Increasing the sustainability of Higher and Further Education provision in Ireland

Economic review of funding options

Deliverable 1.1 and 1.2: Adapting Higher Education and Further Education & Training Provision to Meet the Skill Requirements of Ireland's Labour Market

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Executive Summary

Introduction

This report is submitted to the European Commission DG Reform by AARC, LE Europe and Indecon International Economic Consultants, as a two key Deliverables under the EU funded project "Increasing the sustainability of higher and further education provision in Ireland – economic review of funding options". The project is aligned with the objective of DG Reform to provide support for the preparation and implementation of growth-enhancing administrative and structural reforms by mobilising EU funds and technical experience. Ireland requested support from the European Commission under Regulation (EU) 2017/825 on the establishment of the Structural Reform Support Programme. Following an analysis by the European Commission, the Commission agreed to provide technical support to Ireland in the area of Higher Education funding. This report focuses on the skill elements of the assignment and constitutes Deliverable 1.1 and Deliverable 1.2 of the project. This encompasses an analysis of any misalignment between qualifications and skills provided by the Higher Education and FET and the skills demand of the labour market. Policy recommendations regarding the design of higher education and the provision of FET pathways are also provided. It is intended that the immediate beneficiaries of the project will be the Department of Further and Higher Education, Research, Innovation and Science. The analysis may also help the European Commission's work in other Member States in strengthening skills intelligence.

Background

The background to the wider study is that Ireland acknowledges human capital as one of the country's core economic strengths and a key enabler of the country's future economic, social and cultural development. It also considers of vital importance that Ireland has an appropriately educated workforce that can adapt and respond to the challenges linked to emerging economic priorities. Traditionally, it has strongly supported the participation of Irish youth in higher education.

Ireland faces two important challenges in its efforts to provide its population with the qualifications and skills that are demanded by the labour market and necessary to support innovation and competitiveness. Firstly, the financial sustainability of its higher education system is at risk in view of a growing number of students entering the third-level education system. Secondly, the skills, research and qualification outcomes of the current higher education and further education and training systems show some disparity with the labour market demand.

Participation rates in higher education in Ireland are among the highest in the EU and significant progress has been achieved in making it more accessible to previously under-represented groups such as students with a disability and those from economically disadvantaged backgrounds.

Demographic expansion is expected to pull up demand for higher education in the years ahead, likely to peak at almost 223,000 students in 2030, an increase of over 38,000 on 2017 levels. This forecasting of higher enrolment rates has thus led to an increased focus on investment levels in higher education among Irish public opinion and policy makers. This is particularly important given the expected growth in student enrolments in Irish higher education as is evident from the following table.

Higher Education - Scenarios for Total Fulltime Student Enrolments

Academic Year	Scenario S1	Scenario S2	Scenario S3	Scenario S0
2020/21	196,609	196,609	199,626	193,591
2021/22	199,258	199,623	203,956	194,925
2022/23	202,042	202,774	208,537	196,279
2023/24	204,339	205,437	212,691	197,085
2024/25	206,494	207,957	216,767	197,684
2025/26	209,633	211,462	221,980	199,114
2026/27	213,624	215,819	228,202	201,241
2027/28	217,468	220,028	233,852	203,644
2028/29	220,425	223,351	238,232	205,544
2029/30	222,264	225,556	241,167	206,653
2030/31	222,514	226,172	242,198	206,488
2031/32	222,109	226,133	242,392	205,850

Source: Department of Education and Skills

Scope of Assessment and Methodologies Used

In line with the terms of reference this report addresses the following specific deliverables:

Deliverable 1.1: A draft report on the analysis of the variance between the qualifications and skills provided by higher education and FET in Ireland and the skills' demand of the labour market. This includes:

- Analysis and assessment of the scope and level of variance between the current provisions of skills and qualifications in higher education and FET in Ireland and the labour market demand, taking into consideration economic projections regarding emerging sectors and technologies.
- Analysis of the current level of participation in higher education and FET in Ireland and employment figures by economic sectors.
- Identification of relevant databases that help in mapping the demand for skills, on the one hand, and the existing structures enabling the coordination between the education sector, the labour sector and the innovation and economic sector, on the other.

Deliverable 1.2: A report with policy recommendations to provide a higher education and FET system that will respond to and address the Irish labour market's demand to ensure inclusive, smart and sustainable growth. The report, and associated recommendations, are informed by the following inputs:

- The analysis under Deliverable 1.1 above, which provides information on the skills shortages and surplus that can inform the potential for transformations of the higher education system, such as adapting university programmes and modalities to the needs of emerging sectors, and the development and expansion of vocational options in higher education (e.g., apprenticeships) and further education and training systems in Ireland.
- The analysis also assesses the potential to create new pathways between further and higher education in Ireland and to strengthen existing ones.
- The analysis is complemented by case studies on international practice/approaches in three countries which have met challenges regarding the skills mismatch between higher education and skills demand in their economies. These case studies provide a basis to animate policy discussion in the Irish context.

Extensive new evidence has been analysed on the examination of qualifications and skills provided by the higher education and further education and training systems and the demand for skills in the Irish labour market. Detailed data on the participation levels in HE and FET and employment by economic sectors are also examined. The analysis of skills has been complemented by a review of policy context in Ireland and approaches in Estonia, Canada and New Zealand. As part of this report new innovative econometric modelling was undertaken on the impact of Artificial Intelligence (AI). We also present new econometric modelling on the future demand for higher, medium and low skills taking account of the potential impacts of COVID-19. While the significant econometric modelling work undertaken was outside the scope of the agreed work programme, it was deemed useful to inform the analysis. This was undertaken at no additional cost to the European Commission and the time resources have been funded by the consultancy team.

As part of our research we identified a range of databases which can be used to inform the analysis and which may help in mapping the demand for skills and co-ordination with the training and education sector. The following Irish and international sources, inter alia, were used as part of this methodology:

- CSO GNP estimates;
- Microdatabase from Labour Force Survey;
- HEA destination of Graduate Survey;
- SOLAS FET Outturn Data;
- ABSEI database on Internationally Traded Firms;
- Cedefop European Skills and Jobs Survey;
- OECD Survey of Adult Skills (PIAAC);
- Irish and European Employer Surveys; and
- Previous work on Skills Mismatches undertaken by the European Commission and other researchers.

The consultancy team has benefited from valuable inputs provided by the European Commission and from the Department of Higher Education and Skills. Our analysis has also been informed by inputs from a wide range of stakeholders and from advice from the Interdepartmental Steering Committee.

Overview of Education and Training Policy Framework in Ireland

In Ireland at second-level, students typically take the Junior Certificate state examination after three years of post-primary education, while at the end of the senior cycle students sit the Leaving Certificate state examination.[1] Second-level education students can progress to third-level education – either within the further education and training sector or the higher education sector. The evidence on the overall numbers of students enrolled in education in Ireland highlights the extent of participation in higher and further education in Ireland, with almost 224,000 students undertaking HE and over 202,000 undertaking FET.

In analysing any potential mismatch between the qualification and skills provided by HE and FET in Ireland, and the skills demands of the labour market, it is important to note the valuable work undertaken by the National Skills Council and other groups.[2] The National Skills Council in Ireland provides a mechanism to identify the skills demands of the economy and the Council terms of reference are presented below:

- To receive and consider costed proposals for the annual research/work programme of the EGFSN in advance of the programme being formally submitted for approval for funding by Department of Education and Skills or the Department of Enterprise Jobs and Innovation as appropriate.
- To receive, consider and approve prior to publication agreed action plans based on EGFSN research findings.
- To receive, consider and publish research and reports on skills and labour market data from the Skills and Labour Market Research Unit of SOLAS.
- To receive reports on the work of the Regional Skills Fora and consider assessments from the Regional Fora in relation to skills development in their regions.
- To receive reports from SOLAS, HEA and the Chairs of the Council of Presidents of the Universities and Institutes of Technologies on the delivery of responses to identified skills needs.
- To receive reports from DES, HEA and SOLAS on overall funding allocations for education and training provision.
- To provide updates as required from other Government Departments on related strategies.
- To receive regular updates from other relevant stakeholders (IDA Ireland, Enterprise Ireland, Science Foundation Ireland) on developing sectoral opportunities and potential target areas for increased Foreign Direct Investment and consider and advise on issues associated with the availability of skills to support such employment opportunities.
- To prepare an annual prioritisation of identified skills needs to inform decisions on allocation of funding across FET, HE and Skillnets. This prioritisation should include reference to levels and discipline areas and delivery mechanisms, e.g., mainstream provision/targeted funds.
- To present an annual statement of the work of the Council to the Minister for Education and Skills and published no later than the end of March of the following year. Other reports may be published as agreed by the Council/Minutes of meetings will be published.

[1] Candidature for the Junior Certificate and Leaving Certificate examinations is not limited to post-primary school students. A candidate following an approved course of study outside the State or who is attending an approved course of study organised under the Vocational Training Opportunities Scheme, Adult Literacy and Community Education Schemes, the Department of Social and Family Affairs second-level scheme for the unemployed or an analogous scheme, may be admitted to either examination.
[2] Also important is the work of the Expert Group on Future Skills Needs (EGFSN).

Ireland's National Skills Strategy 2025 provides an overarching framework for supporting the development of an Irish labour force that is well educated and has the ability to adapt to changing skills needs in the market.[3] The six objectives in the NSS, are outlined in the following table. The enhancement of skills and developing and attracting talent is a core pillar of the Irish Government's Future Jobs Strategy.[4]

Objectives of the National Skills Strategy 2025
- Education and training providers will place a stronger focus on providing skills development opportunities that are relevant to the needs of learners, society and the economy; - Employers will participate actively in the development of skills and make effective use of skills in their organisations to improve productivity and competitiveness; - The quality of teaching and learning at all stages of education will be continually enhanced and evaluated; - People across Ireland will engage more in lifelong learning; - There will be a specific focus on active inclusion to support participation in education and training and the labour market; and - To support an increase in the supply of skills to the labour market.
Source: Department of Education and Skills – National Skills Strategy 2025

Since the commencement of this project, Ireland and other countries have been dramatically impacted by the COVID-19 pandemic. The implications of this have been evaluated by the Irish National Skills Council which has identified nine key priorities. These are important in informing the subsequent analysis in this report.

Summary of Irish National Skills Council – Priorities Summer 2020
1. Need for immediate focus on providing skills for those affected by the crisis underpinning their employability and access into sustainable and quality employment while the overall medium- to long-term directions of skills priorities should be sustained. 2. Skills responses should be balanced and encompassing in labour market terms. 3. Need for recognition of a broad skills agenda that can be flexibly delivered to a diverse range of learners. 4. Skill provision to respond to immediate labour market requires short, focussed and agile programme. 5. Important to maintain support for education and training programmes with a strong work-based component. 6. Employers can play an important role advising on shaping and supporting the delivery of education and training. 7. Priorities for skills will continue including skills for lifelong learning, green economy, digital skills, leadership and management development skills and a focus on labour market inclusion. 8. Employment in roles that are often characterised as 'low skilled' will require upskilling and reskilling using digital and technology skills. 9. Online and digital learning will be critical.
Source: National Skills Council

Overview of Approaches in Other Countries

To complement the analysis of any skills mismatches in Ireland, an analysis has been undertaken of relevant international practices. Based on agreement with what is now the Department of Further and Higher Education, Research, Innovation and Science, the international research has focused on the experience of Estonia, Canada and New Zealand.

[3] Department of Education and Skills (2018), "National Skills Strategy 2025 - Ireland's Future" (Pg.47)

[4] See Department of Business, Enterprise and Innovation (2019), "Future Jobs Ireland"

Case Study 1: Estonia

Estonia is rated as having a high-quality education system, with almost universal participation in basic education and literacy and numeracy skills among its second-level students being among the highest in Europe.[5] Estonia ranked first in science and reading, and third in mathematics in the 2018 Programme for International Student Assessment (PISA).[6] Adults have high educational attainment levels with ~90% of 25-64-year-olds having at least upper secondary education and 41% of adults having tertiary qualifications, above the EU average of 33%.[7] One example of Estonia's policy response in the area of skills, of relevance to this study is its system of forecasting future labour market skill requirements. Estonia has updated its system of forecasting future labour market skill requirements through the OSKA (Oskuste Arendamise koordinatsioonisüsteem) analytical tool. It collates information using a mixed methods approach from sectoral surveys assessing the labour/skill needs of each sector using a combination of qualitative and quantitative research methods.[8] This is used in conjunction with quantitative data is collected from relevant registers and surveys (e.g., the Labour Force Survey, the Population and Housing, sectoral surveys, EKOMAR), the Ministry of Economic Affairs and Communications' labour market forecasts and qualitative data from stakeholder and sectoral expert interviews and group discussions on future economic trends, changes in worker and skill supply needs and the provision of education and training in each sector.

Case Study 2: Canada

Canada has a highly educated workforce with 62% of Canadians having a tertiary degree in 2018, compared to 44% in the OECD generally.[9] To enhance the education systems, learning opportunities, and overall outcomes and to ensure quality lifelong learning opportunities for all Canada-wide, the CMEC developed the *Learn Canada 2020* education framework, with four pillars of enhancing early childhood learning and development, elementary to high school systems, postsecondary education and adult learning and skills development.[10] The CMEC outlined five key areas to increase the numbers pursuing post-secondary education, including: addressing post-secondary education's accessibility and affordability (e.g., finding a balance between tuition costs and financial aid); assessing the role of employers to encourage their participation in preparing students for employment; examining the most relevant learning outcomes to postsecondary education and developing instruments to measure these outcomes; to manage and understand key factors that may affect higher education's sustainability (e.g., increasing costs, changing demographics, fiscal context, tuition or debt levels); and to assess the success of students' transition from secondary to postsecondary education.[11] The experience of Canada is also relevant in considering the pathways to further education. In Canada**,** those that undertake vocational pathways in post-secondary colleges can attend university upon receiving a college diploma.[12] Bridging courses are available for those that do not have all the knowledge necessary to undertake a university course and for VET students who did not finish high school.[13] An interesting example of approaches to pathways is the Trade to Degrees programme, developed by the Northern Alberta Institute of Technology. This allows recognised trade professionals the opportunity to progress from an apprenticeship credential, to the third year of their four-year Bachelor of Business Administration Programme.[14]

[5] OECD, 2019. "PISA Results 2018 – Country Report Estonia". Available at: https://www.oecd.org/pisa/publications/PISA2018_CN_EST.pdf
[6] OECD (2019), *PISA 2018 Results (Volume I): What Students Know and Can Do*, PISA, OECD Publishing, Paris, https://dx.doi.org/10.1787/5f07c754-en.
[7] OECD Reviews of School Resources: Estonia 2016 https://www.oecd-ilibrary.org/docserver/9789264251731-5-en.pdf?expires=1587044077&id=id&accname=guest&checksum=0B22A7F04F66986FF8B478697E3F1657
[8] https://oska.kutsekoda.ee/en/oska-management-methodology/oska-methodology/
[9] Education at a Glance (2019) Canada Country Specific Note <http://www.oecd.org/education/education-at-a-glance/EAG2019_CN_CAN.pdf>
[10] http://cmec.ca/Publications/Lists/Publications/Attachments/187/CMEC-2020-DECLARATION.en.pdf
[11] https://www.cmec.ca/158/Postsecondary_Education.html
[12] https://www.sram.qc.ca/international-student/curricula-and-levels
[13] For an example of a bridging programme at the University of Toronto see: http://sites.utoronto.ca/typ/faq.html
[14] https://www.nait.ca/nait/admissions/transfer-and-credit-options/pathways/trades-to-degrees

Case Study 3: New Zealand

New Zealand is characterised by low unemployment levels (between 4% and 7% since 2010)[15] with a consequent shortage of skills in certain areas, such as construction, which New Zealand has traditionally turned to immigration to fill. Occupational shortages are evidenced by almost 6 in 10 managers in New Zealand finding it difficult to fill jobs (in Ireland this is only 2 in 10).[16] There are interesting developments in New Zealand in strengthening skill intelligence. Skills anticipation in New Zealand is largely based around using occupational shortages as a proxy of skills shortages. The Ministry of Business, Innovation and Employment (MBIE) uses Computable General Equilibrium Model to develop yearly employment forecasts for industries, broad occupational and skills groups, underpinned by the macroeconomic outlook in the Consensus Forecasts of the New Zealand Institute of Economic Research.[17] These forecasts set priorities for tertiary education, training for industry and the MBIE's medium- to long-term employment outlook.[18]

Implications of Review of Policy Approaches

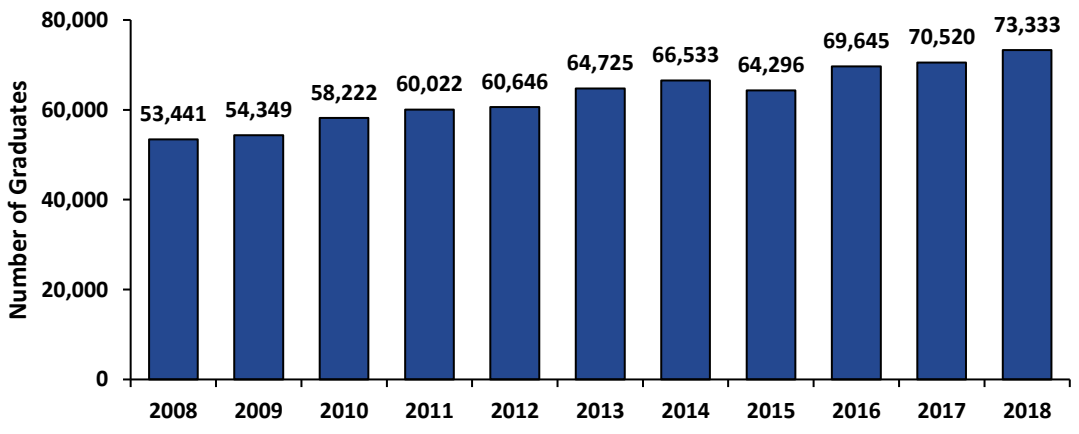
Our analysis of policy approaches to skills provision in Ireland and in other case studies examined suggests that Ireland has a well-developed policy system to align educational and training provision with skill requirements, but there are areas of skill intelligence and in pathways to higher education which can be enhanced. The review of international practice indicates potential areas which merit additional emphasis in Ireland including the development of innovative and seamless pathways between further education and higher education. Approaches to forecasting of further educational and skills requirements should also be strengthened. One issue of note is that while there are inevitable challenges in any forecasting, it is critical that the educational and training system has the flexibility to respond to changing skill requirements and that the focus is on future rather than historical skill needs.

