunct and contain no mechanism that balance labour force and demand for labour, such mechanisms exist in the real labour market. For example, choice of education and workforce participation may depend on earnings or unemployment prospects, people may choose non-standard occupations given their education, firms may substitute workers with one education by another or by capital, and industries may grow more or less because of abundant or scarce labour force of relevantly skilled labour.

Imbalances by level and field of education are projected as growing differences between employment from MODAG and labour force from MOSART. Growing differences give an indication of future changes, relative to the continuation of recent trends, that are necessary to achieve a balance in the future. The projections give little indication of what exactly these changes will be. However, early indications, as those provided by these projections, may facilitate a gradual response. A gradual adjustment will typically be less costly than a more abrupt, e.g. one involving dramatic changes in educational choice in response to high unemployment, or one where firms employ large numbers of inadequately skilled workers.

In this section gaps from the new projections for employment and labour force by level and field of education are presented. Brief comparisons with projections from two previous reports [Cappelen et al. \(2013\)](#) and [Gjefsen et al. \(2014\)](#) are also provided.

7.1 Comparison by level of education

The projections from the two models may be compared as a basis for discussions of possible future mismatches in the labour market. However, comparison is not straightforward. Different data sources for the two models is one reason. While numbers for employment by industry and education in MODAG are collected from National Accounts, the numbers for labour force by education in MOSART are collected from administrative registers. Although National Accounts to a large degree are based on administrative registers, different solutions for treatment of earlier changes in definitions and classifications have caused some deviations in the numbers for labour force and employment by education. Especially this is the case for registration of educational information

among the large amount of immigrants that have arrived to Norway in the past decade.

To compare projections of labour force by level of education from MOSART to the corresponding employment from MODAG it is important that the starting levels for the two series in the base year are consistent. We have therefore chosen to adjust the MOSART-numbers by level of education to make them consistent with the numbers from the National Accounts in 2014 and the number of unemployed. The calibration is made for each of the main five educational groups shown in Table 5 and Figure 22.

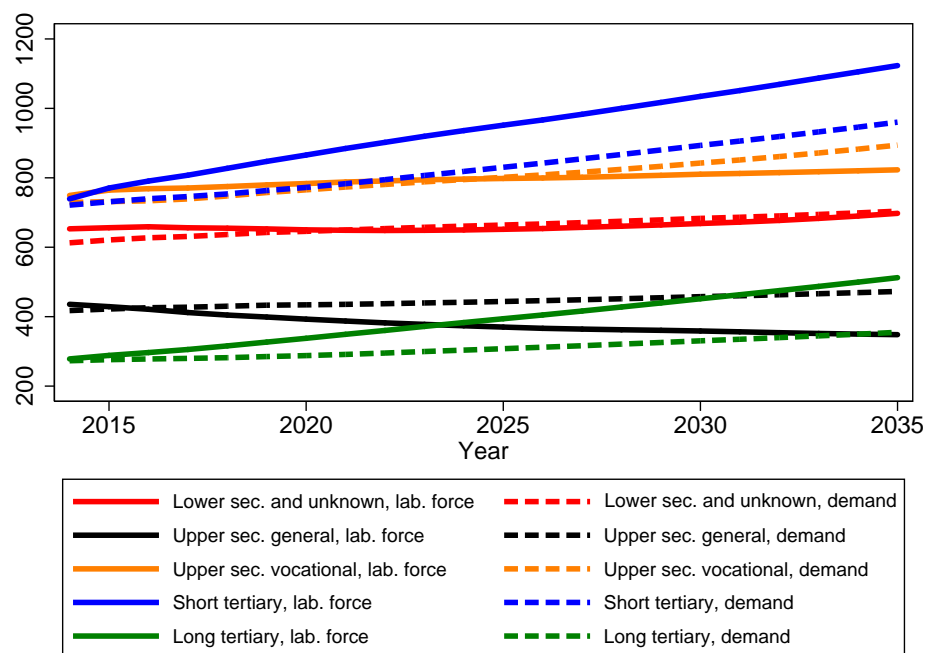
From the base year 2014 projected growth rates for labour force by level and field of education are determined by MOSART. To secure consistency with the projections for total labour force determined by MODAG, the projected numbers by field of education are also corrected each year by the ratio between total labour force from MODAG and MOSART respectively. Because there are only small changes in participation rates in both MODAG and MOSART the deviations between the growth rates for aggregate labour force are of minor importance. Demographic development, and especially net immigration, is the main factor behind growth in labour force in Norway in the coming decades. As a result of the annual correction related to total labour force, the sum of projected imbalances for the different groups is equal to the total number of unemployed from MODAG.

Projected development for employment and labour force for the five groups by level of education from 2014 to 2035 is presented in Figures 22 to 26. The presented imbalances in 2014 reflect the number of unemployed for the five groups in this year according to the Labour Force Sample Surveys (AKU). About 40 per cent of the unemployed were among persons with only primary, lower secondary or unknown education. Unemployment for each of the other groups (Upper secondary education general programmes, Upper secondary education, vocational training and Short tertiary education) amounted to less than 20 per cent of total unemployment. Only few persons with Long tertiary education were unemployed.

As explained in Section 4, total unemployment is expected to increase at the beginning of the projection period and then decline in line with the recovery of the Norwegian economy. In 2030 total unemployment is projected to 117 000 persons by MODAG.

We have chosen to add the results for Primary, Lower secondary and Unknown education together in the presentation. Although some effort has been initiated to collect educational information for immigrants, this information is lacking in administrative registers for a significant part of them. Especially this is the case for immigrants with recently issued permission to stay, affecting the projections of population by level of education with MOSART. The more aggregate information about the level of education among the employed in the National Accounts is also based on the Labour Force Sample Surveys, and projections for demand are thereby not so much affected. Although not perfect, adding the numbers for persons with Unknown education together with the numbers for those with Primary and Lower secondary education seems to be a less severe approximation now than earlier because it is reasonable to think that the effort of collecting educational information among immigrants has been

Figure 22: Projected labour demand and labour force by level of education. 1,000 persons.

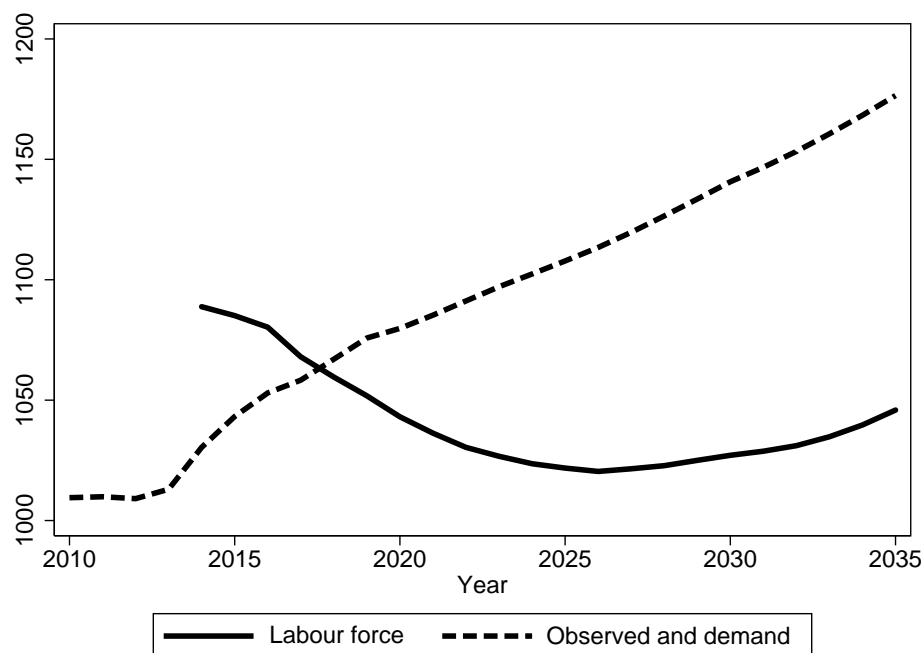


more successful for those in possession of Upper secondary and Tertiary education compared to Primary education. This may be seen from Table 1 in [Gjefsen et al. \(2014\)](#). However, there is still a possible gain in improving information about educational background among new immigrants in the MOSART model.

The present projections of growth in labour force among persons with Primary, Lower secondary and Unknown education show up to be equal to the results from 2014. Growth in the labour force for this group is caused by the growing number of immigrants while the native labour force with this level of education is projected to decrease. This is also the case for the development in employment, see Section 4. However, while demand for persons with Primary, Lower secondary and Unknown education was projected to decrease in [Cappelen et al. \(2013\)](#), it is now projected to increase. This is partly due to the fact that relative wages for the group with Lower secondary education versus Upper secondary education vocational programmes are assumed to decrease. Lower relative wages lead to increased demand for this type of labour. The result is also partly due to the fact that some of the immigrants registered with Unknown education actually hold a higher education. A rationale behind the result could also be that there is an immigrant group that performs jobs that are associated with vocational education at Upper secondary level, even though they are not registered with any formal education. What is observed as demand for persons with unknown education could thus in fact be demand for persons with vocational education.