HE and FET Participation

Higher Education Participation

The number of graduates who were awarded qualifications ranging from NFQ Levels 6-10 between 2008 and 2018 is shown in the figure below. Since 2008, the number of students graduating from HEA-funded institutions has increased by over 37%. These individuals represent an important source of high skills for the Irish economy. However, the rate of growth has implications for the financial sustainability of the HE sector.

Trends in Total Number of Higher Education Graduates (All HEA-funded Institutions), 2008-2018

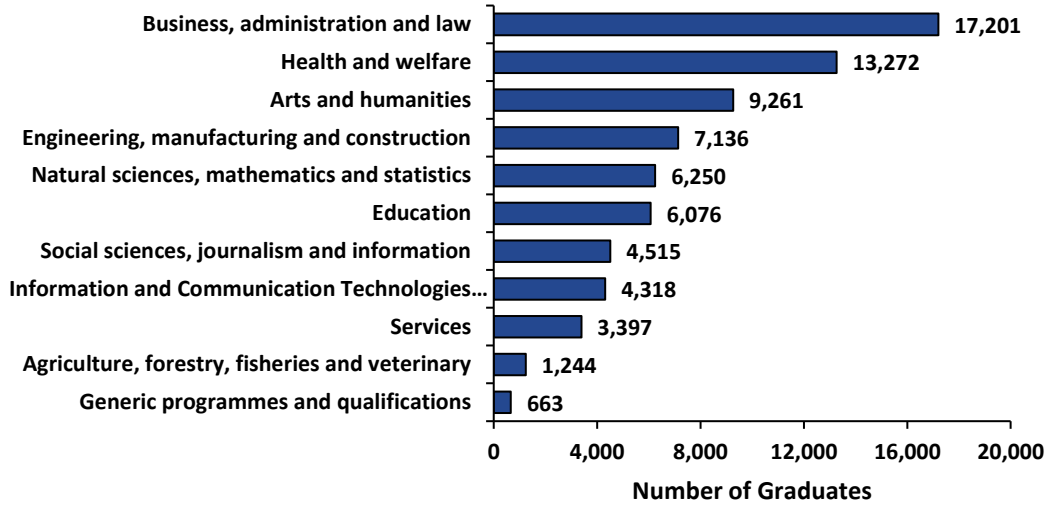


Source: HEA
Note: Figures do not include enrolments in private institutions.

[15] Statistics New Zealand – Unemployment Rates: https://www.stats.govt.nz/indicators/unemployment-rate
[16] OECD, 2016. "Getting Skills Right: Assessing and Anticipating Changing Skill Needs", OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264252073-en
[17] These forecasts cover exports, imports and consumption growth. See OECD, 2017. "OECD Skills Strategy Diagnostic Report: Slovenia 2017."
[18] Ministry of Business, Innovation and Employment, 2019. "Medium to long-term employment projections: Looking ahead to 2028". Available at: https://www.mbie.govt.nz/assets/medium-to-long-term-employment-outlook-looking-ahead-to-2028.pdf

The following figure shows the total number of qualifications awarded by field of study in 2018. It highlights the difference in supply of higher-level graduates by field of study. Business, administration and law had the highest number of graduates at 17,201. Other major areas of field of study include health and welfare, arts and humanities, engineering, manufacture and construction, natural sciences, mathematics and statistics, and education.

Total Number of Levels Awarded by Field of Study in 2018



Source: HEA Note: Figures do not include enrolments in private institutions.

Further Education and Training Provision

Further education and training ('FET') in Ireland is education and training that occurs after second-level education that is not part of the third-level system.[19] The table below shows the change in the number of beneficiaries[20] and new entrants to further education and training between 2014 and 2019. 2018 experienced the highest number of new entrants to FET over the six-year period, with the 2019 figure slightly lower than the previous year.

Further Education and Training Beneficiaries and New Entrants (2014-2019)

	Beneficiaries	New Entrants
2014	341,726	215,929
2015	369,523	231,234
2016	339,283	245,400
2017	323,308	230,641
2018	337,966	251,391
2019	329,293	247,855

Source: Presentation of SOLAS data

Generic programmes and qualifications were the most popular field of study for FET learners in 2018, accounting for almost half of learners as per the following table. Business and administration and law; health and welfare; and services each had around 10% of learners.

[19] Department of Education and Skills

[20] Defined as individuals who will benefit from interventions provided through FET funding in a given year, irrespective of whether they are present at the start of the year or join a course during the year, as per the SOLAS FET Services Plan.

Field of Study of Further Education and Training Learners in 2018		
	Number of FET Learners	**Percentage of Total**
Generic programmes and qualifications	81,488	46.6%
Business and administration and law	18,136	10.4%
Health and welfare	17,691	10.1%
Services	17,476	10.0%
Arts and humanities	9,803	5.6%
Education	9,261	5.3%
Information and communication technology	8,718	5.0%
Engineering, manufacturing and construction	7,369	4.2%
Agriculture, forestry, fisheries and veterinary	3,521	2.0%
Natural sciences, mathematics and statistics	978	0.6%
Social sciences, journalism and information	613	0.4%
Total	**175,054**	**100%**
Source: SOLAS data		

Apprenticeship Training

An important element of FET which has been given increased attention is apprenticeship training. This area of FET provision has historically been less developed in Ireland than in some other countries. Apprenticeships are industry-led programmes which offer learners training in both the workplace and in education and training centres (such as ETB (Education and Training Board) centres, IOTs (Institutes of Technology) or colleges of further education). The programmes are focussed on employment outcomes and on meeting specific skills needs. The main apprenticeships are in the areas of construction, electrical industries and engineering. A QQI Level 6 Advanced Certificate Craft was awarded those who successfully completed an apprenticeship in the years before 2016.[21] Apprenticeships differ from traineeships, which are shorter (generally 40 weeks in duration) work-based learning (usually a minimum of 30% of time is allocated to workplace learning) programmes which are offered in partnership with employers.[22] The table below presents data on the number of new registrations in apprenticeships from 2014 up to September 2019, by the area of the apprenticeship. The annual number of registrations in apprenticeships between 2014 and 2019 have increased from 2,698 to almost 5,648, an increase of 109%. In 2018, 2,249 or 40% of apprenticeship registrations were in electrical, while 1,486 were in construction. Registrations for apprenticeships in the areas of electrical and construction have grown by 114% and 155% respectively, between 2014 and 2018, reflecting the resurgence of the construction sector as the Irish economy recovered in those years. Engineering and motor apprentices accounted for the next largest share of registrations in 2018, at 13% each.

Number of Apprentice Registrations 2014-2019						
	2014	**2015**	**2016**	**2017**	**2018**	**2019***
Auctioneering					53	82
Biopharma					16	23
Construction	582	693	914	1,180	1,486	1,100
Electrical	1,051	1,184	1,617	2,095	2,249	1,773
Engineering	453	508	503	678	709	535
Finance			67	190	189	166
Hospitality & Food				25	150	101
ICT					61	103
Logistics					27	30
Motor	604	760	716	673	708	538
Printing	8	8	4	2	0	0
Total	**2,698**	**3,153**	**3,821**	**4,843**	**5,648**	**4,451**
Source: SOLAS submission to the Joint Oireachtas Committee on Education on Skills 2019.[23]						
Note: *Registrations for 2019 are up to September 2019 and are not for the full year like the figures for the other years displayed. Apprenticeships are to be established in Hairdressing and Retail.						

[21] CSO Further Education Outcomes - Graduation Years 2010-2016, 2019. Available at: https://www.cso.ie/en/releasesandpublications/ep/p-feo/furthereducationoutcomes-graduationyears2010-2016/apprenticeships/

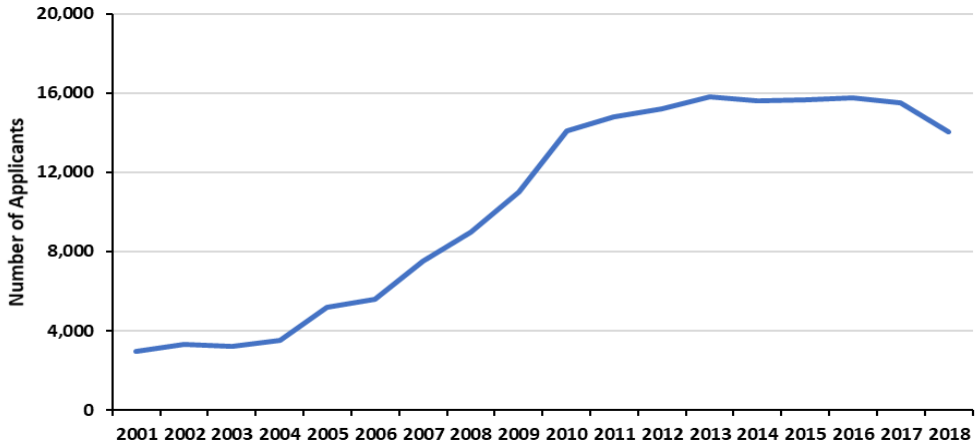
[22] Department of Education and Skills, 2016. "Action Plan to Expand Apprenticeship and Traineeship in Ireland". Available at: https://www.education.ie/en/Publications/Policy-Reports/Action-Plan-Expand-Apprenticeship-Traineeship-in-Ireland-2016-2020.pdf

[23]https://data.oireachtas.ie/ie/oireachtas/committee/dail/32/joint_committee_on_education_and_skills/submissions/2019/2019-10-22_opening-statement-andrew-brownlee-ceo-solas_en.pdf

Pathways Between FET and HE

Of relevance to this study is the relationship between FET and HE, as well as the pathways that exist between the two. The following graph shows that there was a steady increase between 2004 and 2010 in the number of CAO applicants who had a FET QQI award. Since 2010 there have been between 14,000 and 16,000 applicants per year with a noticeable decline in the number of applicants in 2018. Just over half of those who completed remained in education with 18% of completers moving into higher education and 34% continuing with another FET course. Over two-fifths (41%) of completers were in sustainable employment, for at least 12 fulltime weeks' work, after the date of course completion.

Trends in CAO Demand from Applicants with FET QQI Awards



Source: Transitions Reform Sub-Group – confidential data from working paper

Implications of Review of HE and FET Participation

Our analysis of HE and FET participation indicates that Ireland has supported very high levels of participation in higher education and there has been dramatic growth in enrolments in HE over the decade to 2019. The largest number of qualifications are in honours degrees but there has been a significant increase in postgraduate qualifications. The largest fields of study by numbers for HE graduates are business, administration and law; followed by health and welfare; and arts and humanities. Within the FET sector, the largest field of study is generic programmes and qualifications. Generic qualifications may subsequently provide a foundation for more specific employment-related training and can support life-long training programmes.

Labour Demand for Graduates by Sector

Participation rates in higher education in Ireland are very high and this is reflected in the levels of educational attainment in the Irish labour force. The figures presented in below also show that there has been steady growth in the percentage of the labour force with primary degrees or higher.

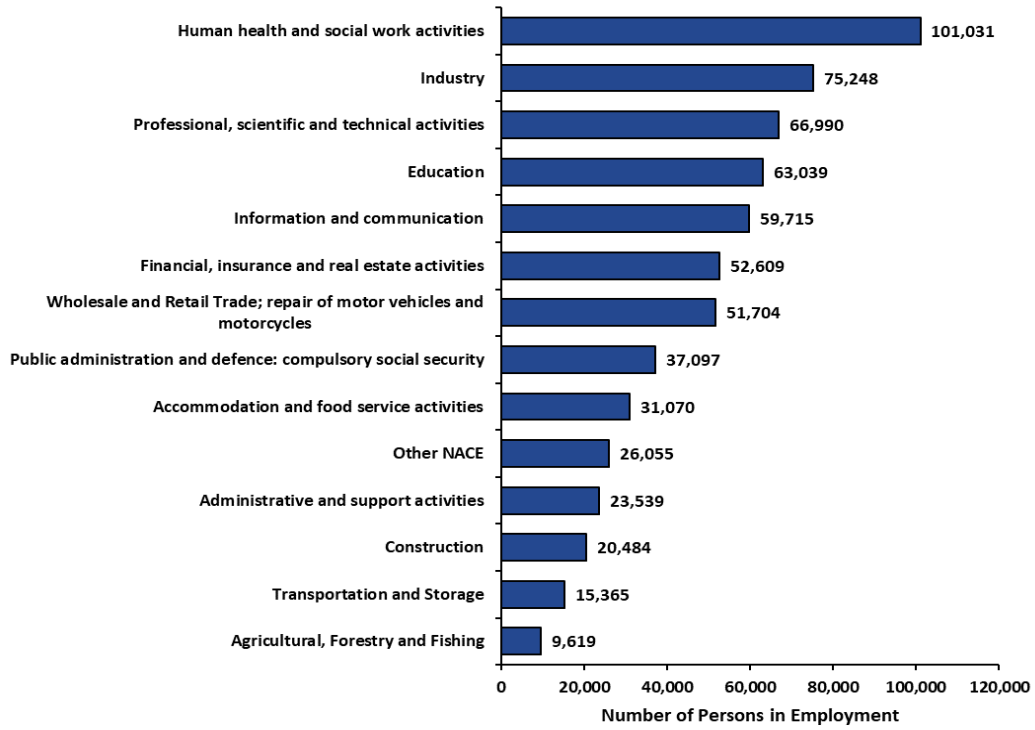
Education Level of Those in Labour Force in Q4 of Year (2014-2019)

	2014	2015	2016	2017	2018	2019
Primary or below	3.1%	3.2%	2.7%	2.6%	2.4%	2.8%
Lower secondary	11.0%	10.3%	10.3%	9.5%	9.1%	8.7%
Higher secondary	24.2%	23.9%	23.5%	23.8%	23.1%	23.5%
Post-secondary non-tertiary	13.6%	13.0%	13.8%	14.3%	14.8%	14.6%
Third-level non-honours degree	11.9%	12.1%	11.8%	11.3%	11.3%	10.6%
Third-level honours degree or higher	32.9%	34.3%	34.6%	35.8%	36.7%	37.2%
Other/not stated	3.4%	3.3%	3.4%	2.7%	2.6%	2.7%
Total Number in Labour Force	**2,203**	**2,229**	**2,264**	**2,297**	**2,332**	**2,379**

Source: Analysis of CSO LFS data

There is a correlation between education and employment which is evident from the data on the labour market status by educational attainment. Approximately half of those had a bachelor's degree or higher. When including those who have attained a higher certificate/PLC and above, the cohort accounts for almost two-thirds of those in employment. A much higher percentage of those with low levels of education were unemployed. Health and social work activities is the largest single sector amongst those with an honours bachelor's degree, employing over 100,000 in 2019. Industry was the second-largest sector of employment for those with ordinary degrees followed by professional, scientific and technical activities. Amongst those with a postgraduate degree/diploma or above, education is the single largest sector of employment, followed by health and social work. Information and communications, professional scientific and technical activities, and industry are also major employers of those with postgraduate degrees.

Persons with Honours Bachelor's Degree in Employment by Sector (2019)



Source: Analysis of LFS data

Sectoral Employment Breakdown by Education Level

To further inform the analysis it is useful to examine sectoral employment by education level for each of the NACE Rev 2 classifications. NACE provides the framework for collecting and presenting a large range of statistical data according to economic activity.[24] As an illustration of this, it is useful to consider two very different sectors which are major employers in the Irish economy, namely, the wholesale and retail trade and information and communications.[25]

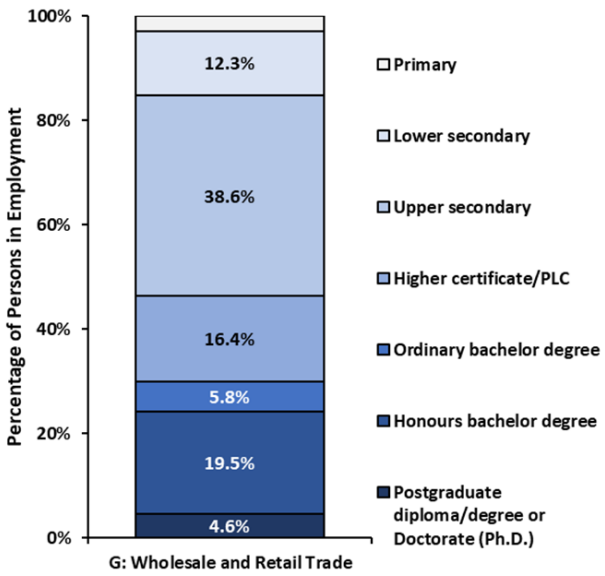
The wholesale and retail trade sector is composed primarily of those with a higher certificate/PLC or lower, with those with upper secondary as their highest level of education the largest cohort. However, a significant minority (almost one-third) of employees in the sector have and ordinary bachelor's degree or above.

[24] Eurostat methodologies and working papers- NACE Rev.2 Statistical Classification of economic activities in the European Community. https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF

[25] Data for all the major sectors is presented in the main report.

Education Breakdown of Persons in Employment in Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles (2019)

Level of Education	Number of Persons
Primary	7,686
Lower secondary	32,548
Upper secondary	102,275
Higher certificate/PLC	43,454
Ordinary Bachelor's degree	15,421
Honours Bachelor's degree	51,704
Postgraduate diploma/degree or Doctorate (Ph.D.)	12,200
Total	**265,288**

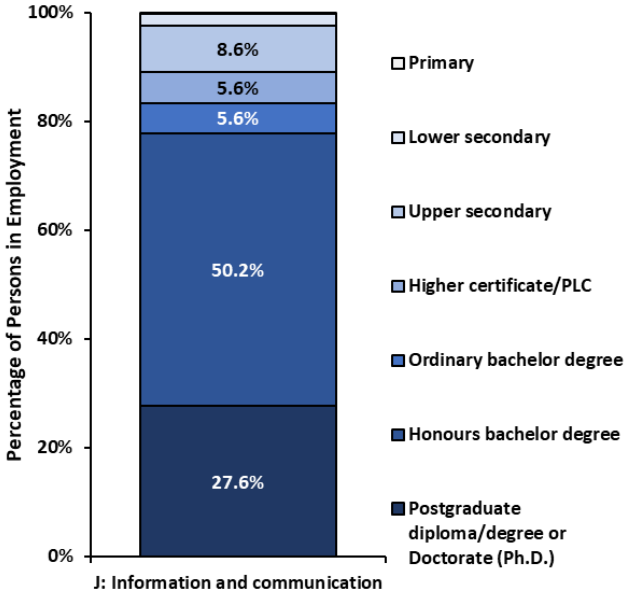


Source: Analysis of CSO LFS data

The information and communication sector in contrast to the wholesale and retail sector is mostly comprised of individuals who have some form of higher education. Over 50% of employees in the sector in 2019 had attained an honours bachelor's degree, with a further 27.6% achieving some form of postgraduate qualification. Thus, approximately 83% of the employees in the sector had attained a higher education qualification.

Education Breakdown of Persons in Employment in Information and Communication (2019)

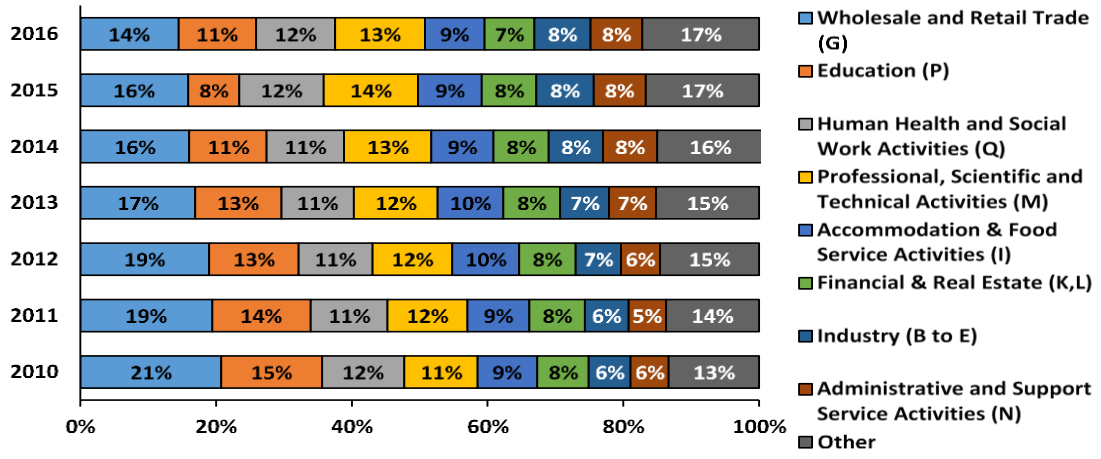
Level of Education	Number of Persons
Primary	391
Lower secondary	2,439
Upper secondary	10,244
Higher certificate/PLC	6,677
Ordinary Bachelor's degree	6,664
Honours Bachelor's degree	59,715
Postgraduate diploma/degree or Doctorate (Ph.D.)	32,800
Total	**118,929**



Source: Analysis of CSO LFS data

An analysis of economic sectors entered by graduates one year after education shows that a wide range of sectors in the Irish economy employs graduates. However, the percentage of employees who are graduates in each of the sectors varies significantly.

Economic Sectors Entered by Graduates 1 year since Graduation



Source: CSO

Employment by Sector and Field of Study

European-wide economic activities are organized under NACE Rev 2 classifications. NACE provides the framework for collecting and presenting a large range of statistical data according to economic activity.[26] The table below lists NACE Rev 2 sectors according to their classifications A-U.

NACE Rev 2 Classifications	
A-	Agriculture, forestry and fishing
B-E	Industry
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food storage activities
J	Information and communication
K-L	Financial, insurance and real estate activities
M	Professional, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R-U	Other NACE activities

Source: CSO

The following table contains data on the number of employed persons (aged between 15 and 64) with high qualifications by their field of study and sector of work. Social sciences/business was the largest field of study amongst those with high levels of qualification. The largest sectors of employment for those with high levels of qualifications are health and social work and education.

[26] Eurostat methodologies and working papers- NACE Rev.2 Statistical Classification of economic activities in the European Community. https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF

Total Employed Persons (aged 15-64) with High Qualification by Educational Field and Industry, 2019															
	A	BCDE	F	G	H	I	J	KL	M	N	0	P	Q	RSTU	Total
General Programmes	65	2,134	426	2,011	566	1,206	2,182	1,519	2,040	661	1,879	1,037	1,781	1,728	**19,234**
Education	382	2,209	297	2,775	166	2,176	974	951	1,310	1,103	1,255	72,898	5,558	2,069	**94,124**
Arts and Humanities	318	3,987	912	7,577	1,566	5,345	8,150	4,980	6,294	3,300	5,942	14,463	6,237	9,099	**78,169**
Social Sciences/Business	2,566	32,999	5,664	28,179	9,635	13,911	27,947	53,133	45,902	14,987	26,271	14,185	20,015	8,954	**304,347**
Natural Sciences and Math	1,029	17,003	760	4,163	809	1,781	5,070	3,114	7,791	1,230	4,441	8,538	4,732	1,202	**61,663**
ICT	160	7,984	842	5,509	1,768	1,494	36,555	8,342	3,409	2,653	3,360	4,386	1,653	1,639	**79,754**
Engineering	1,082	30,814	15,396	7,489	4,237	2,243	7,766	3,103	20,816	3,566	4,450	3,057	1,783	1,734	**107,535**
Agriculture	5,986	3,534	510	1,695	926	780	290	412	2,417	1,156	1,829	445	738	1,349	**22,066**
Health/Welfare	830	6,333	804	7,151	1,249	3,353	1,764	1,434	3,150	1,962	6,355	7,950	113,037	4,919	**160,291**
Services	356	4,593	1,116	4,949	2,467	10,454	1,425	1,539	1,625	2,554	5,366	1,961	3,553	4,839	**46,796**
Unknown	92	765	110	703	258	468	686	524	418	349	568	358	337	228	**5,865**
Total	**12,865**	**112,354**	**26,838**	**72,201**	**23,645**	**43,210**	**92,809**	**79,052**	**95,171**	**33,520**	**61,717**	**129,278**	**159,425**	**37,760**	**979,845**
Source: Analysis of Labour Force Survey data															

The following table shows that in some sectors there was a high level of concentration of persons from individual fields of study. Over 70% of employees in health and social with high qualifications studied health or welfare, whilst 67% of those employed in financial, real estate or insurance activities studied the social sciences or business.

% Employed Persons (aged 15-64) with High Qualification by Field of Study in Top 6 Economic Sectors, 2019						
	P	Q	BCDE	M	J	KL
Agriculture	0%	0%	3%	3%	0%	1%
Arts and Humanities	11%	4%	4%	7%	9%	6%
Education	56%	3%	2%	1%	1%	1%
Engineering	2%	1%	27%	22%	8%	4%
General Programme	1%	1%	2%	2%	2%	2%
Health/Welfare	6%	71%	6%	3%	2%	2%
ICT	3%	1%	7%	4%	39%	11%
Natural Sciences and Math	7%	3%	15%	8%	5%	4%
Services	2%	2%	4%	2%	2%	2%
Social Sciences/Business	11%	13%	29%	48%	30%	67%
Unknown	0%	0%	1%	0%	1%	1%
Source: Analysis of Labour Force Survey data						

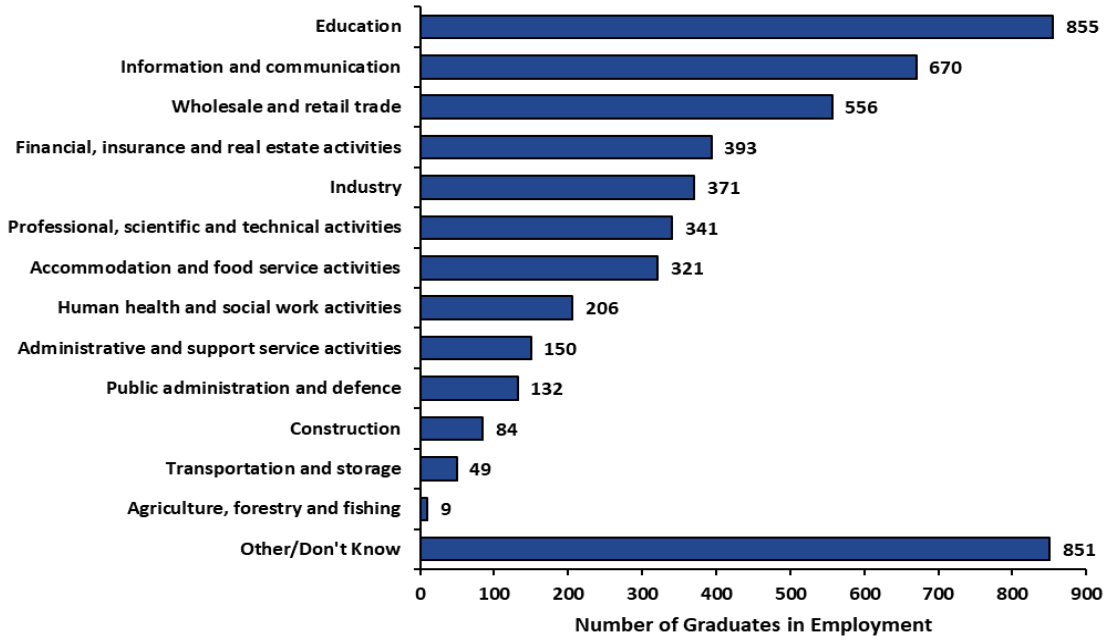
Implications of Review of Sectoral Employment

Our analysis of labour demand for graduate by sector indicates that there are marked differences in employment of graduates by sector. The most important sectors for employment of graduates are wholesale and retail trade; professional, scientific and technical activities; health and social work; education; and accommodation and food services. Graduates with degrees or higher certificates have lower levels of unemployment than other groups in labour market. Over 89,000 persons with education levels below higher certificate/PLC are unemployed. Individuals with lower than higher certificates/PLC accounted for 34% of those unemployed in the labour market. Our analysis suggests that in addition to the need to meet high skill requirements, there is an important role for FET in addressing under-education in certain groups in the labour force.

Sectoral Employment of HE Graduates by Field of Study

A breakdown of the sectoral employment of higher education (HE) graduates by their fields of study allows an assessment of alignment of fields of study with sector of employment. To highlight the issues, it is useful to consider the examples of arts and humanities graduates, business administration and law graduates and ICT graduates.[27] For example, an analysis of employment for graduates who studied arts and humanities is presented in the figure below. Whilst education was the largest destination of graduates who studied arts and humanities, there were a number of other sectors which accounted for significant employment, including information and communication, and wholesale and retail trade. This suggests that graduates from arts and humanities are in demand across a number of different sectors in the economy.

Arts and Humanities HE Graduates by Sector of Employment

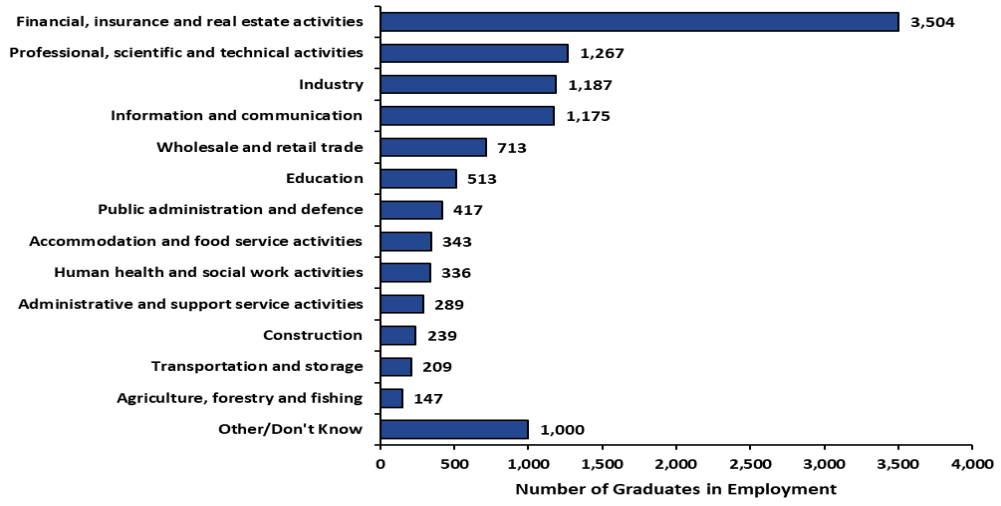


Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

It is clear from the following figure that a large portion of graduates from HE business, administration and law courses obtained employment in the financial, insurance and real estate activities sector. However, over 1,000 graduates also obtained employment in each of the professional, scientific and technical activities, industry, and information and communication sectors. Whilst this suggests a degree of alignment between the field of study and these sectors, there are still significant numbers of graduates entering employment in other sectors in the economy.

[27] Details on all sectors are included in the main report.

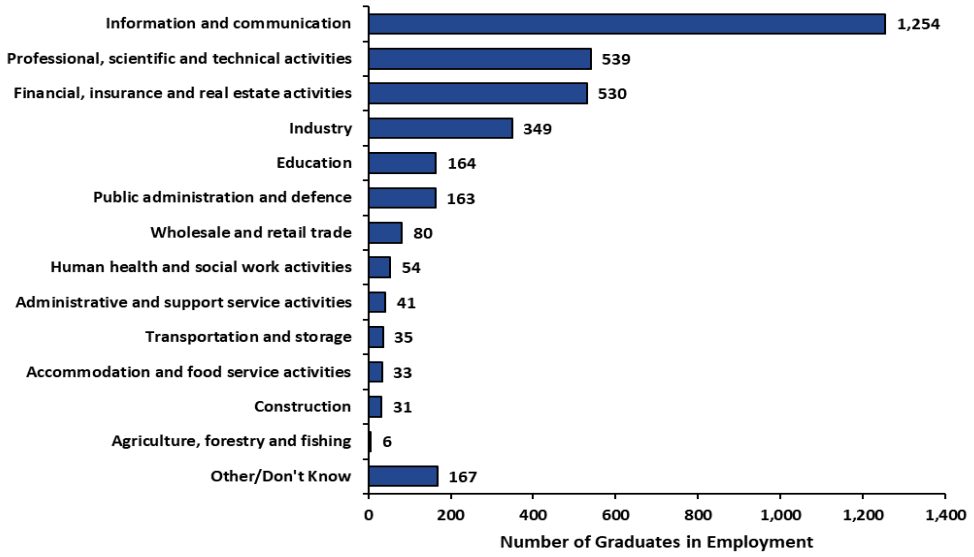
Business, Administration and Law HE Graduates by Sector of Employment



Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

The following table shows the clear alignment of the ICT field of study with the information and communication sector. The sector employed more than twice the number of ICT graduates of any other individual sector. There were significant numbers of graduates employed in the professional, scientific and technical activities, and financial, insurance and real estate activities sectors.