As presented in Figure 24 there is only projected a modest growth for labour force with Upper secondary vocational education towards 2035. The re-

Figure 23: Projected labour demand and labour force with Primary, Upper secondary general and Unknown education. 1,000 persons.



sult is caused by rather small rates of youths starting at these educations, and a significant part of them do not complete. In the first years growth in demand is also low, mainly due to the downturn for important manufacturing industries related to the petroleum industry. The negative impulse from the petroleum sector is counteracted by growth in construction that prevents a more profound decline in demand. In the longer run when the economy starts to recover, and growth in demand for labour with Upper secondary education in health care increases as a result of the ageing of the population, demand increases stronger than labour force creating excess demand for these groups.

Due to high propensities to start and complete both short and long Tertiary educations, see figure 25 and 26, we have projected a strong growth in the labour force for these groups towards 2035. For Long tertiary educations the number of persons in the labour force will almost double from 2014 to 2035. Although we have projected a large growth in demand for these groups, it is not as strong as growth in the labour force. The difference in growth in projected demand and labour force creates increasing excess supply if the high educational propensities continue.

In Table 5 we have compared the current projections for labour demand and labour force by level of education in 2030 with the previous projections in Cappelen et al. (2013) on the demand side, and with Gjefsen et al. (2014) on the labour force and for imbalances. As mentioned above the projected imbalances for the different fields of education in 2030 sum up to the projected total number of unemployed in MODAG at 119 000 persons corresponding to a rate of unemployment of 3.6 per cent. Deviations between the current and previous results

Figure 24: Projected labour demand and labour force with upper secondary vocational education. 1,000 persons.

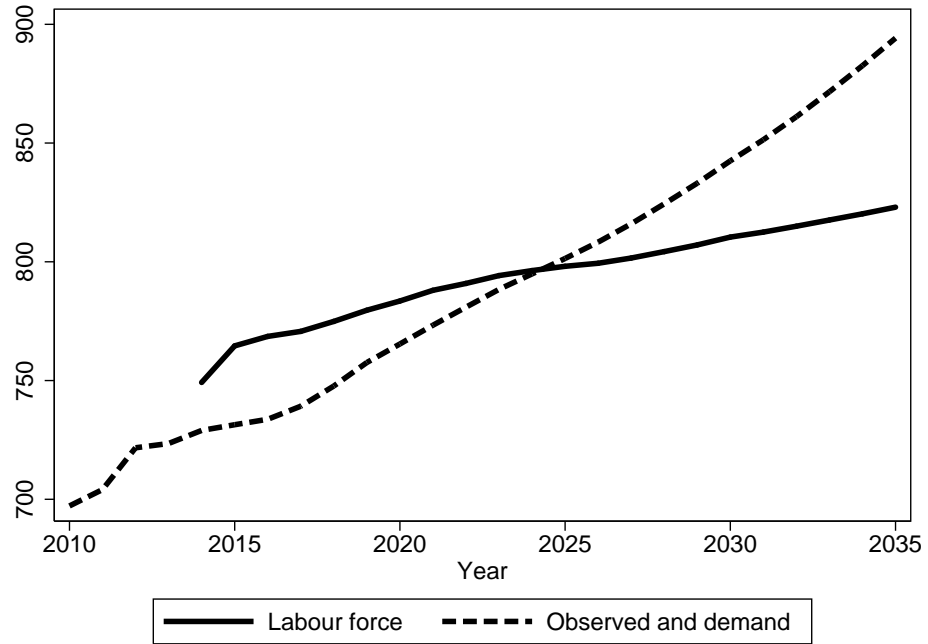


Figure 25: Projected labour demand and labour force with short tertiary education. 1,000 persons.

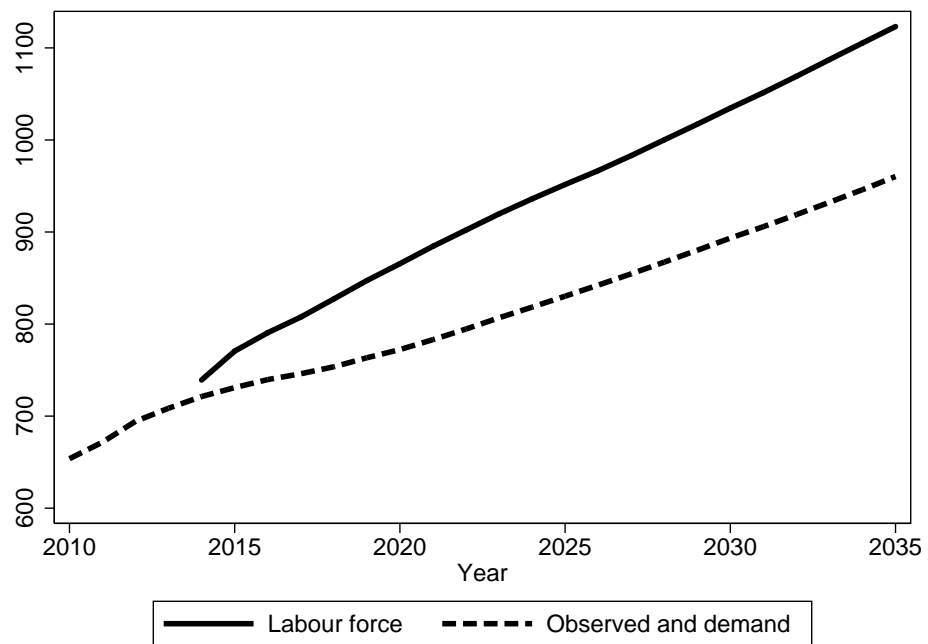
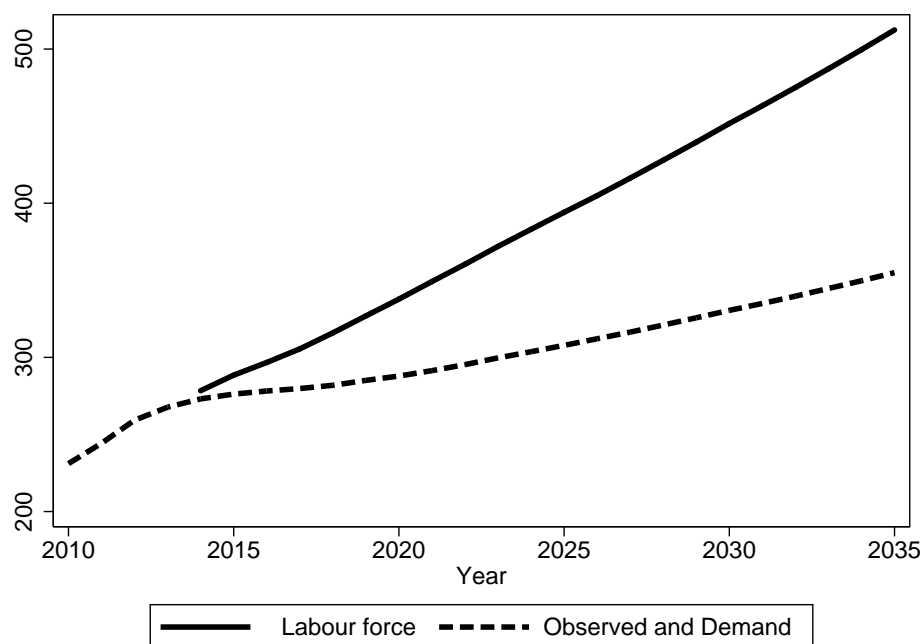


Figure 26: Projected labour demand and labour force with long tertiary education. 1,000 persons.



for total demand and supply projected by the macroeconomic model MODAG are rather small. The aggregate rate of unemployment is only slightly higher for the current projections.

The deviations for different levels of education are larger. For Lower secondary and Unknown education, demand is projected to grow more with the present report compared to the former, while projections for the labour force are almost unchanged. A larger projected growth in wages for persons with Upper secondary vocational education compared to Lower secondary than in Cappelen et al. (2013) is the main reason for the altered result. As a consequence, the former result of projected excess demand is turned to a balance between the labour force and demand for this group towards 2030.

Compared to Gjefsen et al. (2014), the labour force with Upper secondary education is reduced mainly because of increased propensities for those with Upper secondary general education to continue in Tertiary education. Growth in demand for Upper secondary education is mainly reduced because of growth in relative wages for Upper secondary education vocational programmes compared to Cappelen et al. (2013). Projected difference between the labour force and labour demand this group towards 2030 is therefore reduced compared to Gjefsen et al. (2014).

Due to increasing propensities to start and complete both short and long Tertiary education the labour force for these groups is projected to grow stronger with the present report than with the previous projection. On the other hand, growth in demand is reduced for Short tertiary education mainly because of a downward adjustment in growth in demand for personnel educated in health

and care as well as education at this level. The positive difference between the labour force and the labour demand for the groups with the level of Tertiary education is thus projected to grow stronger towards 2030 with the present projections compared to the previous.

Table 5: Projected labour demand and labour force by level of education. Comparison in 2030 of results from current analysis with [Gjefsen et al. \(2014\)](#). 1,000 persons.