Information and Communication Technologies HE Graduates by Sector of Employment



Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

Implication of Review of Sectoral Employment of Graduates

The evidence presented shows that there are very significant differences in the sectoral employment of HE graduates in terms of outcomes by field of study. For business administration and law graduates, main sectors of employment were financial, insurance and real estate; professional scientific and technical activities; industry; and information and communications. For FET graduates there are also very significant differences in sector of employment by field of study. The evidence also indicates significant differences in sectors where FET graduates are employed, compared with HE graduates even when adjustments are made for field of study. For

example, sectors where FET business administration and law graduates are mainly employed are in wholesale and retail trade, accommodation and food services, and administrative and support services. This contrasts with sectoral concentration of HE graduates. In some sectors FET graduates are directly related to field of study such as in health and welfare, and in agriculture, forestry and fishing. FET graduates' sectoral employment in a number of areas is less related to their field of study than HE graduates. For example, FET graduates in ICT are mainly employed in wholesale and retail trade, and in accommodation and food services.

Future Labour Demand and Implications for HE and FET

Intelligence on Future Skill Needs

In ensuring efficient and effective FET and higher education provision and in order to better match the provision of skills provision and the demand of the labour market, it is important to consider the future developments in employment in the Irish economy by levels of educational qualification for the next five years (up to 2025). This is aligned with the European Skills Agenda for sustainable competitiveness, social fairness and resilience. Specifically, our analysis is an example of the implementation of Action 2 of the European Commission's Skills Agenda which is designed to strength skills intelligence. Our forecast analysis aims to project labour demand for individuals at different levels of education by looking at the responsiveness of labour demand to the Irish economy. Scenarios have been developed across industries as well as occupational groups, with the aim of highlighting the relationships between industries and fields of study and future demand.

It is important in strengthening skills intelligence to separate labour demand skills into three qualification levels: high, medium and low, based on the official ISCED classification system. The basic underlying model of our labour demand forecast is derived from an econometric model regressing employment on GDP by type of employment-education level. We differentiate employment by highest level of education attained. Different models are then run for both the aggregate economy and each economic sector, as well as by educational field. To investigate the relationship between employment and skill demand, we specify the following model(s):

$$Y_{i,j,t} = \alpha_{i,j} + \beta_{i,j} GDP_t + \varepsilon_{i,j,t}$$

Where Y is employed individuals (working age 20-64) in industry *i,* qualification *j*, and at time *t*; GDP is at time *t* and in current prices, and represents skill demand of the Irish economy; ε_t is an error term at time *t,* and α is a constant; the specificity of the coefficients depends on the model estimated and we estimated models both aggregated over industry and specific to each industry, but always differentiated by qualification level, high, medium and low. The coefficients β estimate the responsiveness of employment across education levels to the requirement of skills within an economic sector. A number of different specifications were tested, including dummy variables for GDP-once off changes, seasonal dummies, ln GDP_2, but none of these models proved successful in both a) improving the forecasts (in terms of a sense check[28] and within-sample prediction MSE or the b) other general regression diagnostics.

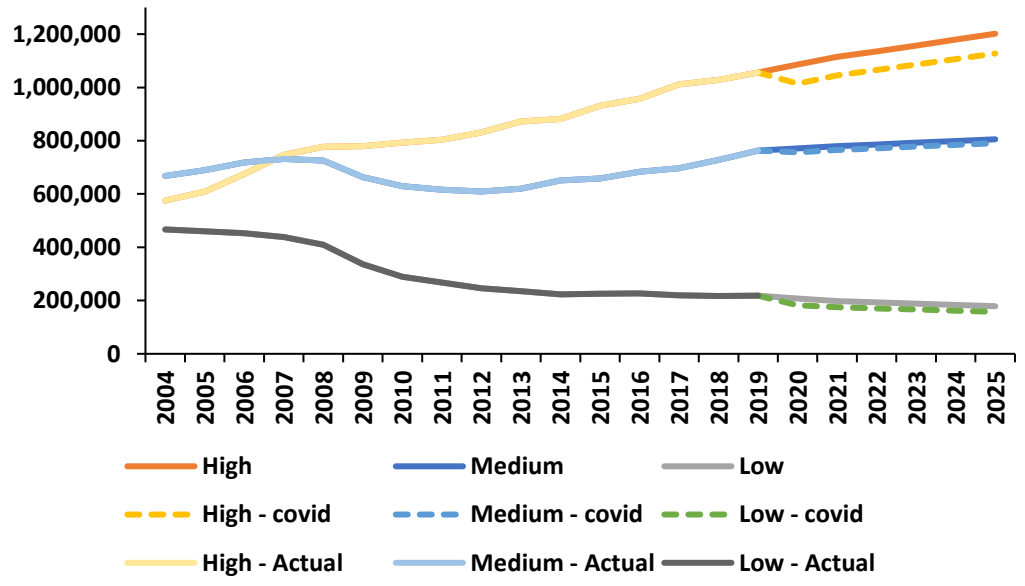
It is useful to compare the labour demand projections across high, medium and low qualifications. We begin with a comparison of the aggregate employment or labour demand by the aggregate qualification levels: high, medium and low. The following table shows the coefficients from our Model 2. The coefficients for GDP can be interpreted as the percentage change in labour demand as a result of a 1% change in GDP from the aggregate models. For example, labour demand for high qualifications is modelled to increase by 0.517% as GDP increases by 1%. However, a 1% increase in GDP is forecast to lead to a 0.677% decline in demand for labour with low qualifications. This is consistent with our analysis of expected demand for labour with low qualifications by sector.

[28] For example, GDP_2, improved the fit and within sample forecasts but extrapolation out to five years often led to implausible results, e.g., reversal of the overall direction of GDP causality on labour demand.

Summary of Outputs from Our Modelling (Model 2)			
Coefficient-variable	**Low**	**Medium**	**High**
β-gdp	-0.677*** (0.024)	0.150*** (0.009)	0.517*** (0.014)
δ-MA(1)	0.975*** (0.026)	0.954*** (0.0398)	0.914*** (0.035)
α-Constant	19.944*** (0.266)	11.797*** (0.095)	8.007*** (0.156)
n-Observations	64	64	64
R-squared	0.974	0.932	0.972
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			
Source: Economic modelling by consultancy team.			

The figure below presents aggregate labour demand projections by qualification. This suggests that the projected increase in labour demand for high qualifications, whilst medium qualifications are expected to be relatively stable. Labour demand for low qualifications is forecast to decline gradually.

Aggregate Labour Demand Forecast for High, Medium and Low Qualification, Q1 2004 – 2025



Source: Economic modelling by consultancy team.

Implications of Modelling on Future Skills

While there are difficulties in estimating future demand by qualifications, the econometric modelling undertaken is focused on enhancing Ireland's skills intelligence of importance. Some key findings from models suggest that all sectors show positive relationship between high qualifications and economic growth and negative relationship between low qualifications. This indicates that the shift in the sectoral mix of qualifications towards higher skills is predicted to continue in post-COVID-19 scenario. The impact of COVID-19 on the forecasts highlights how developments in the economy can quickly change skill requirements. This reinforces the importance of flexibility within the FET and HE systems. The move towards higher skills does not imply increased numbers have to be accommodated within the HE system, and the likely loss in low skill jobs suggests an increasing role for FET in assisting individuals with the skills needed to adapt to these changes. Overall, the analysis suggests that FET and HE system will need great flexibility to adjust to the expected changes in labour market requirements in order to avoid significant skill mismatches.

Emerging Sectors and Technologies

Emerging industries come into existence with the creation of a new industrial value chain, or the radical reconfiguration of an existing one, driven by a disruptive idea or ideas. This leads to new products/services with higher added value, driving a high growth rate in the industries concerned and further market potential.[29] Technological change, and the increased reliance on that technology, can also result in changes in the skill needs within industries. Further, changing societal needs, such as the need to address climate change, are resulting in the emergence of new sectors and activities.

The disruptive nature of technological change makes the task of predicting future skill needs evermore challenging.[30] Long-term labour market forecasts are limited by the difficulty of estimating future skill demand, as the latter is sensitive to unpredictable technological or other changes, which reduces the reliability of such exercises.[31] However, developing a longer-term view of labour market changes in the face of technological changes, and updating this regularly, can help ensure that any structural changes in the economy are captured in the estimation process, while allowing for the alteration of assumptions in the face of new economic and social developments.[32] Skills assessment and anticipation exercises do not attempt to predict the future with certainty or precision. They are tools to help prepare or plan for future scenarios constructed from reliable evidence-based information.[33]

Ireland is one of the most open trading nations in the world, with a very high rate of engagement with international trade. The composition of Ireland's export base has also changed rapidly over the last number of decades, as Ireland transitioned from relatively low value-added operations in the 1990s to higher-end R&D, logistics, and management functions today. Ireland has a concentration in a number of industrial sub-sectors, which in turn influences the nature of skills needs. These include: pharmaceuticals and chemicals, medical devices, ICT/internet services, financial services, and business services. The employment composition of exporting firms has also changed significantly over the last two decades, as shown in the figure below. There has been a notable increase in services employment, with over 160,000 jobs in 2019 compared to 84,000 ten years previously, mirroring the increased share of services value-added as a percentage of GNP. This changing composition towards greater services is likely to have a significant impact on skill demand.

[29] European Commission, https://ec.europa.eu/growth/industry/policy/cluster/emerging-industries_en, accessed on 25.05.20.

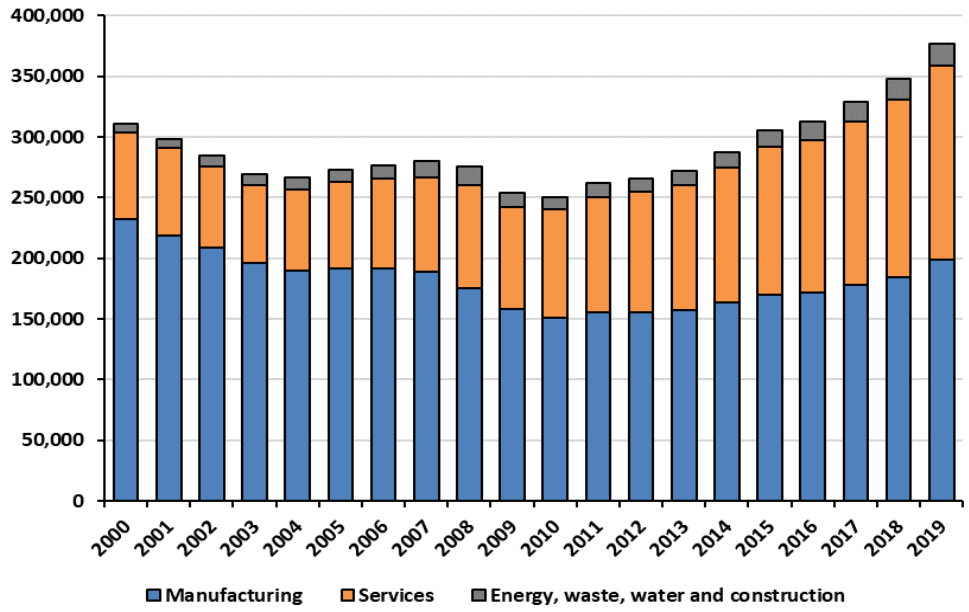
[30] ILO and OECD (2018), "Approaches to anticipating skills for the future of work", Report prepared by the ILO and OECD for the G20 Employment Working Group.

[31] Wilson and Zukersteinova (2011), as cited in ILO and OECD (2018).

[32] Thomas (2015), "Review of best practices in labour market forecasting."

[33] Wilson (2012), "Wilson, R. (2012), "Skills Forecasting: Applying the Cedefop Skills Forecasting Framework to Transition and Developing Countries", ETF Workshop on Foresight and Policies and Strategies for VET.

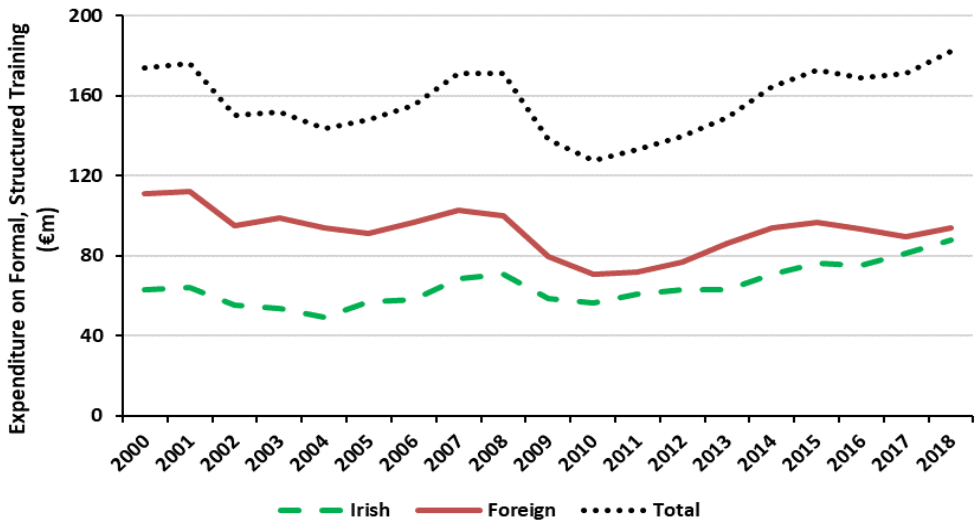
Employment in Agency-Supported Firms by Broad Sector, 2000-2019



Source: Annual Business Survey of Economic Impact

Export-orientated firms spend over €180m per annum on formal, structured training. The aggregate level of expenditure for 2000-2018, broken down by form of ownership, is show in the next figure. It shows that aggregate expenditure by Irish-owned firms on formal training of their employees has increased over the last ten years to almost match the expenditure of foreign-owned firms, despite the latter catering for more employees. This evidence is important in understanding the contribution of employers in certain sectors in enhancing skills in the Irish economy.

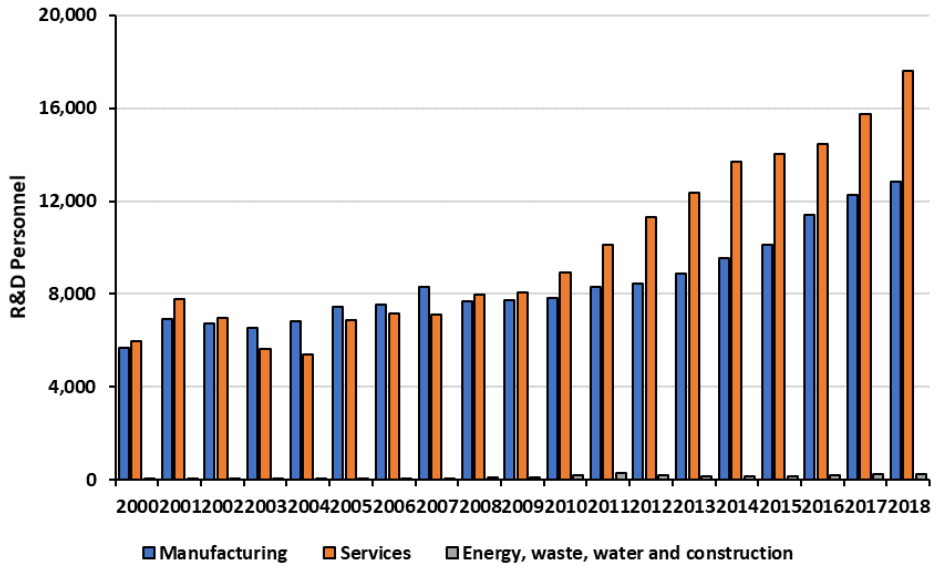
Expenditure on Formal, Structured Training (€ Million)



Source: Annual Business Survey of Economic Impact

Ireland has increasingly become a R&D centre for many indigenous and foreign-owned companies and the availability of high-quality R&D skills has become increasingly important. The following figure shows the number of R&D personnel employed in exporting firms, broken down between manufacturing and services firms. Employment in R&D activities by services firms has become increasingly important, with researchers in this area outnumbering the manufacturing sector for the last decade.

R&D Employment of exporting firms by broad industrial area, 2000-2018



Source: Annual Business Survey of Economic Impact

Automation, Digitisation and Artificial Intelligence

Technological development has major implications for labour markets. Innovations such as automation and digitalisation drive productivity growth, increase revenues, generate new jobs, and thus can contribute to higher living standards.[34] Increased automation and digitalisation is already having an impact on demand in the labour market. Cedefop skills forecasts for Ireland up to 2025[35] predict an increase in demand for high-level ICT skills such as skills in cloud computing and big data analytics, as well as an increase in the demand for various other levels of ICT skills across all sectors as a result of technology becoming increasingly embedded in business functions and processes. The European Skills and Jobs Survey (ESJS) highlights that 43% of adult employees have recently experienced changes in the technologies they use at work and 47% saw changes in their working methods or practices as a result of changes to technology.[36] Artificial intelligence ('AI') also has the potential to impact on the skills required in the modern economy. Artificial intelligence can be defined as systems that display intelligent behaviour by analysing their environment and acting with some degree of autonomy to achieve specific goals.[37] Given the importance of internationally traded sectors to the Irish economy, it is important to understand the potential impact in terms of skills to examine the employment of those sectors which are believed to have high levels of AI adoption. Building on the findings by McKinsey and others, we have grouped internationally traded sectors which have high levels of AI adoption. Our analysis of the employment levels in those sectors in 2019 is presented in the table below.

[34] OECD (2018), "Job Creation and Local Economic Development 2018: Preparing for the future of work."
[35] http://www.cedefop.europa.eu/en/publications-and-resources/country-reports/ireland-skills-forecasts-2025
[36] Cedefop: Insights into skill shortages and skill mismatch- Learning from Cedefop's European skills and jobs survey
[37] European Commission (2018), "Coordinated Plan on Artificial Intelligence"

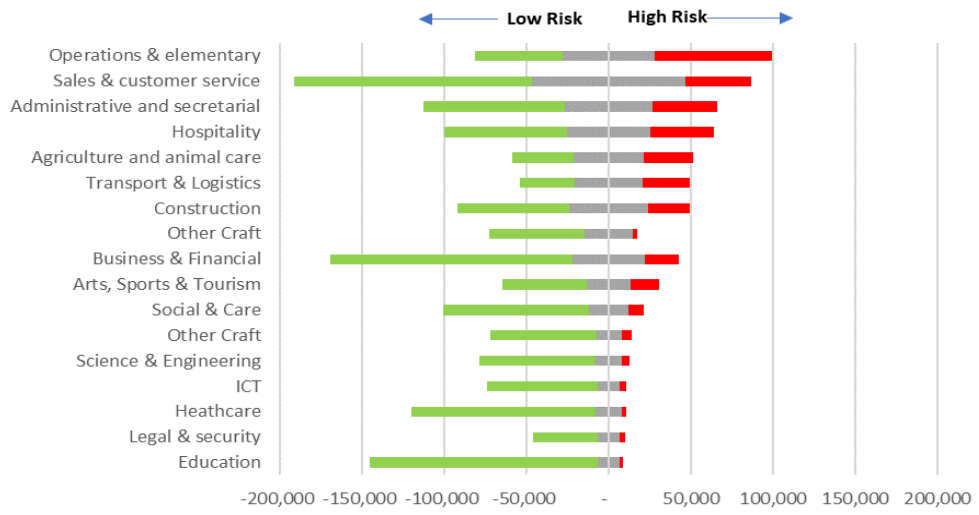
Employment in the Irish Economy in Top AI Adoption Sectors in Ireland (2019)			
Sectoral Groups	**Sectors in Detail**	**Employment (Number)**	**Employment (% of Total Supported by IDA, EI and Údarás)**
High-technology Manufacturing	Chemicals	27,449	7%
	Computer, Electronic, and Optical products	17,285	5%
	Electrical equipment	6,120	2%
	Machinery and equipment	13,560	4%
	Transport equipment	5,160	1%
	Medical Device Manufacturing	31,276	8%
	Sub-total	***100,850***	**27%**
High-technology Services and Telecommunication	Publishing, Broadcasting & Telecommunication	8,021	2%
	Computer Programming	33,140	9%
	Computer Consultancy	31,475	8%
	Computer Facilities Management	12,832	3%
	Other IT and Computer Services	18,664	5%
	Sub-total	***104,132***	**28%**
Financial and Business Services	Financial Services	17,142	5%
	Business Services	27,642	7%
	Sub-total	***44,784***	**12%**
Grand-Total in These Sectors		***249,766***	***66%***
Source: Analysis of ABSEI database.			

In considering the impact on future skills of automation and artificial intelligence it is important to consider two aspects. Firstly, the impact of automation on those with lower skills as this has implications for the FET sector in helping impacted individuals to re-train for other occupations or for employment in other sectors. Secondly, it is important to consider the opportunities for an expansion in opportunities for those with higher skills arising from the growth of internationally traded high-tech sectors in Ireland. We note that there has been a lot of detailed work done on the impact of automation on opportunities for those with lower skills. As less work has been undertaken on the labour market opportunities arising from AI and the implications for increased skill requirements in the economy, we present the results of new econometric modelling estimating the potential benefits.

The Irish Government Economic and Evaluation Service carried out an assessment on the impact of automation in Ireland in 2018, extended by SOLAS in 2020 to quantify occupations in Ireland in terms of their level of automation risk. This analysis is based on the 16 occupational groups in the occupational employment profiles section of the National Skills Bulletin. These estimates were based on a methodology developed by Frey and Osbourne (2013) and Nedelkoska and Quintini (2018). These in turn were based on a probabilistic model that depended on a two-by-two matrix with routine versus non-routine tasks on one axis and manual versus non-manual on the other (Autor et al, 2003). The first study was the first substantive attempt to measure the potential impact of automation on labour markets. The second paper, published by the OECD in 2018, reflects the most recent attempt at measuring the impact of automation and incorporates a number of refinements of the Frey and Osbourne methodology. Nedelkoska and Quintini, using their refined model, found lower estimates than in the original study.

The estimates for Ireland show that around two in five workers are at high or medium risk of automation. Over 370,000 people in Ireland are estimated to be employed in occupations at high risk of automation, representing 15% of the working population. A further 600,000 were in jobs considered at medium risk of automation, representing a further 26% of the working population. This is illustrated in the figure below. Of the top six occupational groups with the largest number of persons employed whose jobs were at high risk of automation, operations and elementary had the highest share (40%) with sales and customer service having the lowest share (15%). The individual occupations driving the high-risk weight in each group were assemblers and routine operatives, drivers, farmers, kitchen and catering assistants, other administrators, and sales assistants.

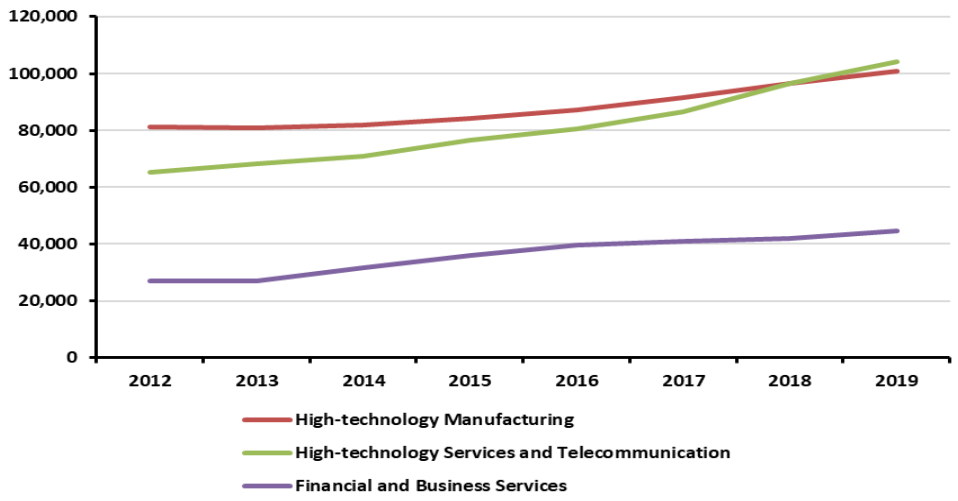
Occupational groups by level of automation risk, total persons employed



Source: SOLAS/SLMRU analysis of CSO LFS, Q4 2019

In assessing the employment and skills impacts of AI, it is important to note that AI is a different concept than automation. Application of AI is often driven by the handling of data requirements which are needed to facilitate innovation in new service areas. Automation, in contrast, involves the automation of repetitive tasks without human intervention. A recent study commissioned by the National Standards Authority of Ireland (NSAI) shows that almost four of 10 Irish companies currently use AI.[38] Moreover, the survey results suggest that more than half of businesses say that they plan to use AI in the next five years, while 82% believed that the development of standards in AI is important to their businesses. There has been very fast growth in AI capital stock in recent years in Ireland. The following figure presents the trend of employment for three broad sectors encompassing manufacturing and services that are identified as having high levels of AI adoption. The data shows that overall employment levels have grown strongly in internationally traded sectors with high levels of AI adoption.

Trend of Employment in Sectors with Higher AI adoption in Ireland



Source: Analysis of ABSEI database.

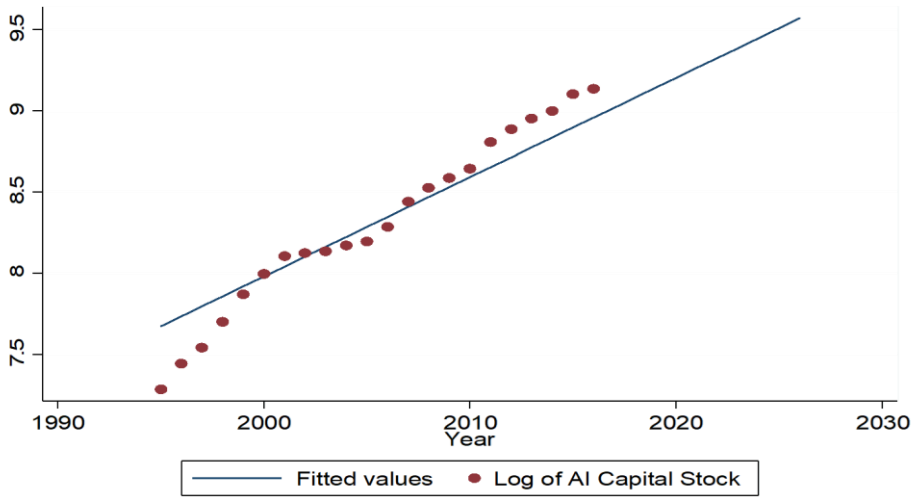
[38] Four in ten Irish companies currently use Artificial Intelligence (AI) published on 8th April, 2019. Retrieved from: https://www.adaptcentre.ie/news/four-in-ten-irish-companies-currently-use-artificial-intelligence-ai

By potentially increasing productivity, AI and digitisation more widely impacts on the employment levels required to produce a given level of output.[39] In examining the likely skills and employment impact, it is useful to empirically model the relationship between labour and capital stock- both AI[40] and non-AI. In order to inform the analysis, we completed new econometric modelling on this using panel data from CSO for total labour (hours worked), real fixed capital stock for AI[41] and non-AI, and total output. The panel dataset is based on sectoral data available for: agriculture, forestry, and fishing; human health and social work activities; education; financial and insurance activities; information and communication; construction; professional, scientific and technical services; and transportation and storage. The regression, as shown in Equation 1, is estimated using panel fixed effects to account for unobserved time invariant fixed effects at the sectoral level (α_i).

$$\ln(L)_{i,t} = \alpha_i + \beta \ln(Y)_{i,t-1} + \mu \ln(K^{AI})_{i,t-1} + \theta \ln(K^{N})_{i,t-1} + \gamma(Sector_i * \ln Y_{t-1}) + \sigma(Sector_i * \ln K^{AI}) + \delta(Crisis)_t + \varepsilon_{i,t} \quad \textbf{(Equation 1)}$$

The results for our key variables of interest, the marginal effect of AI capital stock on labour input for each sector '$\boldsymbol{i}$', as captured by '$\boldsymbol{\mu} + \boldsymbol{\sigma}$', are presented in the third column of Table 8.9. The results indicate that additional AI capital stock has a negative relationship with labour input in sectors such as agriculture, forestry and fishing. However, there are sectors such as education and human health and social work where there appears to be significant complementarity of labour input with AI capital stock. We also find no significant relationship for AI capital stock on employment in sectors such as financial and insurance activities, ICT, and Transportation. The econometric results suggest that the net effect of AI expansion on total employment will vary across different economic sectors and may be influenced by other factors such as the extent to which AI enhances competitiveness in internationally traded activities or Ireland's attractiveness as a location for foreign investment in certain sectors. Our analysis of employment growth in high AI adoption sectors noted previously has demonstrated the significance of employment in these sectors. The estimated rate of growth of AI is used to obtain the trend of AI Capital stock for Ireland, keeping other things constant, as shown below.

AI Capital Stock Time Trend in Ireland



Source: Analysis of EU KLEMS database.

[39] See for example: (1) Brynjolfsson, E. and McAfee, A. (2014). *The Second Machine Age: Work, Progress and Prosperity in a Time of Brilliant Technologies,* New York: W.W. Norton and Company; (2) Autor, D. H. (2015). Why Are There Still So Many Jobs? The History and Future of Workplace Automation. *Journal of Economic Perspectives*, 29(3): 3-30; (3) Frey, C. B., and Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological forecasting and social change*, 114, 254-280; (4) Crowley, C. and Doran, J. (2019). *Automation and Irish Towns: Who's Most at Risk?* Spatial and Regional Economics Centre, Department of Economics, University College Cork. SRERCW2019-1.

[40] In this section, AI will be used as shorthand for AI/digitisation.

[41] Taken as intangible fixed assets such as computer software, research and development, and other computing software as a proxy for AI Capital, while the rest is taken as non-AI Capital stock.

The evidence shows that productivity is likely to grow as a result of the application of AI. This will reduce employment for any given level of output. However, the overall employment impact will depend on the extent to which AI facilitates the expansion of economic activity in the relevant sectors. A key contributing factor to the extent to which advancements in AI impact on employment will be the availability of the skills in the Irish labour force to take advantage of new opportunities in those sectors experiencing the greatest increase in productivity from the application of AI. The analysis presented suggests that increased employment opportunities are likely to emerge education and human health and social work activities as AI adoption increases. However, we note that this analysis is based on trends to date, as the technology continues to develop there is the potential for AI and digitisation in different sectors to having an even greater impact on productivity. Such an outcome may lead to additional demand for high-skilled employees in Ireland's high-tech, export orientated sectors.

Transitioning to a Low Carbon Economy

Agenda 2030 and the Paris Agreement on climate change require a transformational shift of the world's economies and societies towards climate resilient and sustainable development. At European level, the European Green Deal provides a roadmap with actions to boost the efficient use of resources, with the intention that the EU is climate neutral in 2050. To do this, a proposed European Climate Law is being proposed which would turn this aspiration into a legal obligation, and require a reform of all sectors of the European economy. This includes:

- Investing in environmentally friendly technologies;
- Encouraging industry to innovate;
- Rolling out cleaner, cheaper and healthier forms of private and public transport;
- Decarbonising the energy sector; and
- Ensuring buildings are more energy efficient.

As signalled in the Climate Action Plan 2019, the Irish Government supports the adoption of a net zero target of carbon emissions by 2050 at EU and Ireland level. The Climate Action Plan sets out a decarbonisation pathway to 2030 which would be consistent with the adoption of a net zero target in Ireland by 2050. The plan also commits to evaluating in detail the changes which would be necessary in Ireland to achieve this target. The movement to a carbon-neutral economy will have a significant impact on the jobs needed in the future. Some forms of environmental change may have a negative effect on certain sectors and regions but there will also be opportunities to develop new skills as Ireland transitions to a low greenhouse gas economy. Worldwide, it is projected that this will lead to a net creation of jobs across Europe equivalent to around 0.2% of the working population.[42] The Government's Future Jobs Ireland document includes the challenge of transitioning to a low carbon economy as one of its five core pillars. The transition to a more sustainable economy and society can result in changes in the number of workers in different occupations, and changes in the skills required for a particular occupation without changing the number of jobs.[43] According to the European Commission, the climate and energy transition may require skills not fully available in the current labour market, nor provided by the education system. Providing workers with the skills required would require investing more in education and training.[44]

Implications of Review of Emerging Sectors and Technologies

This evidence on emerging sectors and technologies on skills needs in Ireland indicates that increased automation and digitisation are already having an impact on demand in the labour market. Cedefop skills forecasts for Ireland up to 2025 predict an increase in demand for high-level ICT skills such as skills in cloud computing and big data analytics, as well as an increase in the demand for various other levels of ICT skills. Technology change and digitisation can also have an impact on non-ICT occupations. The estimates for Ireland show that around two in five workers are at high or medium risk of automation. Over 370,000 people in Ireland are estimated to be employed in occupations at high risk of automation. The scale of potential impact of AI on

[42] Triple E Consulting (2014).
[43] Gregg, Strietska-Ilina and Büdke, (2015) "Anticipating skill needs for green jobs: A practical guide"
[44] European Commission (2020), "Country Report Ireland 2020."

low skilled employees may require special attention by the FET system with tailored programmes to address the transition to other sectors. The internationally traded sectors in Ireland which have highest levels of AI adoption employ almost 250,000 workers, representing two in three of the total employment in such firms. The evidence shows that productivity is likely to grow as a result of the application of AI. This will reduce employment for any given level of output. However, the overall employment impact will depend on the extent to which AI facilitates the expansion of economic activity in the relevant sectors.

The movement to a carbon-neutral economy will have a significant impact on the jobs needed in the future. Some forms of environmental change may have a negative effect on certain sectors and regions but there will also be opportunities to develop new skills as Ireland transitions to a low greenhouse gas economy.