Education group	Demand		Labour force		Labour force - Demand	
	2014 report	Current report	2014 report	Current report	2014 report	Current report
Lower secondary and unknown	517	683	664	668	147	-15
Upper secondary	1452	1300	1281	1169	-171	-131
Short tertiary	957	893	999	1035	42	142
Long tertiary	318	331	408	452	90	121
Total	3244	3207	3352	3324	108	117

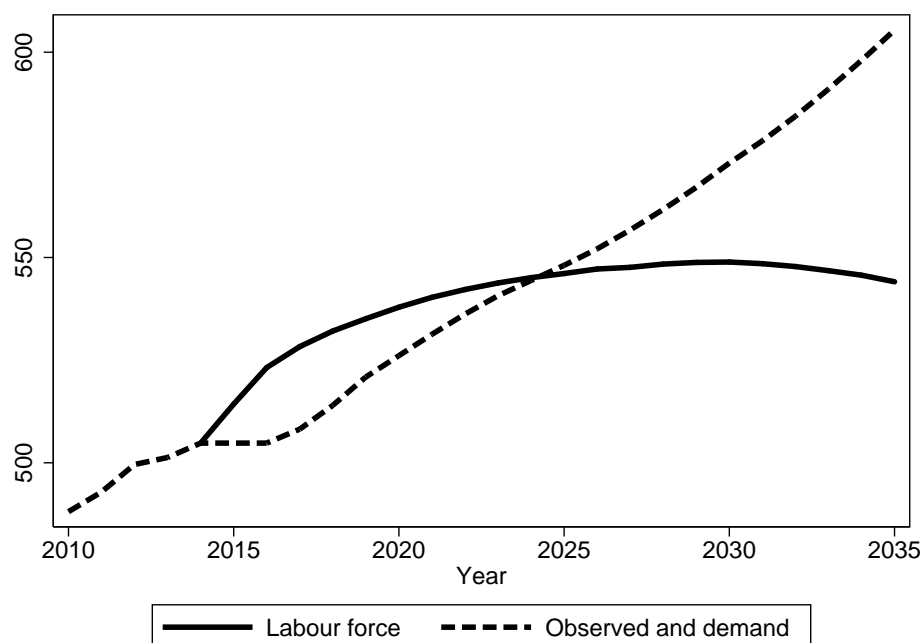
7.2 Labour force and demand for labour by field of education

Experiences from earlier projections indicate that assumptions regarding substitution between different educational groups on the demand side, as well as assumptions regarding educational propensities for the labour force, are far more uncertain for detailed groups than at a more aggregate level. We have therefore chosen to present results for more aggregate groups. The effort on improving information about educational level among immigrants has also taken place on a more aggregate level than the classification used for the labour market projections.

We aggregate the three groups with upper secondary vocational education directed towards manufacturing and building and construction together as shown in [Figure 27](#). Educational propensities for these educations are reduced since the 2014-report leading to only a small growth in the labour force. As mentioned above substitution towards these educations at the demand side is considerably reduced indicating almost balance between demand and labour force versus significantly excess demand in the projections from 2014. In the first years it is especially projected that demand for this labour in manufacturing industries is reduced due to lower activity in production of platforms in the Petroleum industry. Reduced activity in these industries was foreseen in [Cappele et al. \(2013\)](#), but in the first years this downturn has turned out to be stronger than earlier predicted. When the economy starts to recover, demand for these educations will grow stronger. This is especially the case for employment in Building and construction.

For important groups with Tertiary education directed towards Manufacturing and Building and construction there have been fluctuations in educational propensities for the labour force, as well as changes in composition of demand. We have therefore chosen to add the groups for education in Engineering lower degree, Graduate engineering and Other short and long tertiary education in fields of science together in [Figure 28](#). Educational propensities for these groups have increased somewhat since the projections in 2014, while projections on the demand side are almost equal to those produced in 2013. The possibilities of future excess in the labour force are thus larger than what follows

Figure 27: Projected labour demand and labour force with upper secondary education vocational training directed towards manufacturing and crafts. 1,000 persons.



from the former projections. The slower growth in demand in the first years as a result of the downturn in Petroleum related industries is also visible for these educational groups.

Because of uncertainty regarding composition of demand for labour with master versus bachelor level, as well as uncertainty regarding propensities to continue education at the master level, labour demand and labour force for these two levels are added together for tertiary education in respectively Economics and administration, Social sciences and law and Humanities and arts. The results are presented in Figures 29 to 31. For Economics and administration projections of both labour demand and labour force are almost equal to the projections from 2013/14 indicating a strong growth in excess labour force. For Social sciences and law, growth in the labour force is adjusted more downwards than growth in demand, indicating a smaller growth in excess demand than in the former projections. For Humanities and arts demand projections are equal to those projected in 2013 while there has been a strong growth in educational propensities indicating a larger growth in excess demand.

Because of lower fertility, and thereby a lower number of children and youths, growth in demand for persons with short Tertiary education in education is reduced compared to the projections from 2013. The projections only show a small increase in the labour force as a result of the fact that many persons in this group are expected to retire in the closest decades. Even a modest expected growth in the labour force will cause excess demand, but because demand is reduced compared to Gjeften et al. (2014) the projected excess demand

Figure 28: Projected labour demand and labour force with tertiary education in engineering and other science. 1,000 persons.

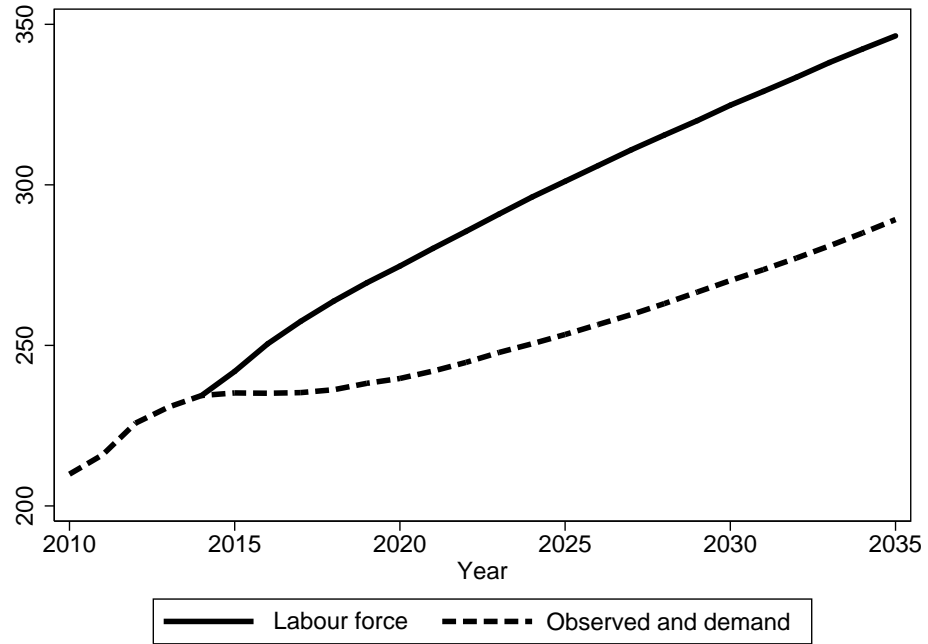


Figure 29: Projected labour demand and labour force with tertiary education in economics and administration. 1,000 persons.

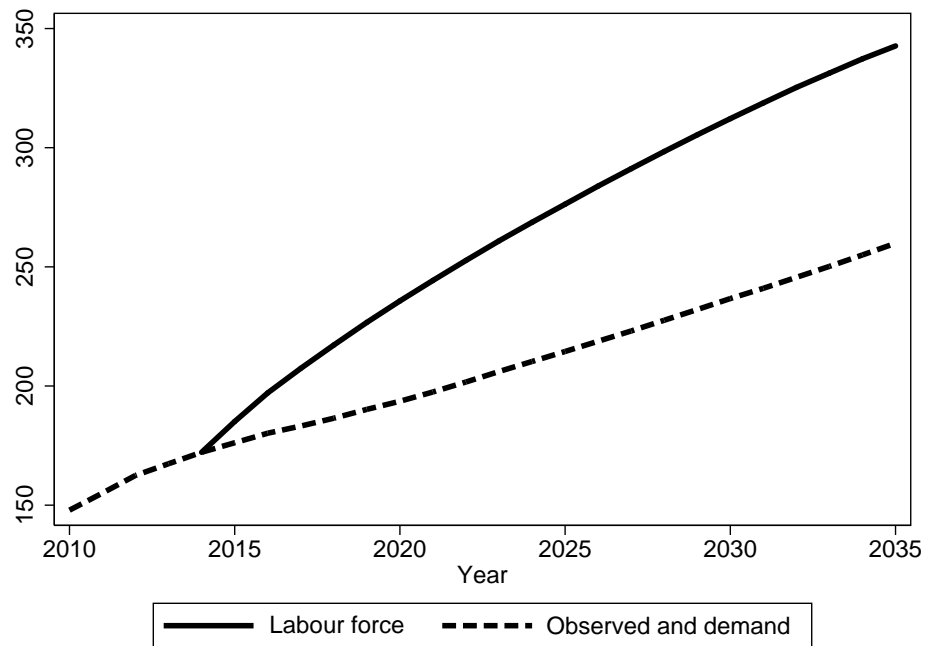


Figure 30: Projected labour demand and labour force with tertiary education in social sciences and law. 1,000 persons.