Alignment of Skills Provision and Existing Labour Demand

Skill Mismatches

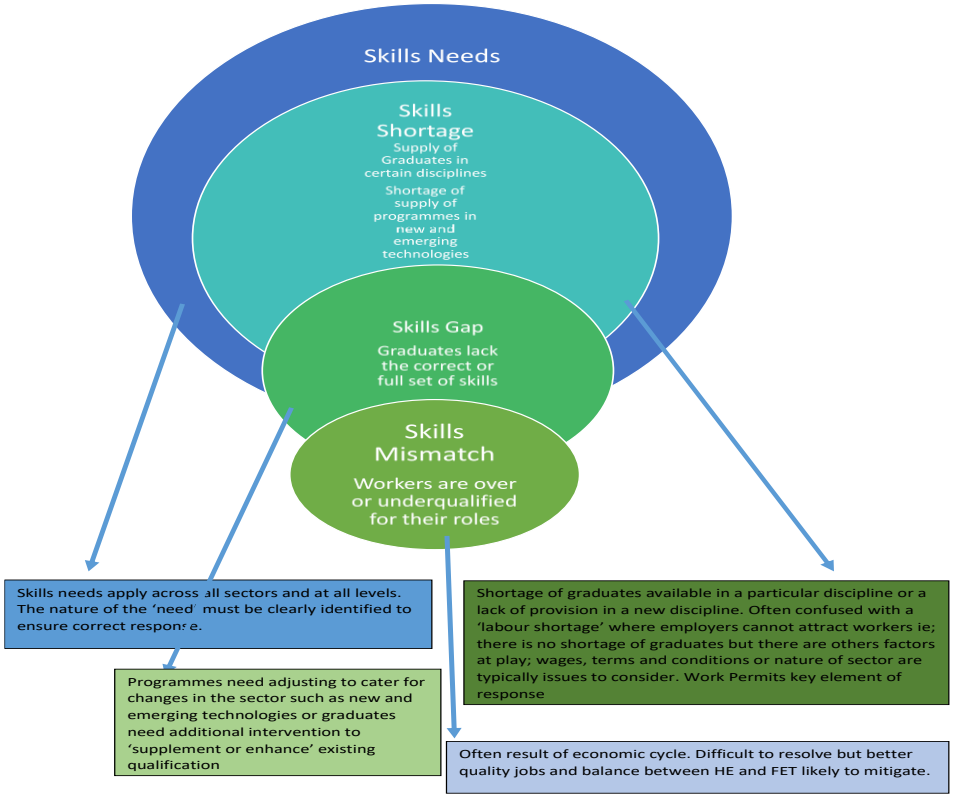
In examining the alignment of skills provision and existing labour demand, it is necessary to consider different concepts of skills mismatches, and various measurements of skills mismatches in Ireland.[45] The following table outlines the various types of skills mismatch, including vertical skills mismatch, horizontal skills mismatch and skills shortages or gaps. A vertical skills mismatch may be due to over- or underqualification of the workforce when compared to market requirements. Horizontal mismatch relates to graduates who are employed in sectors that are not directly aligned with their field of study, which may lead to a wage penalty incurred by the graduate. The third type is where there are difficulties in recruiting suitable graduates at market rates due to skills shortages or gaps.

Different Concepts of Potential Skill Mismatches	
Vertical Skills Mismatch	**Implications**
Over education/over-skilling compared to market requirements	• Potentially suggests that levels of education and training for some individuals is in excess of current requirements. • Need to consider wider societal impacts • Critical to take account of future rather than existing demand. • Underutilisation of human capital imposes substantial costs for employees and society
Undereducation/under-skilling compared to market requirements	• Has received less attention in empirical studies • Impacts on wage levels and probability of employment
Horizontal Skills Mismatch	
Graduates employed in occupations not directly related to principal field study	• Wage penalty compared to where field of study is matched but may be other determinants of wage differences
Skills Shortages/Skills Gaps	
Difficulties in recruiting suitable graduates at market rates	• Skill gaps impact on economic output / productivity • Impacts of attractiveness of Ireland for Investment
Source: Economic modelling by consultancy team.	

The following figure shows the relationships between skills needs, shortages, gaps and mismatches, and outlines how these may be subsets of each other.

[45] See References in Annex.

Relationship Between Skills Needs, Shortages, Gaps and Mismatches



***Source: Department of Education and Skills*[46]**

Macroeconomic Skills Mismatch

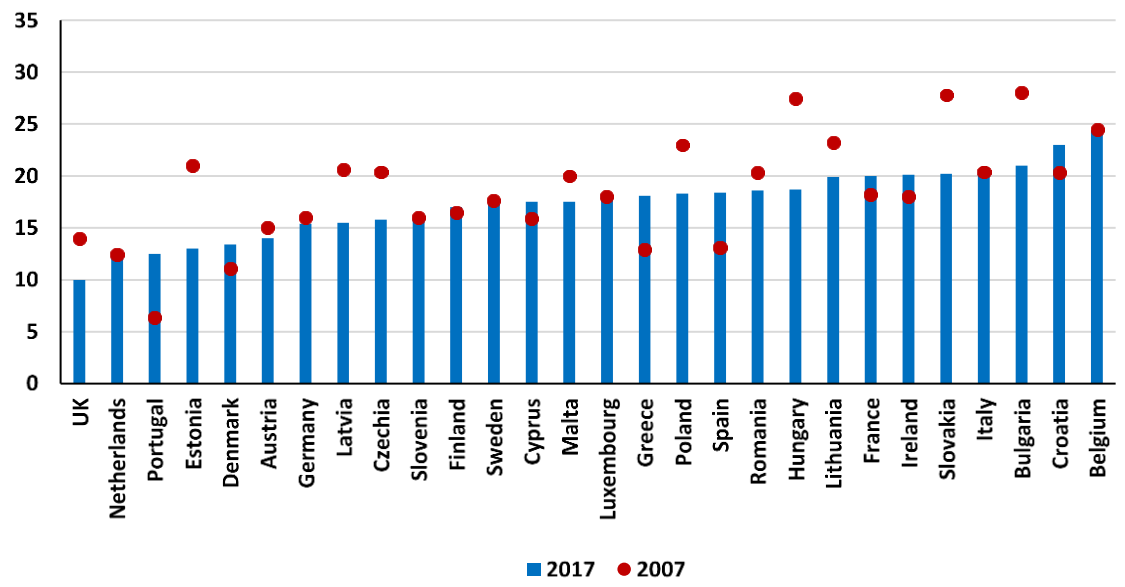
In considering skills mismatches, it is useful to compare Ireland to other EU Member States in relation to macroeconomic skills mismatch in terms of employment. The macroeconomic skills mismatch indicator (SMI) is based on the following formula:

$$SMI = \sum_{i=L,M,H} \left| \frac{E_i}{E_t} - \frac{P_i}{P_t} \right| = \frac{1}{e_t} \sum_{i=L,M,H} \left| \frac{P_i}{P_t}(e_i - e_t) \right|$$

Where L, M and H denote the different qualification groups, E represents the number of people in employment, P representations the working age population and e represents employment rates of groups by education level. Thus, the higher the difference in ratios between employment by education level to overall employment and working age population by education level to overall working age population, the higher the skills mismatch indicator is. Another way of describing this is that the closer employment rates by education are to the overall employment rate, then all else equal the lower the indicator. The data in the next figure suggests relatively high levels of macroeconomic skill mismatches in Ireland.

[46] Thanks are due to Kathleen Gavin for providing this helpful chart.

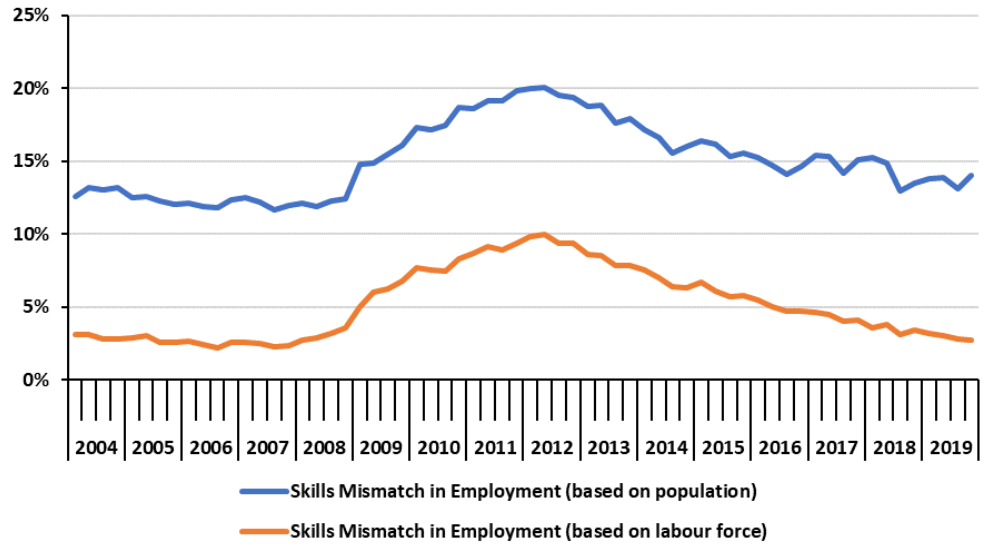
Comparison of Macroeconomic Skills Mismatch in terms of Employment (%) Across EU Member States



Source: European Commission, Skills Mismatch and Productivity in the EU Discussion Paper July 2019

The following figure calculates the SMI for Ireland over time, based on the formula used in the previous EU discussion paper. We have estimated skills mismatch applying both the entire working age population and separately the population of the labour force. Under both measures there was an increase in mismatch following the recession. Both measures have experienced a downward trend since 2012, suggesting a decrease in the level of mismatch.

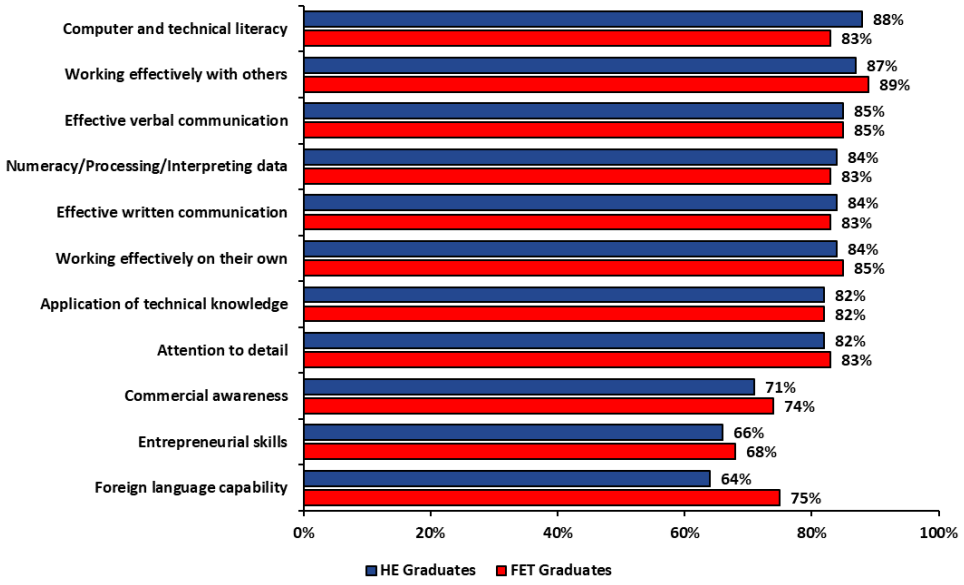
Macroeconomic Skills Mismatch in Employment in Ireland (2004-2019)



Source: Analysis of LFS data

The following figure is based on the Irish National Employer and Eurobarometer surveys, which asked employers for their views on the skills of HE and FET graduates, their recent recruits and the potential skill gaps in the future. The majority of employers were satisfied with both HE and FET graduates across a range of skills, including computer and technical literacy, working effectively with others, effective verbal communication as well as other skills outlined in the following figure.

Irish Employers' Satisfaction Levels with Skills of HE and FET Graduates



Source: Irish National Employer Survey (SOLAS, HEA, QQI and Fitzpatrick's Associates)

Irish employers tended to be more satisfied with the HE graduates recruited when compared to the rest of the EU. However, similar percentages of employers felt that they were either very or rather satisfied with their graduates across the different skills.

Employer Satisfaction with HE Graduates Recruited by Your Company in Last 3-5 Years by Skills (Ireland and EU 27)

	Ireland		EU 27	
	Very satisfied	Rather satisfied	Very satisfied	Rather satisfied
Good reading / writing skills	63.2%	34.6%	34.0%	59.4%
Good with numbers	48.9%	48.9%	28.5%	66.9%
Computer skills	58.9%	38.9%	38.3%	56.7%
Team-working skills	56.3%	41.0%	31.5%	61.7%
Communication skills	53.3%	43.4%	27.2%	62.0%
Analytical and problem-solving skills	48.3%	47.2%	24.3%	62.5%
Decision-making skills	38.9%	56.1%	19.5%	63.4%
Ability to adapt to and act in new situations	39.6%	54.4%	24.7%	63.4%
Planning and organisational skills	40.9%	52.5%	22.8%	64.0%
Sector specific skills	45.6%	47.4%	30.7%	59.4%
Foreign language skills	31.9%	54.9%	23.8%	59.4%

Source: Flash Eurobarometer 304: Employers' perception of graduate employability

The following table breaks down responses of Irish employees by their level of education. Just under half of those with post-secondary education (either non-tertiary or tertiary) felt that their skills were higher than those required by their job. This was compared to 34.3% for those with a Leaving Certificate as their higher level of education.

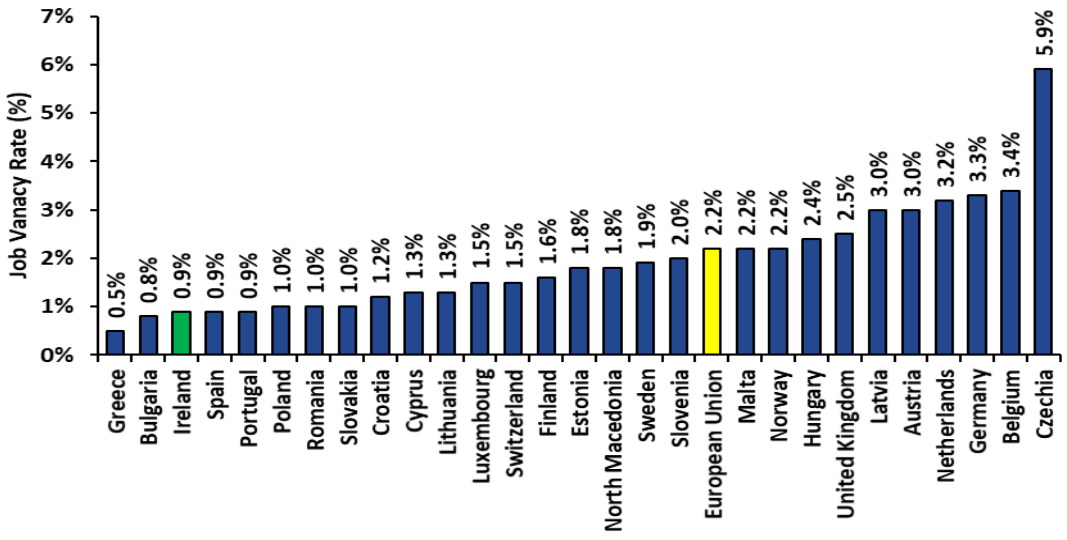
Cedefop Respondent Views on Skills Levels by Level of Education (Ireland)

	My skills are higher than required by my job	My skills are matched to what is required by my job	Some of my skills are lower than what is required by my job and need to be further developed
Junior Cert or Below	21.4%	68.6%	10.0%
Leaving Cert	34.3%	59.9%	5.8%
Post-Secondary (not tertiary)	49.0%	40.1%	10.9%
Third-level (Bachelors, Masters or Doctoral)	49.0%	43.6%	7.4%

Source: Analysis of Cedefop European Skills and Jobs Survey, 2014

When compared against other EU Member States, Ireland had one of the lowest job vacancy rates, measured at 0.9% in Q4 of 2019. This was less than half of the vacancy rate across the European Union as a whole (2.2%), as shown in the following figure.

Job Vacancy Rate (% 2019 Q4)



Source: Analysis of LFS

Implications of Review of Alignment of Skills and Labour Demand

The analysis presented indicates that the different concepts of skill misalignment are interlinked. While the empirical focus has been mainly on vertical over-education/horizontal skills mismatch, the policy focus has been on skill gaps. We also note that there has been relatively little emphasis in empirical research on under-education.[47] The methodological techniques used to measure skill mismatches have deficiencies and alternative approaches often suggest different rankings. Of key importance for Ireland is to ensure that the alignment of skill provision is with future demand rather than existing demand. There is some evidence of macroeconomic skill mismatches in the Irish economy but issues re methodologies used and such mismatches exist in all countries. There is also evidence that 49% of graduates suggested they had skills higher than required by their jobs compared to 42.4% average for EU and this has implications for the utilisation of human capital. The importance of responding to mismatches in terms of under-education is also important. Job vacancy rates in Ireland prior to the COVID-19 pandemic, were only 0.9% compared to EU average of 2.2%, which may suggest that the HE and FET system have been successful in meeting current needs but there is a challenge of responding to future requirements.

CONCLUSIONS

The key conclusions for the detailed evidence on any mismatch between the qualifications and skills provided by higher education and FET in Ireland and the skills demand of the labour market are presented in the table below.

Summary of Conclusions
1. Higher Education and FET provision has in general been successful in meeting skills and human capital requirements of Ireland's labour market to date.
2. There is evidence of misalignment between output of the HE and FET system in terms of specific skills, existing and potential future labour market needs.
3. Effective pathways required between further and higher education remain underdeveloped.
4. Expected changes in future labour market, skills and human capital requirements will require continued and fundamental reform of the HE and FET system.
5. COVID-19 has had an unprecedented impact on job losses in labour intensive sectors and highlights essential features of future model of HE and FET.
6. Significant intensification of employer engagement is essential to development and implementation of required further education and training model.
7. HE faces major challenges in responding to rapidly changing labour market, educational, and socio-economic trends while maintaining quality and securing excellence.

1. Higher Education and FET provision has in general been successful in meeting skills and human capital requirements of Ireland's labour market to date.

The Irish economy has in recent years been one of the fastest growing economies in the EU and has performed very well in per capita output and this could not have been achieved without the improvements in the labour force in which the Irish HE and FET system played a key role. Very high levels of employment outcomes have been achieved by HE and FET graduates in line with economic growth and there has been a strong income premium obtained by Irish higher education graduates. Employers indicated high levels of satisfaction with skills of HE and FET graduates and levels of satisfaction were much higher than average for EU countries. Job vacancy rates in Ireland have been among the lowest in Europe though the strength of the economy was an important factor.

[47] This was also highlighted in research by the ESRI and others.

2. There is evidence of misalignment between output of the HE and FET system in terms of specific skills, existing and potential future labour market needs.

The research completed for this project shows that the percentage of employees who reported education or skill levels in excess of those required to do their job was higher in Ireland than in many of the other EU countries. The available evidence indicates a concern over the underutilisation of human capital in the Irish economy. There is also evidence that some employees have higher qualifications than the average/mode in their sector and this may indicate potential vertical mismatch. However, methodological issues arise concerning interpretation of the evidence. A significant percentage of graduates' work in areas not directly related to their field of study and research suggests that such graduates secure lower incomes than if a horizontal match occurs. Determinants of income variance, however, include many other factors. Some cohorts in the Irish labour market are assessed to be under-skilled relative to labour market needs and while this mismatch has been given less attention in empirical studies it is a very important area for policymakers.

3. Effective pathways required between further and higher education remain underdeveloped.

Irish higher education is very concentrated at the point of school leaving and pathways between Further and higher education remain underdeveloped despite a significant policy focus. There has been significant progress made in enhancing access pathways but only a small percentage of new entrants to higher education came from the further education sector. In some parts of HE system greater progress has been made and around one-fifth of annual intake of institutes of technology represent transitions from FET. Overall progression from FET to HE remains low and requires significant additional policy focus. The Action in the European Skills Agenda to develop a European approach to micro-credentials will be of value but reforms within Ireland are also urgently needed to ensure effective pathways.

4. Expected changes in future labour market, skills and human capital requirements will require continued and fundamental reform of the HE and FET system.

New modelling completed for this study demonstrates that the shift in labour demand towards higher qualifications is likely to continue and become stronger. Emerging sectors and technologies including AI will likely result in fewer jobs in low skilled sectors but will open up opportunities for significant expansion in high skilled internationally traded sectors. There will be an imperative for the entire education and training sector to respond proactively to the rapidly changing requirements in all sectors including where substantial new opportunities exist (e.g., in sectors related to climate adaption). The scale and nature of changes which are very likely will require significantly enhanced flexibility, responsiveness to change and reform in HE and FET.

5. COVID-19 has had an unprecedented impact on job losses in labour intensive sectors and highlights essential features of future model of HE and FET.

Job losses have been concentrated in younger age cohorts with lower levels of educational qualifications in lower productivity labour intensive sectors. COVID-19 will require major adjustments in the model of HE and FET to include greater utilisation of online/blended education and part-time options. While there is uncertainty on the impact of COVID-19 on the operation of HE sector, there are likely to be constraints on the utilisation of existing facilities and this will impact on the ability to accommodate increased student numbers. The transition of workers from low productivity declining sectors into higher productivity growing occupations and sectors should build on the skills profile of workers in these sectors. Ways to ensure that the FET and training sector responds to the rise in youth employment is also needed. This should build on the European Commission's recent youth employment and skills package.

6. Significant intensification of employer engagement is essential to development and implementation of required further education and training model.

Employers and employees currently play an important role in shaping and supporting the education and training sector but this role needs to be enhanced and mainstreamed. This is aligned with the European Skills Agenda which inter alia plans to promote the participation of social partners in labour market projections and the identification of training needs to develop skill intelligence. This arises in relation to providing advice and

information on existing and future skills, education and training and human capital requirements. Employers also play a critical role in offering work placements and apprenticeship opportunities that strengthen links between education and training and employment. Employer investment in training in internationally traded sector has increased significantly but ongoing investment in all sectors is required.

7. HE faces major challenges in responding to rapidly changing labour market, educational, and socio-economic trends while maintaining quality and securing excellence.

The long-term financial sustainability of Ireland's higher education system is at risk in view of projected demographic trends and the need to invest to enhance quality and excellence of HE provision in key areas such as teaching and learning and research. These challenges will be further exacerbated by the rapidly changing needs of the labour market demand which evidences a continued strong shift towards higher qualifications. Emerging sectors and technologies will also result in transformed environment for HE. COVID-19 has exacerbated challenges facing the sector but also highlighted opportunities in particular to digitalisation of HE system and greater flexibility in delivery options.

RECOMMENDATIONS

In line with the terms of reference to the project, we outline below preliminary draft recommendations which are designed to improve the co-ordination and the match between the skills demand and supply.

Summary of Recommendations
1. Higher Education and FET system working preliminary draft with employers, employees and other stakeholders should implement measures to reduce underutilisation of human capital while also tackling undereducation in specific cohorts of Irish society and labour market through targeted and accelerated upskilling programmes.
2. The HE and FET system should be strongly encouraged and supported to continue to respond to the significant shift in future labour market requirements towards high skilled employment and the rapidly changing needs of emerging sectors and technologies.
3. Resources should be allocated to further strengthen predictions of demand for skills and qualifications on an integrated and cohesive basis.
4. Investment and a strong additional emphasis should be given to putting in place seamless pathways between and further and higher education.
5. Focused, flexible, agile and responsive education and training measures should be introduced as a priority to reskill and upskills those who have lost employment in COVID-19 pandemic.
6. Employers should have an enhanced role in shaping and delivering the education and training system reflecting the prioritisation of skills and human capital development and securing greater socio-economic equality.
7. A sustainable model of financing for the HE and FET system should be prioritised to support the future development of the HE and FET system in meeting the economy's human capital and skills needs.

1. Higher Education and FET system working with employers, employees and other stakeholders should implement measures to reduce underutilisation of human capital while also addressing undereducation in certain groups in Irish society.

Enhanced information on the skills and qualification requirements of different occupations should be developed as a priority to ensure greater alignment of education and training with skills and human capital requirements in the labour market. A particular focus is required on the introduction of flexible modular HE programmes yielding 'stackable' micro-credentials meeting targeted human capital and skills needs required for the future world of work. Higher education work placements and high skilled apprenticeship programmes should be given

greater emphasis within the HE system. Labour market intelligence, career guidance and job placement programmes to assist HE and FET students and learners should be expanded.

2. The HE and FET system should be supported to adjust to the significant shift in future labour market requirements towards high skilled employment and the changing needs of emerging sectors and technologies.

Securing the substantial adaption in the HE and FET system to meet the future skills of the economy will require significant policy and financial measures. These measures should be designed to ensure greater flexibility, agility and responsiveness of the sector to changing needs and a commitment to reform and transformation. Support for two-way pathways between FET and HE will also be essential.

3. Resources should be allocated to further strengthen predictions of demand for skills and qualifications.

Very important work has been undertaken by National Skills Council and Skills and Labour Market Research Unit in SOLAS and the Expert Group on Future Skills Needs in examining future skills gaps. Significant academic and policy research has also been undertaken into potential areas of education mismatches including vertical mismatches in terms of over education. Less empirical research has been undertaken into areas of undereducation. Some of the subjective research on vertical skills mismatches for Ireland are based on small sample surveys as part of wider international surveys. Testing of results with larger Irish surveys would be useful. More emphasis is needed on future demand for qualifications and this has been a relatively underdeveloped area in Ireland. While there are inevitable uncertainties inherent in any future predictions of demand in potential high productivity and high growth sectors and occupations is a key area for further research. This proposed work is directly aligned with the European Skills Agenda and in particular Action 2 which is focused on strengthening skills intelligence.

4. Investment and substantial additional emphasis should be given to enhancing pathways between further and higher education.

Standardisation of entry requirements to higher education system for FET awards including integration with the CAO points system to achieve a more level playing field should be implemented, as well as significantly greater flexibility in access in terms of location, mode and timing of participation. This will be particularly important in the context of COVID-19. It will also assist in increasing participation in higher education by mature students and in particular, NAP target groups. Introduction of short-cycle flexible co-provision within higher education institutions in co-operation with FET providers should be implemented. Shortened and elongated programmes to suit differential needs of FET graduates should be expanded. An enhanced role for FET in improving learner standards with lower education attainment and requiring significant support prior to entering higher education should be a focus of investment, and a seamless pathway to transfer non-completing HE course participants to FET. This would enhance the efficiency and cost effectiveness of higher education. HE outreach and support programmes including foundation courses should be expanded. Specific targets should be set for learner access numbers between FET and HE sectors.

5. Short-term targeted education and training measures should be introduced to assist those who have lost jobs arising from COVID-19.

Particular focus will be needed to assist those in sectors or demographic or social groups which will not recover quickly to obtain skills needed in emerging high-growth and high-productivity sectors and occupations. Targeted access pathways into higher education including focused on flexible modular programmes should be designed to assist individuals who have lost jobs and who have potential for upskilling to transition into growth sectors. This should include measures targeted at youth unemployment. An early action and a proactive approach is required in order to maximise the probability of returns to employment on a sustained basis. The co-ordination of a labour market activation system with education and training opportunities will be critical. This should be aimed at reducing long-term unemployment.

6. Employers, employees and other stakeholders should have an enhanced role in shaping and delivering the education and training system.

Successful models in place in the internationally traded sector delivering high levels of quality training outcomes should be identified and implemented more broadly across the SME sector of the economy. A national target should be set for investment in training by employers and examination undertaken of the supports that may underpin the achievement of the national targets. The use of National Training Fund resources or funding arising from PRSI income should be also considered. Work based learning with support of the HE and FET system should be strongly promoted and encouraged. Measures to assist employers to facilitate work placements and apprenticeship programmes should be supported by the National Training Fund.

7. A sustainable model of financing for the HE and FET system should be introduced.

Careful evidence-based consideration by policymakers of the impacts of various alternative funding models is needed. The extensive work undertaken in other deliverables as part of this study on developing a model to test the impact of alternative funding approaches will assist in this work. It is essential that that HE system is not expected to accommodate additional students in the absence of putting in place a sustainable funding model as this creates significant risks in terms of standards and the quality of provision. Sustainable model of funding should be underpinned by examination of the appropriate mix of HE and FET provision in meeting future skills and human capital needs and ensuring alignment of HE and FET provision with labour market requirements.

1 Introduction and Background

1.1 Introduction

This report is submitted to the European Commission DG Reform by AARC, LE Europe and Indecon International Economic Consultants, as a two key Deliverables under the EU funded project "Increasing the sustainability of higher and further education provision in Ireland – economic review of funding options". The project is aligned with the objective of DG Reform to provide support for the preparation and implementation of growth-enhancing administrative and structural reforms by mobilising EU funds and technical experience. Ireland requested support from the European Commission under Regulation (EU) 2017/825 on the establishment of the Structure Reform Support Programme. Following an analysis by the European Commission, the Commission agreed to provide technical support to Ireland in the area of Higher Education funding. This report focuses on the skill elements of the assignment and constitutes Deliverable 1.1 and Deliverable 1.2 of the project. This encompasses an analysis of any misalignment between qualifications and skills provided by the Higher Education and FET and the skills demand of the labour market. Policy recommendations regarding the design of higher education and the provision of FET pathways are also provided. It is intended that the immediate beneficiaries of the project will be the Department of Further and Higher Education, Research, Innovation and Science. The analysis may also help the European Commission's work in other Member States in strengthening skills intelligence.

1.2 Background

The background to the wider study is that Ireland acknowledges human capital as one of the country's core economic strengths and a key enabler of the country's future economic, social and cultural development. It also considers of vital importance that Ireland has an appropriately educated workforce that can adapt and respond to the challenges linked to emerging economic priorities. Traditionally, it has strongly supported the participation of Irish youth in higher education.

Ireland faces two important challenges in its efforts to provide its population with the qualifications and skills that are demanded by the labour market and necessary to support innovation and competitiveness. Firstly, the financial sustainability of its higher education system is at risk in view of a growing number of students entering the third-level education system. Secondly, the skills, research and qualification outcomes of the current higher education and further education and training system show some disparity with the labour market demand.

Participation rates in higher education in Ireland are among the highest in the EU and significant progress has been achieved in making it more accessible to previously under-represented groups such as students with a disability and those from economically disadvantaged backgrounds.

However, since the fiscal crisis of 2008, the level of State investment in higher education has not kept pace with the growth in student numbers because of the scale of the economic downturn and the competing demands across Government under tight budget constraints. This trend, in addition to restrictions on the teaching staff employed in the higher education sector, has contributed to increases of student-staff ratio (which remains considerably above the OECD average), and a concurrent decline in the performance of Irish higher education institutions in international ranking systems.

Demographic expansion is expected to pull up demand for higher education in the years ahead, likely to peak at almost 223,000 students in 2030, an increase of over 38,000 on 2017 levels. This forecasting of higher enrolment rates has thus led to an increased focus on investment levels in higher education among Irish public opinion and policy makers. This is particularly important given the expected growth in student enrolments in Irish higher education as is evident from Table 1.1.

Table 1.1: Higher Education - Scenarios for Total Fulltime Student Enrolments

Academic Year	Scenario S1	Scenario S2	Scenario S3	Scenario S0
2020/21	196,609	196,609	199,626	193,591
2021/22	199,258	199,623	203,956	194,925
2022/23	202,042	202,774	208,537	196,279
2023/24	204,339	205,437	212,691	197,085
2024/25	206,494	207,957	216,767	197,684
2025/26	209,633	211,462	221,980	199,114
2026/27	213,624	215,819	228,202	201,241
2027/28	217,468	220,028	233,852	203,644
2028/29	220,425	223,351	238,232	205,544
2029/30	222,264	225,556	241,167	206,653
2030/31	222,514	226,172	242,198	206,488
2031/32	222,109	226,133	242,392	205,850

Source: Department of Education and Skills

The then Minister for Education and Skills in 2014 appointed an Expert Group on Future Funding for Higher Education (hereinafter the Expert Group), "to identify and consider issues related to the long-term sustainable funding of higher education in Ireland and to identify funding options for the future." The Expert Group report, "*Investing in National Ambition: A Strategy for Funding Higher Education*"[48] confirmed that higher education makes a significant contribution to the development of individuals, employers, society and the State. The report concluded that the current approach to funding is unsustainable, and that substantial increases in investment in higher education were necessary to ensure that the sector can remain viable and provide the capacity to meet the major increase in student demand projected up to 2030.

In response to the work of the Expert Group on Future Funding (thereinafter "the Expert Group") and demographic pressure, there has been a significant increase in Government investment in higher education in the period since 2015, while the Government also committed to a five-year programme of increased investment under the Human Capital Initiative (HCI). However, the Expert Group report has opened an important debate in Ireland regarding the funding of its third-level education system, which is particularly important given the stated national ambition to have the best education and training system in Europe by 2026.

In order to build a consensus regarding a future approach to funding the higher education sector, the Minister for Education and Skills referred the Expert Group report to the Parliamentary Committee on Education for their consideration. After a period of 18 months, the Committee wrote back to the Minister requesting that the Department of Education and Skills (hereinafter DES) undertake an economic examination of the three policy options proposed by the Expert Group to assist the Committee in forming its view of the most appropriate option.

[48] The report is available here: https://www.education.ie/en/Publications/Policy-Reports/Investing-in-National-Ambition-A-Strategy-for-Funding- Higher-Education.pdf

The Department of Public Expenditure and Reform published a paper "Understanding the Funding Needs in Higher Education"[49] as part of the 2018 Spending Review, which concluded that, by their nature, projecting future costs of higher education is highly sensitive to different assumptions and parameters. It therefore recommended basing the assessment of funding pressures arising from the future costs of higher education on a robust interrogation of granular data, to ensure a clear understanding of the efficient cost of delivering a quality education and to reflect of the diversity of the sector. The identification based on available information and data of projected costs of higher education provision across different discipline areas and taking into account different delivery models for higher education would therefore provide a necessary basis for assessing the three funding options put forward in the Expert Group report.

Furthermore, demographic projections of demand for full-time higher education highlight the current high transfer rate of approximately 65% between second-level and third-level education. While this transfer rate is expected to continue at current levels, the latest demographic projections also include a scenario demonstrating the impact on projected demand for higher education of a 10-percentage point reduction in the transfer rate. This could arise, for example, if there was a significant increase in the proportion of second-level students transitioning to further education and training (FET) instead of higher education or taking up employment directly after school.

The debate on the future of higher education has therefore also brought forward the issue of qualification mismatches in the Irish labour market. While the Irish Government is strongly committed to providing access on equal basis to tertiary education to meet economic and societal need and support the continued human capital development that has underpinned Ireland's economic performance and convergence to high-income EU levels, some research suggests that Irish workers may be over-qualified in particular areas of the workforce.