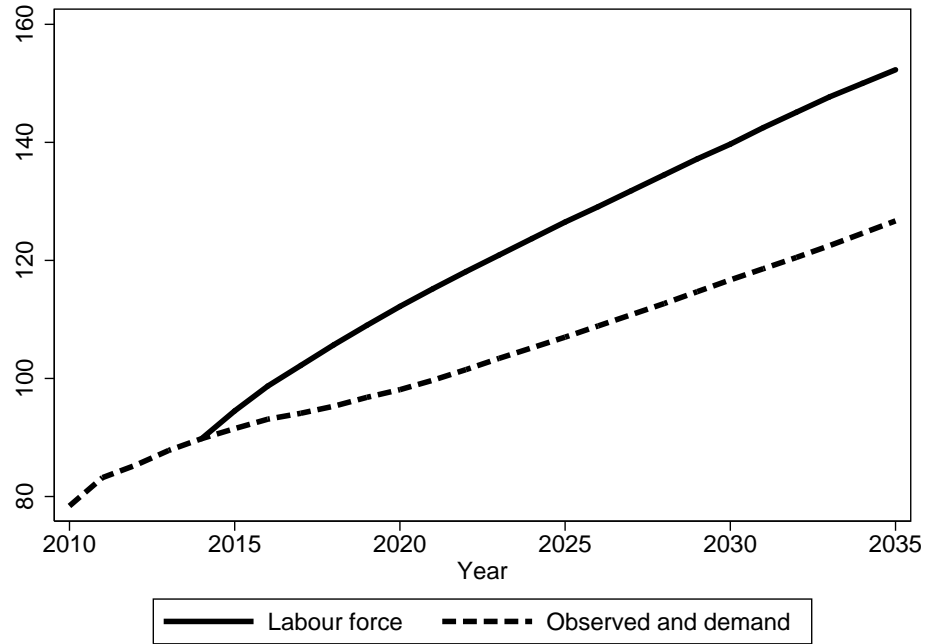


Figure 31: Projected labour demand and labour force with tertiary education in humanities and arts. 1,000 persons.

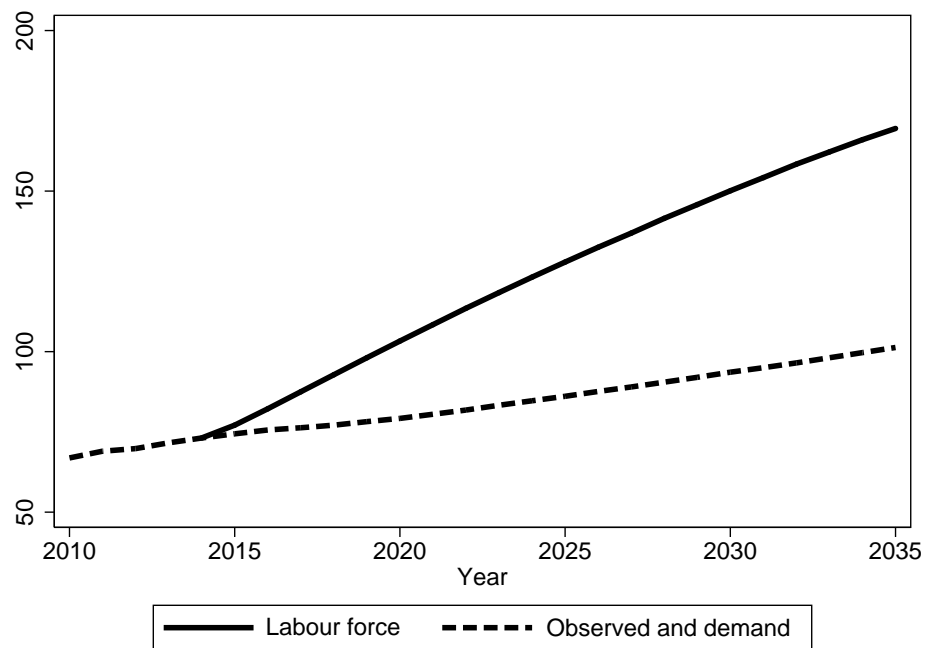
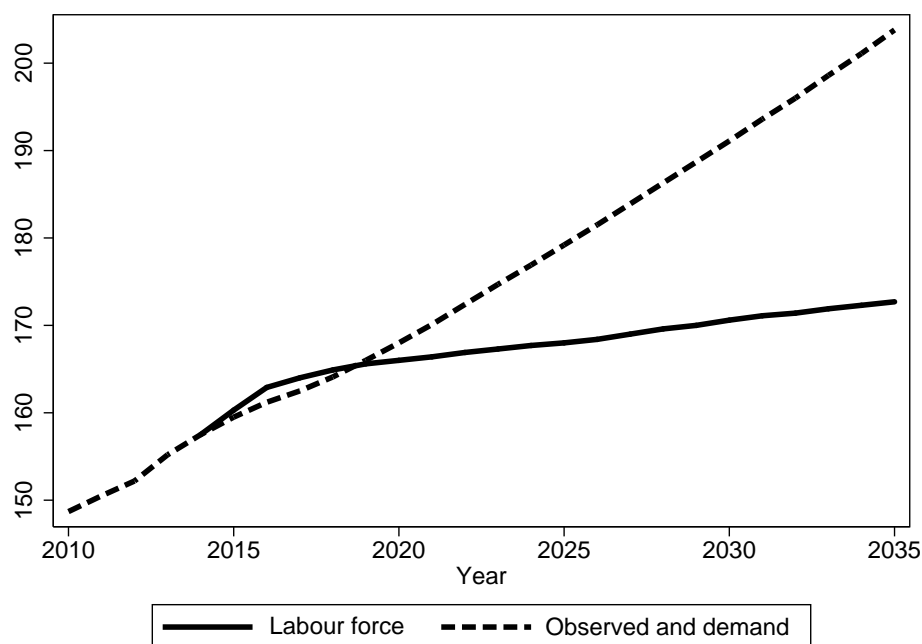


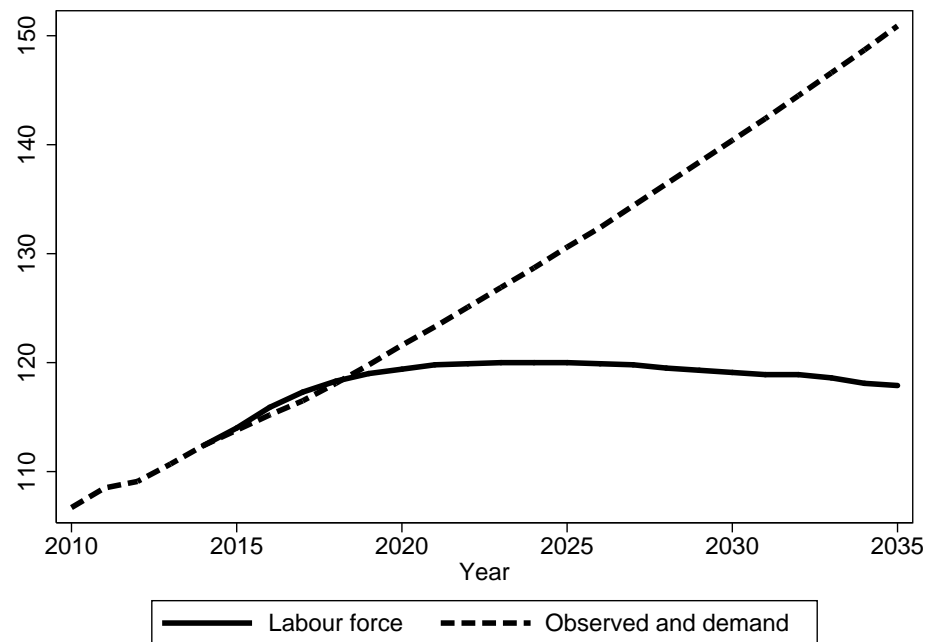
Figure 32: Projected labour demand and labour force with short tertiary education within the field of education. 1,000 persons.



is also reduced.

Contrary to former projections we are now able to produce labour force projections for Upper secondary education in health and social services that may be compared with projections for demand. The results are presented in Figure 33. As a result of a rather high share of elderly workers in this group in combination with a reduced number of youths entering into the education, the number of persons entering the labour market is about equal to the number retiring. The labour force is thereby projected to stay constant. There is larger uncertainty regarding demand, and growth is now assumed to be slightly lower than with the former projections in 2013. Because of a growing demand when the labour is constant, excess demand is increasing. Similar to the projections in [Roksvaag and Texmon \(2012\)](#), we take into account a growing number of elderly. However, if labour saving productivity in the Health Sector is lower than 0.5 percent per year or the quality of the provided healthcare services is to increase, a substantially higher employment in this sector is required to provide a given volume services defined by service quality and the number of users of the services. This would lead to an even higher growth in excess demand for this group. In addition, the elderly also receive a substantial share (67 percent) of Long-Term Care from family and relatives, according to the best available assessments. Given the demographic development, there will be fewer young per elderly in the future. According to [Holmøy et al. \(2016\)](#) a constant volume of healthcare services per elderly in the future requires either more informal care from relatives or more publicly provided health care services and thus higher employment in this sector.

Figure 33: Projected labour demand and labour force with secondary education in health and social services. 1,000 persons.



For persons with Tertiary education in nursing and care giving growth in the labour force is projected to slow down mainly because a growing number of workers with this type of education is expected to retire towards 2035. Demand is projected to grow, mainly because of the ageing of the population, a modest increase in the number of nurses per patient and substitution from unskilled labour and persons with Upper secondary education in nursing and caregiving towards persons with Tertiary education. Projected growth in demand is somewhat reduced compared to the projections from 2013. The main reasons are lower assumed priority of Health and social services within strict government budgets, and lower substitution towards nurses from personell with lower qualifications.

The other groups of labour with short Tertiary educations in health and social services are more directed towards social services than persons educated in Nursing and caregiving. Growth in demand is thus less affected by ageing of the population. On the other hand there has been a strong substitution in favour of these groups in the past years. This is probably also the reason why the level of employment for these groups has been shifted upwards from 2010 to 2012 in the National Accounts. Demand is approximately projected to grow by the same rate as in the former projections. Because we expect an unaltered strong growth in the labour force, the upward shift in demand causes a smaller projected labour force excess compared to the projections from 2014.

Figure 34: Projected labour demand and labour force with tertiary education in nursing and care giving. 1,000 persons.

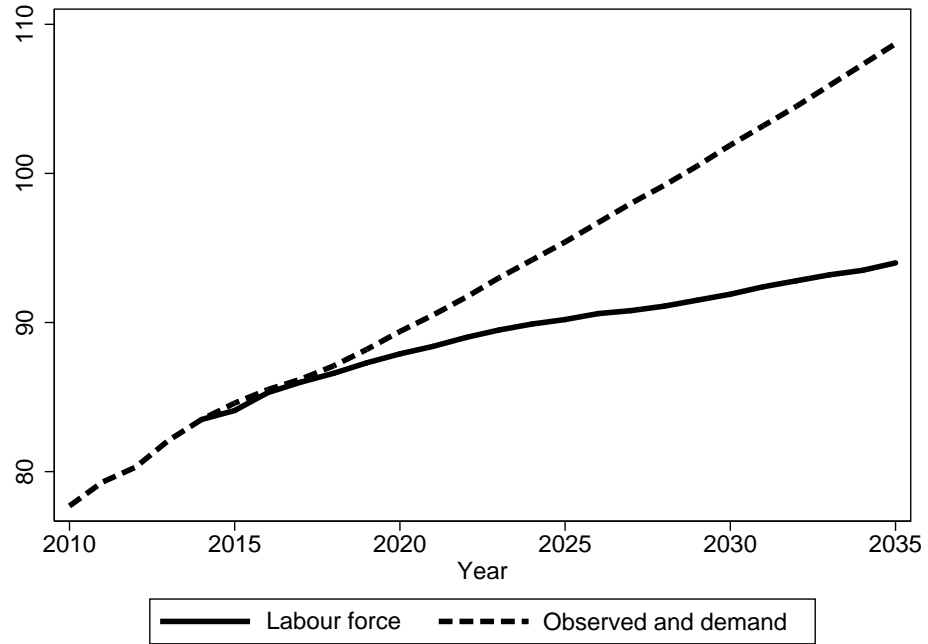
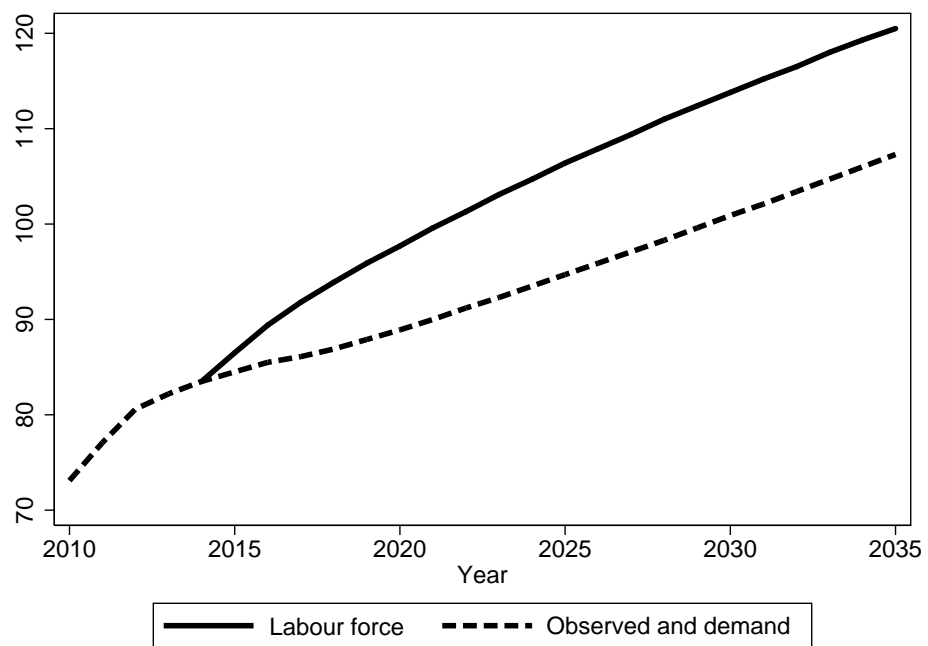


Figure 35: Projected labour demand and labour force with other short tertiary education in health and social services. 1,000 persons.



References

- Ahamad, W. and Blaug, M.: 1973, *The practice of manpower forecasting*, Elsevier.
- Armington, P. S.: 1969, A Theory of Demand for Products Distinguished by Place of Production, *International Monetary Fund Staff Papers* **16**(1), 159–178.
- Bjørnstad, R., Gjelsvik, M. L., Godøy, A., Holm, I. and Stølen, N. M.: 2010, Demand and supply of labor by education towards 2030 Linking demographic and macroeconomic models for Norway, *Reports Statistics Norway* **2010/39**.
- Boug, P. and Dyvi, Y.: 2008, MODAG - en makroøkonomisk modell for norsk økonomi, Vol. 111, *Statistics Norway*, Oslo - Kongsvinger, Norway.
- Cappelen, Å., Gjefsen, H., Gjelsvik, M., Holm, I. and Stølen, N. M.: 2013, Forecasting demand and supply of labour by education, *Reports Statistics Norway* **2013/48**.
- Fredriksen, D.: 1998, Projections of population, education, labour supply and public pension benefits, *Sosiale og Økonomiske Studier* .
- Gjefsen, H. M.: 2013, Educational behavior in the dynamic micro-simulation model MOSART, *Reports Statistics Norway* **15**.
- Gjefsen, H. M., Gunnes, T. and Stølen, N.: 2014, Framskrivninger av befolkning og arbeidsstyrke etter utdanning med alternative forutsetninger for innvandring, *Reports Statistics Norway* **2014/31**.
- Gjelsvik, M. L., Nymoen, R. and Sparrman, V.: 2015, Resilience and adaptation. An Econometric Study of Pattern Wage Bargaining in Norway, *Discussion paper Statistics Norway* .
- Haraldsen, K. W., Hammersland, R. and Sparrman, V.: 2015, Wage equations and labour demand by education, *Reports Statistics Norway* **2015/49**.
- Holmøy, E., , Haugstveit, F. V. and Otnes, B.: 2016, Behovet for arbeidskraft og omsorgsboliger i pleie- og omsorgssektoren mot 2060, *Reports Statistics Norway* **2016/20**.
- Layard, R., Nickell, S. and Jackman, R.: 2005, *Unemployment*, 2 edn, Oxford University Press, Oxford.
- Nymoen, R. and Sparrman, V.: 2014, Equilibrium Unemployment Dynamics in a Panel of OECD Countries, *Oxford Bulletin of Economics and Statistics* pp. 164–190.
- OECD: 2016, Getting Skills Right: Assessing and Anticipating Changing Skill Needs, OECD Publishing, Paris.
- Psacharopoulos, G.: 1991, Education and work: The perennial mismatch and ways to solve it., *The Vocational Aspect of Education* **43**(1), 127–132.
- Roksvaag, K. and Texmon, I.: 2012, Arbeidsmarkedet for helse- og sosialpersonell fram mot 2035, *Reports Statistics Norway* **2012/14**.

Statistics Norway: 2016, Economic Survey, *Økonomiske analyser 4/2016*.

Steinkellner, A. and Holseter, A. M. R.: 2013, Befolkningens utdanningsnivå, etter spørreundersøkelsen om utdanning fullført i utlandet, *Reports Statistics Norway 2013/24*.

St.meld.: 2001, Guidelines for economic policy (Retningslinjer for den økonomiske politikken), *Det Kongelige Finansdepartement 29*.

Tønnessen, M., Leknes, S. and Syse, A.: 2016, Befolkningsframskrivninger 2016-2100: Hovedresultater, *Økonomiske Analyser 3/2016*.

A Appendix

In the following section, there are projections of labour supply by field of education. The figures correspond to those of Section 7, but show number of persons instead of share of labour force.

Figure 36: Projections of the labour force with education unknown, lower and upper secondary general (upper figure) and upper secondary vocational (lower figure). Number of persons.

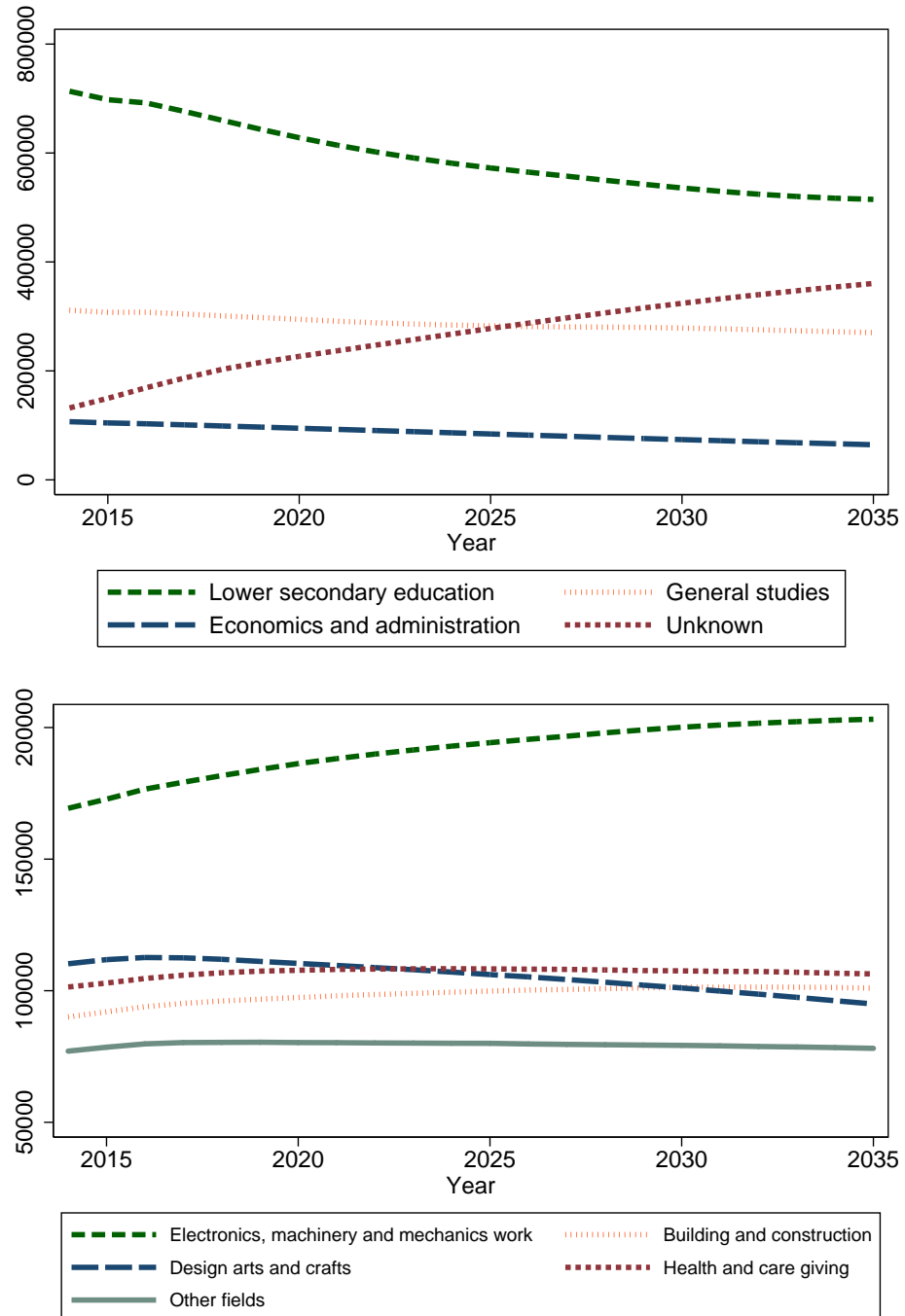


Figure 37: Projections of the labour force with short tertiary education. Number of persons.

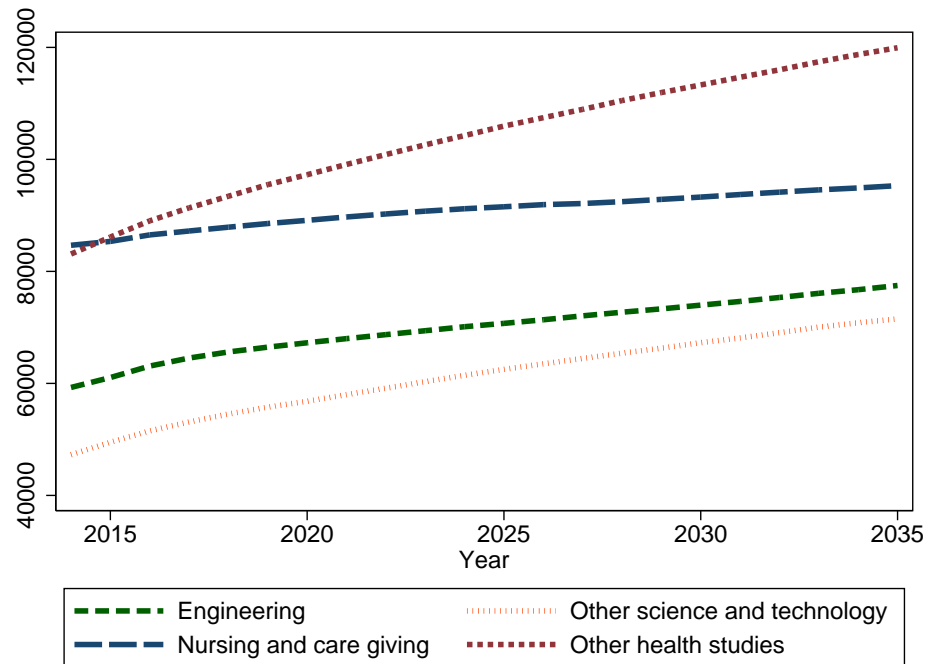
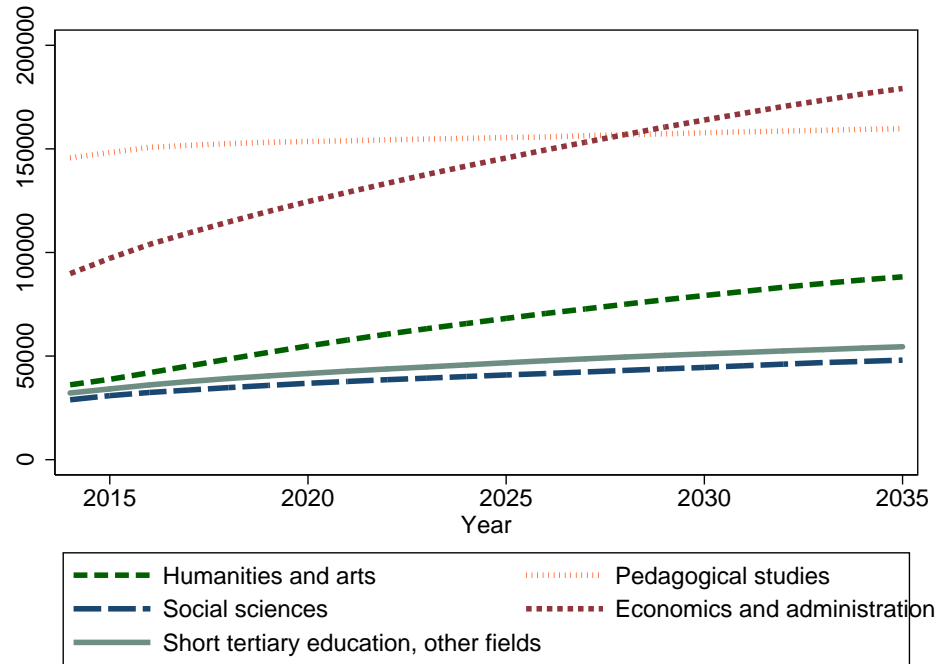
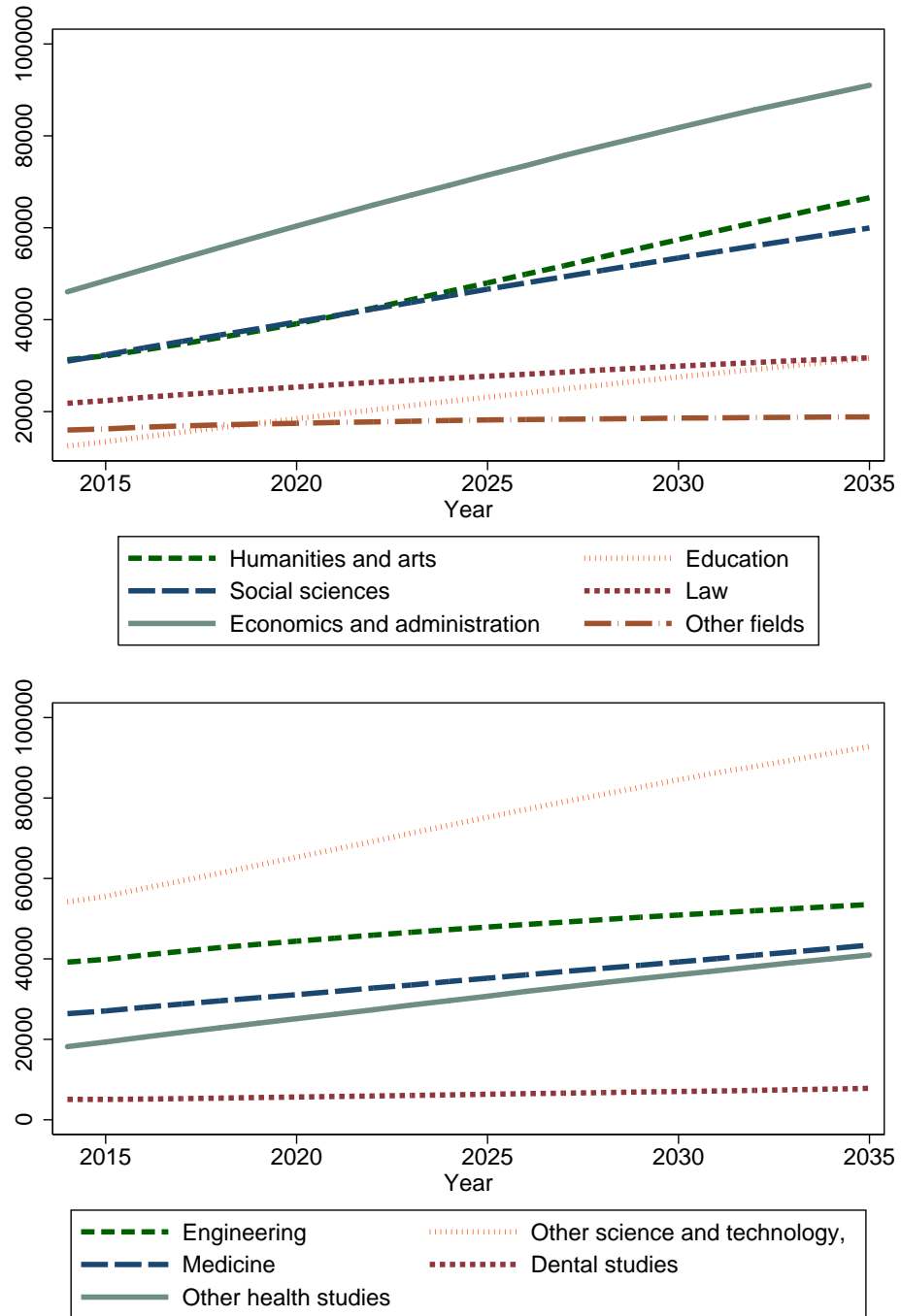


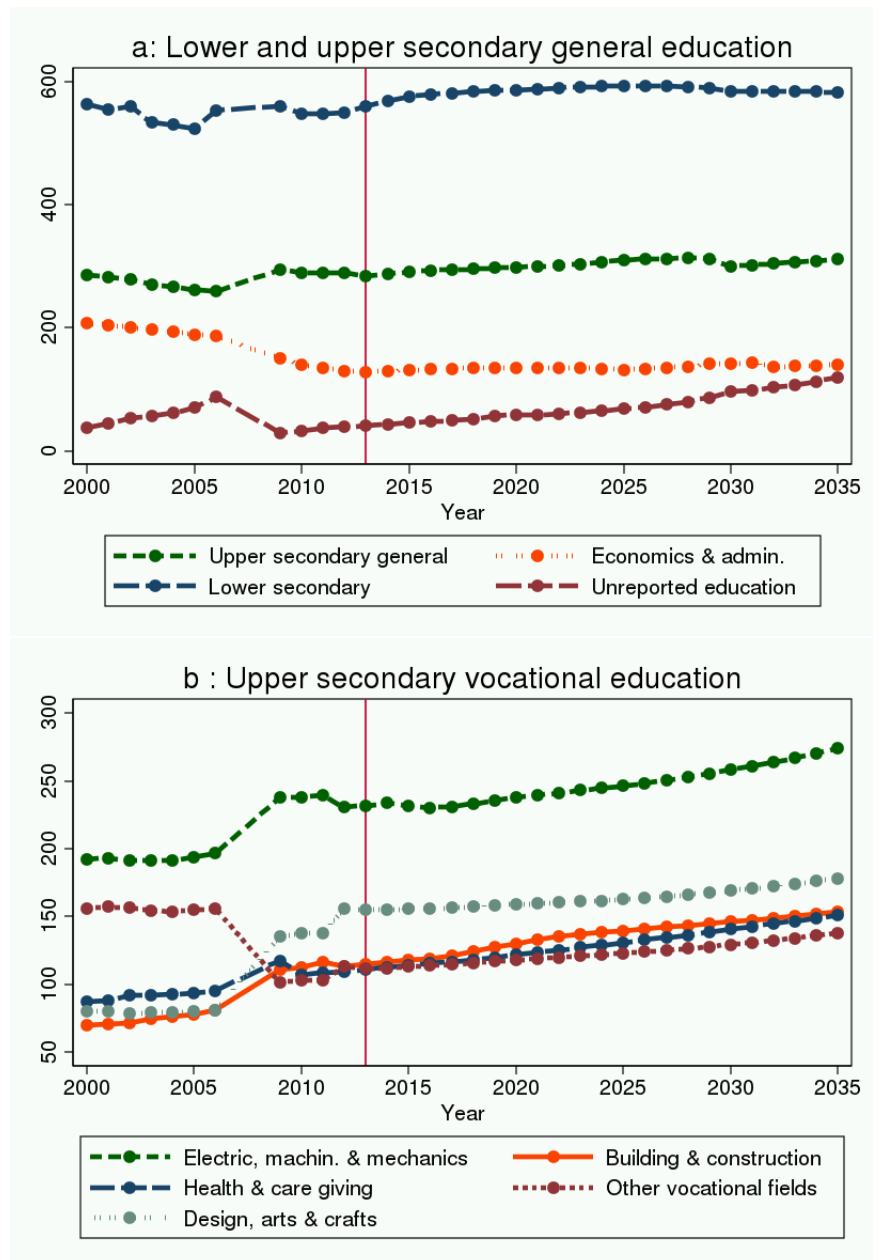
Figure 38: Projections of the labour force with long tertiary education. Number of persons.



B Appendix

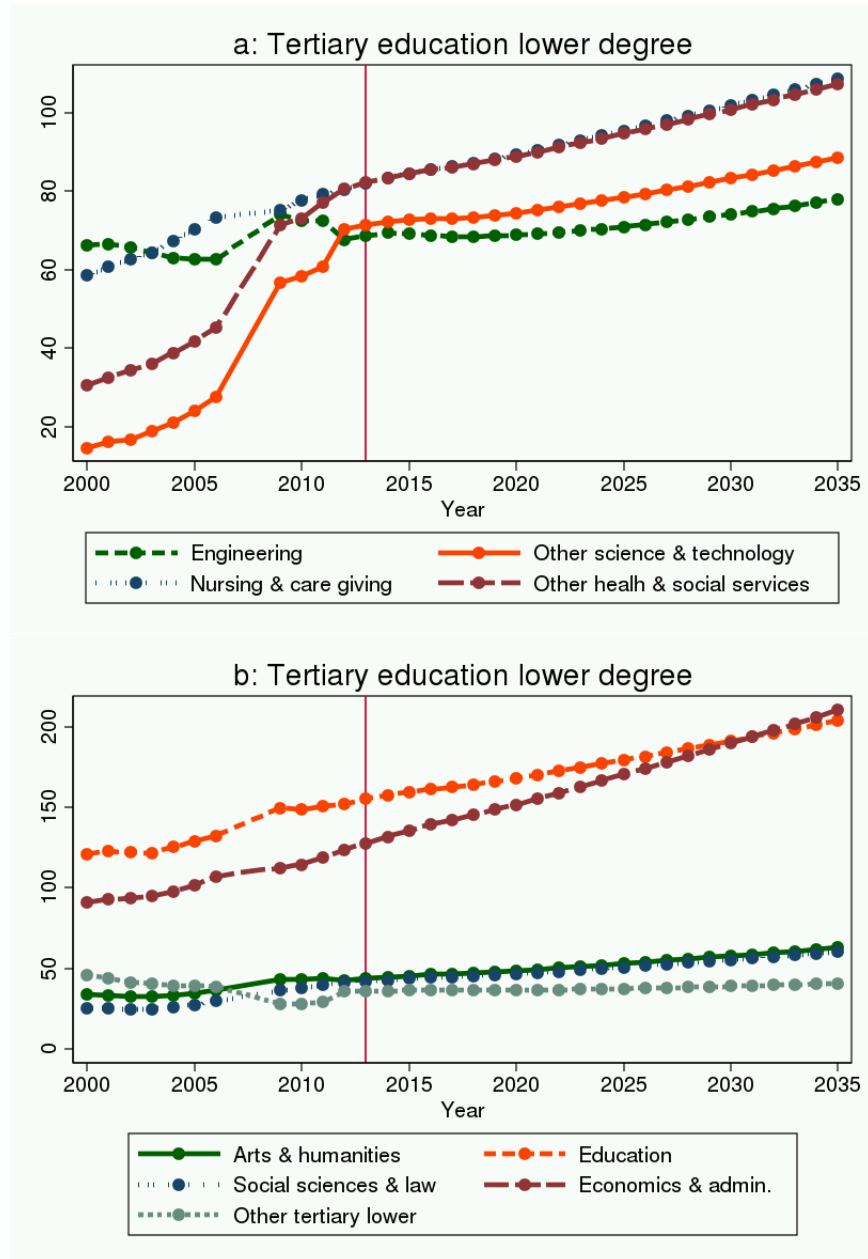
The following section shows projections of labour demand by field of education. The figures correspond to those of Section 5, but show 1000 of persons instead of share of labour force.

Figure 39: Number of employed workers with lower and upper secondary education, in 1000 persons.



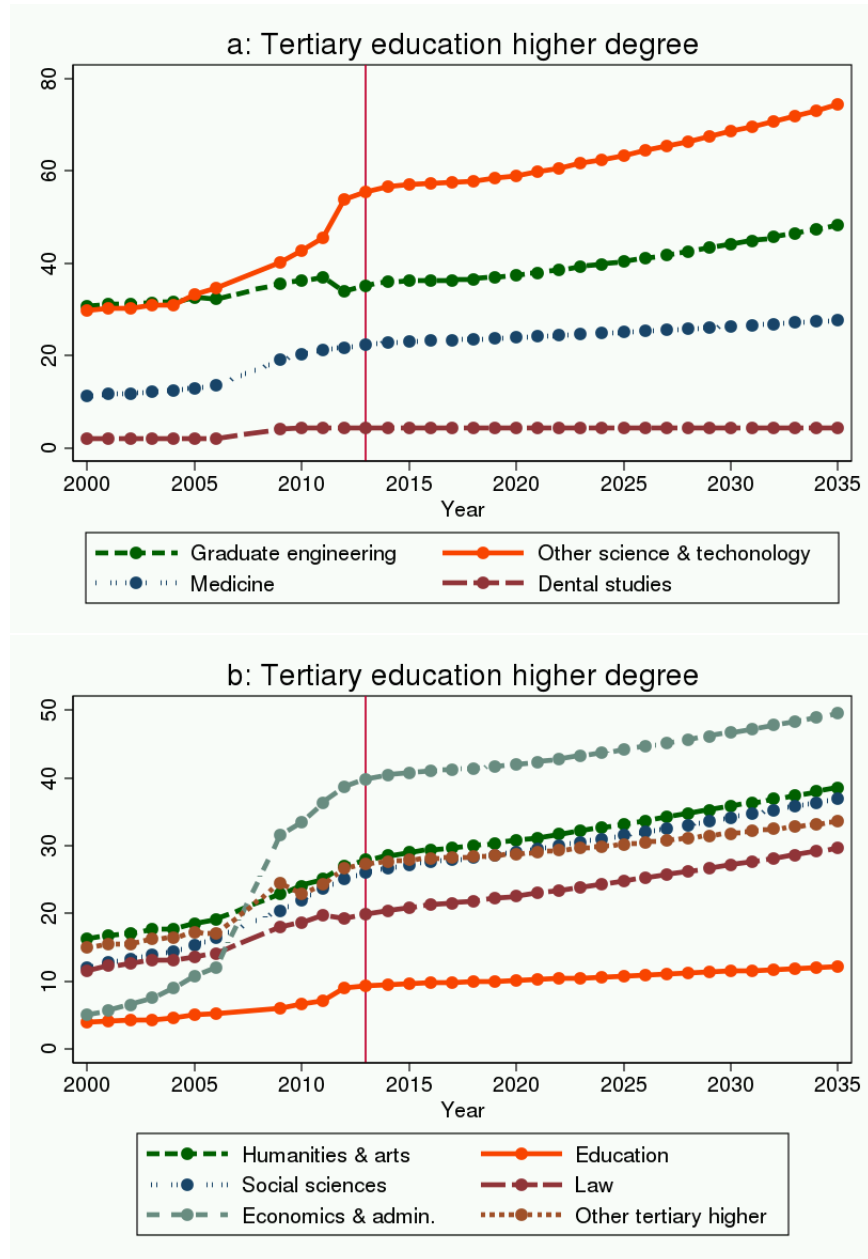
Note: There is a break in the time series for the years 2007 and 2008.

Figure 40: Number of employed workers with short tertiary education, in 1000 persons.



Note: There is a break in the time series for the years 2007 and 2008.

Figure 41: Number of employed workers with long tertiary education, in 1000 persons.



Note: There is a break in the time series for the years 2007 and 2008.

List of Figures

1.	Growth in exports markets, in per cent.	20
2.	Population based on register data 1980-2013 and forecasted 2014-2035. In thousands.	21
3.	Public employment share by level of education.	22
4.	Projections of gross products. Volumes are indexed relative to the volume in 2013.	28
5.	Projections of employment by industries. Volumes are indexed relative to the volume in 2013.	29
6.	The unemployment rates by educational group.	30
7.	Hourly wage rates by educational group relative to the average hourly wage rate.	31
8.	Employment by level of education relative to total employment.	32
9.	Projections of educational level in the petroleum sector. Volumes are indexed relative to the values in 2013.	33
10.	Projections of educational level in services. Volumes are indexed relative to the values in 2013.	34
11.	Number of employed workers with lower and upper secondary education relative to overall employment.	36
12.	Number of employed workers with tertiary education, lower degree, relative to overall employment.	37
13.	Number of employed workers with tertiary education, higher degree, relative to overall employment.	38
14.	Relative labour force by highest completed level of education.	45
15.	Labour force by highest completed level of education. 1,000 persons.	46
16.	Projections of the labour force with education at unknown, lower and upper secondary general level. Relative to total labour force	47
17.	Projections of the labour force with education at upper secondary vocational level. Relative to total labour force	47
18.	Projections of the labour force with short tertiary education, first group. Relative to total labour force	48
19.	Projections of the labour force with short tertiary education, second group. Relative to total labour force	49
20.	Projections of the labour force with long tertiary education, first group. Relative to total labour force	50
21.	Projections of the labour force with long tertiary education, second group. Relative to total labour force	50
22.	Projected labour demand and labour force by level of education. 1,000 persons.	54
23.	Projected labour demand and labour force with Primary, Upper secondary general and Unknown education. 1,000 persons.	55
24.	Projected labour demand and labour force with upper secondary vocational education. 1,000 persons.	56
25.	Projected labour demand and labour force with short tertiary education. 1,000 persons.	56

26.	Projected labour demand and labour force with long tertiary education. 1,000 persons.	57
27.	Projected labour demand and labour force with upper secondary education vocational training directed towards manufacturing and crafts. 1,000 persons.	59
28.	Projected labour demand and labour force with tertiary education in engineering and other science. 1,000 persons.	60
29.	Projected labour demand and labour force with tertiary education in economics and administration. 1,000 persons.	60
30.	Projected labour demand and labour force with tertiary education in social sciences and law. 1,000 persons.	61
31.	Projected labour demand and labour force with tertiary education in humanities and arts. 1,000 persons.	61
32.	Projected labour demand and labour force with short tertiary education within the field of education. 1,000 persons.	62
33.	Projected labour demand and labour force with secondary education in health and social services. 1,000 persons.	63
34.	Projected labour demand and labour force with tertiary education in nursing and care giving. 1,000 persons.	64
35.	Projected labour demand and labour force with other short tertiary education in health and social services. 1,000 persons.	64
36.	Projections of the labour force with education unknown, lower and upper secondary general (upper figure) and upper secondary vocational (lower figure). Number of persons.	68
37.	Projections of the labour force with short tertiary education. Number of persons.	69
38.	Projections of the labour force with long tertiary education. Number of persons.	70
39.	Number of employed workers with lower and upper secondary education, in 1000 persons.	72
40.	Number of employed workers with short tertiary education, in 1000 persons.	73
41.	Number of employed workers with long tertiary education, in 1000 persons.	74

List of Tables

1.	Classification by education. In 1000 persons. National Accounts and administrative educational registers.	12
2.	Assumptions incorporated in the macroeconomic model MODAG	23
3.	Macroeconomic projections, average growth in percent when not otherwise stated	25
4.	Employment level and employment deviations between the current analysis and the 2013-report. In 1000 persons.	42
5.	Projected labour demand and labour force by level of education. Comparison in 2030 of results from current analysis with Gjefsen et al. (2014). 1,000 persons.	58

Statistisk sentralbyrå

Postadresse:
Postboks 8131 Dep
NO-0033 Oslo

Besøksadresse:
Akersveien 26, Oslo
Oterveien 23, Kongsvinger

E-post: ssb@ssb.no
Internett: www.ssb.no
Telefon: 62 88 50 00

ISBN 978-82-537-9408-2 (printed)
ISBN 978-82-537-9407-5 (electronic)
ISSN 0806-2056

ISBN 978-82-537-9408-2



9 788253 794082



Statistisk sentralbyrå
Statistics Norway