For this reason, it has been a major priority over recent years to develop and enhance vocationally focused education and training options including through the provision of apprenticeships and traineeships and other learning opportunities in the FET sector for all learners including those that have recently completed second-level education. These options are intended to provide strong pathways into employment to meet the economy's skills and labour demand needs, and to facilitate access into the higher education sector.

1.3 Scope of Assessment and Methodologies Used

In line with the terms of reference this report addresses the following specific deliverables:

- Deliverable 1.1: A draft report on the analysis of the variance between the qualifications and skills provided by higher education and FET in Ireland and the skills demand of the labour market. This includes:
  - Analysis and assessment of the scope and level of variance between the current provisions of skills and qualifications in higher education and FET in Ireland and the labour market demand, taking into consideration economic projections regarding emerging sectors and technologies.
  - Analysis of the current level of participation in higher education and FET in Ireland and employment figures by economic sectors.
  - Identification of relevant databases that help in mapping the demand for skills, on the one hand, and the existing structures enabling the coordination between the education sector, the labour sector and the innovation and economic sector, on the other.

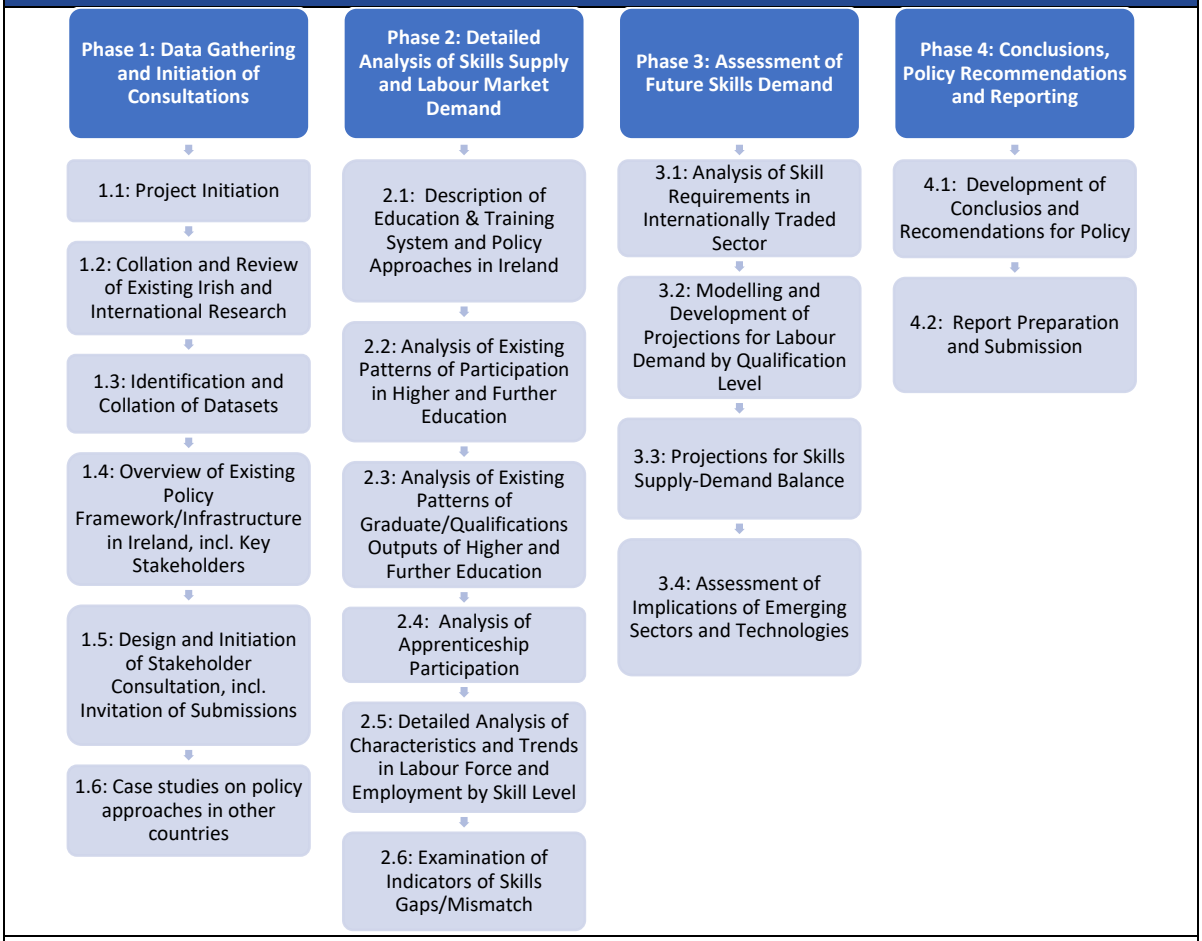
[49] See: https://assets.gov.ie/7301/181f50ae3885404c8f9cabbbe8525048.pdf.

- Deliverable 1.2: A report with policy recommendations to provide a higher education and FET system that will respond to and address the Irish labour market's demand to ensure inclusive, smart and sustainable growth. The report, and associated recommendations, are informed by the following inputs:
  - The analysis under Deliverable 1.1 above, which provides information on the skills shortages and surplus that can inform the potential for transformations of the higher education system, such as adapting university programmes and modalities to the needs of emerging sectors, and the development and expansion of vocational options in higher education (e.g. apprenticeships), further education and training system in Ireland.
  - The analysis also assesses the potential to create new pathways between further and higher education in Ireland and to strengthen existing ones.
  - The analysis is complemented by case studies on international practice/approaches in three countries which have met challenges regarding the skills mismatch between higher education and skills demand in their economies. These case studies provide a basis to animate policy discussion in the Irish context.

1.4 Methodological Approach

A detailed methodological approach and associated work programme was applied in the completion of this report, with the objective of addressing the above deliverables. A schematic description is presented in the figure below.

Figure 1.1: Schematic Description of Methodology and Work Programme



Source: ***Economic modelling by consultancy team.***

Extensive new evidence has been analysed on the examination of qualifications and skills provided by the higher education and further education and training systems and the demand for skills in the Irish labour market. Detailed data on the participation levels in HE and FET and employment by economic sectors are also examined. The analysis of skills has been complemented by a review of policy context in Ireland and approaches in Estonia, Canada and New Zealand. As part of this report new innovative economic modelling was undertaken on the impact of Artificial Intelligence (AI). We also present new econometric modelling on the future demand for higher, medium and low skills taking account of the potential impacts of COVID-19. While the significant econometric modelling work undertaken was outside the scope of the agreed work programme, it was deemed useful to inform the analysis. This was undertaken at no additional cost to the European Commission and the time resources have been funded by the consultancy team.

As part of our research we identified a range of databases which can be used to inform the analysis and which may help in mapping the demand for skills and co-ordination with the training and education sector. The following Irish and international sources, inter alia, were used as part of this methodology:

- CSO GNP estimates;
- Microdatabase from Labour Force Survey;
- HEA destination of Graduate Survey;
- SOLAS FET Outturn Data;
- ABSEI database on Internationally Traded Firms;
- Cedefop European Skills and Jobs Survey;
- OECD Survey of Adult Skills (PIAAC);
- Irish and European Employer Surveys; and
- Previous work on Skills Mismatches undertaken by the European Commission and other researchers.

The consultancy team has benefited from valuable inputs provided by the European Commission and from the Department of Higher Education and Skills. Our analysis has also been informed by inputs from a wide range of stakeholders and from advice from the Interdepartmental Steering Committee.

1.5 Acknowledgments and Disclaimer

The consultancy team would like to acknowledge the assistance and inputs to this evaluation provided by a number of individuals. We would particularly like to acknowledge the valuable assistance provided by officials within the European Commission DG Skills Reform. Particular thanks are due to Patricia Perez-Gomez, Lukas Demoen and Elisa Gomez-Aleman for their guidance and inputs. We would also like to acknowledge the important inputs provided by senior officials in the Department of Further and Higher Education, Research, Innovation and Science for their assistance and inputs, including William Beausang, Phil O'Flaherty, Orla Lynch, Dervila Flynn, Kathleen P. Gavin, Dean Mooney and Enda Hughes.

A wide range of other stakeholders provided detailed submissions and other inputs to this assessment. These include: Orlaigh Quinn, Alan Power and Kevin Daly (Department of Business, Enterprise and Innovation); Alan Wall, Vivienne Patterson, Victor Pigott and Denise Frawley (Higher Education Authority); Mary Burke (Dublin Chamber); Dr. Anna Murphy (Quality and Qualifications Ireland); Claire McGee (IBEC); Professor David Collings (Dublin City University); Julie Sinnamon

(Enterprise Ireland); Paul Healy (Skillnet Ireland); Andrew Brownlee (SOLAS); and Nessa White (General Secretary of ETBI). In addition, we would like to thank other members of the Inter-Departmental Group on Future Funding, including Patricia Coleman, Alan Dunne and John Howlin (Department of Public Expenditure and Reform); Kevin Daly (Department of Business, Enterprise and Innovation); John McCarthy (Department of Finance); and Tony Crean (Department of Employment Affairs and Social Protection). Last but not least, we would like to express our thanks to officials in the labour market division of the CSO, including Martina O'Callaghan, in facilitating a special request for data on educational attainment by economic sector.

The usual disclaimer applies and responsibility for the analysis and findings in this independent report remains the sole responsibility of Indecon.

2 Policy Approaches to Skills Provision

2.1 Overview of Education and Training Policy Framework in Ireland

In Ireland at second-level, students typically take the Junior Certificate state examination after three years of post-primary education, while at the end of the senior cycle students sit the Leaving Certificate state examination.[50] Students who complete second-level education can progress to third-level education – either within the further education and training sector or higher education sector. The evidence on the overall numbers of students enrolled in third-level education in Ireland highlights the extent of participation in higher and further education in Ireland, with almost 224,000 students undertaking HE and over 202,000 undertaking FET.

Table 2.1: Overview of Numbers of Students Enrolled in First, Second and Third-level Education & Training Institutions Aided by the Department of Education and Skills – 2018/2019

Level	Enrolments - 2018-19
First Level (incl. Primary and Special Education Schools) – Full-Time Students	567,772
Second-level (incl. Secondary, Vocational, and Community and Comprehensive Schools) – Full-Time Students	362,899
Second-Level students engaged in Post Leaving Certificate Courses – Full-Time Students	29,368
Higher Education – No. of Enrolments (full-time and part-time)**	223,743
Further Education & Training – No. of unique learners*	202,025

Sources: Department of Education and Skills, Key Statistics (release of July 2019); SOLAS, This is FET – Facts and Figures 2018, FET in Numbers 2018 eCollege 2018 Learners Report, and SOLAS Apprentice Registrations; Higher Education Authority –Enrolment Statistics.

* Further education and training figures includes PLSS registrations, eCollege registrations and apprentice population in 2018.

** Higher education enrolments are for 2017/18.

In analysing any potential mismatch between the qualification and skills provided by the higher education and FET in Ireland, and the skills demands of the labour market, it is important to note the valuable work undertaken by the National Skills Council and other groups.[51] The National Skills Council in Ireland provides a mechanism to identify the skills demands of the economy and the Council terms of reference are presented below:

- To receive and consider costed proposals for the annual research/work programme of the EGFSN in advance of the programme being formally submitted for approval for funding by Department of Education and Skills or the Department of Enterprise Jobs and Innovation as appropriate.
- To receive, consider and approve prior to publication agreed action plans based on EGFSN research findings.
- To receive, consider and publish research and reports on skills and labour market data from the Skills and Labour Market Research Unit of SOLAS.

[50] Candidature for the Junior Certificate and Leaving Certificate examinations is not limited to post-primary school students. A candidate following an approved course of study outside the State or who is attending an approved course of study organised under the Vocational Training Opportunities Scheme, Adult Literacy and Community Education Schemes, the Department of Social and Family Affairs second-level scheme for the unemployed or an analogous scheme, may be admitted to either examination.

[51] Also important is the work of the Expert Group on Future Skills Needs (EGFSN).

- To receive reports on the work of the Regional Skills Fora and consider assessments from the Regional Fora in relation to skills development in their regions.
- To receive reports from SOLAS, HEA and the Chairs of the Council of Presidents of the Universities and Institutes of Technologies on the delivery of responses to identified skills needs.
- To receive reports from DES, HEA and SOLAS on overall funding allocations for education and training provision.
- To provide updates as required from other Government Departments on related strategies.
- To receive regular updates from other relevant stakeholders (IDA Ireland, Enterprise Ireland, Science Foundation Ireland) on developing sectoral opportunities and potential target areas for increased Foreign Direct Investment and consider and advise on issues associated with the availability of skills to support such employment opportunities.
- To prepare an annual prioritisation of identified skills needs to inform decisions on allocation of funding across FET, HE and Skillnets. This prioritisation should include reference to levels and discipline areas and delivery mechanisms, e.g., mainstream provision/targeted funds.
- To present an annual statement of the work of the Council to the Minister for Education and Skills and published no later than the end of March of the following year. Other reports may be published as agreed by the Council/Minutes of meetings will be published.

Irelands National Skills Strategy 2025 provides an overarching framework for supporting the development of an Irish labour force that is well educated and has the ability to adapt to changing skills needs in the market.[52] The six objectives in the NSS are outlined in Table 2.2. The enhancement of skills and developing and attracting talent is a core pillar of the Irish Government's Future Jobs Strategy.[53]

Table 2.2: Objectives of the National Skills Strategy 2025
- Education and training providers will place a stronger focus on providing skills development opportunities that are relevant to the needs of learners, society and the economy; - Employers will participate actively in the development of skills and make effective use of skills in their organisations to improve productivity and competitiveness; - The quality of teaching and learning at all stages of education will be continually enhanced and evaluated; - People across Ireland will engage more in lifelong learning; - There will be a specific focus on active inclusion to support participation in education and training and the labour market; and - To support an increase in the supply of skills to the labour market.
Source: Department of Education and Skills – National Skills Strategy 2025

[52] Department of Education and Skills (2018), "National Skills Strategy 2025 - Ireland's Future" (Pg.47)

[53] See Department of Business, Enterprise and Innovation (2019), "Future Jobs Ireland".

Since the commencement of this project, Ireland and other countries have been dramatically impacted by the COVID-19 pandemic. The implications of this have been evaluated by the Irish National Skills Council which has identified nine key priorities. These are important in informing the subsequent analysis in this report.

Table 2.3: Summary of Irish National Skills Council – Priorities Summer 2020
1. Need for immediate focus on providing skills for those affected by the crisis underpinning their employability and access into sustainable and quality employment while the overall medium- to long-term directions of skills priorities should be sustained. 2. Skills responses should be balanced and encompassing in labour market terms. 3. Need for recognition of a broad skills agenda that can be flexibly delivered to a diverse range of learners. 4. Skill provision to respond to immediate labour market requires short, focussed and agile programme. 5. Important to maintain support for education and training programmes with a strong work-based component. 6. Employers can play an important role advising on shaping and supporting the delivery of education and training. 7. Priorities for skills will continue including skills for lifelong learning, green economy, digital skills, leadership and management development skills and a focus on labour market inclusion. 8. Employment in roles that are often characterised as 'low skilled' will require upskilling and reskilling using digital and technology skills. 9. Online and digital learning will be critical.
Source: National Skills Council

2.2 Overview of Approaches in Other Countries

To complement the analysis of any skills mismatches in Ireland, an analysis has been undertaken of relevant international practices. Based on agreement with what is now the Department of Further and Higher Education, Research, Innovation and Science, the international research has focussed on the experience of:

- Estonia,
- Canada, and
- New Zealand.

Case Study 1: Estonia

Estonia is rated as having a high-quality education system, with almost universal participation in basic education and literacy and numeracy skills among its second-level students being among the highest in Europe.[54] Estonia ranked first in science and reading and third in mathematics in the 2018 Programme for International Student Assessment (PISA). [55] Adults have high educational attainment levels with ~90% of 25-64-year-olds having at least upper secondary education and 41% of adults having tertiary qualifications, above the EU average of 33%.[56] Estonia is a highly digitalised society with 61% of its citizens having basic or above basic digital skills and over 99% of state services provided online.[57] Estonia's economy expanded rapidly in recent years though low birth rates and out migration in after its 2004 EU accession resulted in skills shortages in the workforce.[58] The structure of the economy has changed with employment increasingly concentrated in knowledge intensive high-tech industries, with new skills in demand and older skills becoming obsolete, reflected in Estonia having highest proportion of workers in the EU believing that some of their skills would be obsolete in the next five years in 2015.[59]

Despite high educational attainment and adult educational participation levels in Estonia, there are skills gaps, with Cedefop estimating in 2010 that 26%-32.9% of Estonian adults have upskilling and reskilling potential.[60] Cedefop has suggested that almost 40% of Estonians feel they are under-skilled when starting a new job, the highest in Europe.[61] While the employment share of vocational education and training ('VET') occupations in Estonia in 2018 was 57.6%, indicating much need of VET qualifications,[62] most Estonians prefer to pursue higher education rather than VET and there consequently is a surplus of HE graduates and a deficit of VET graduates. This lack of popularity of VET is seen as a contributor to skills gaps in Estonia.[63] In 2018, Cedefop estimated that 15.4% of Estonian tertiary graduates aged 25-34 were overqualified, lower than Europe's 24.7%.[64] However, Eurostat in the same year estimated that almost 25% of people aged 20-64 in Estonia with a tertiary education were overqualified. In 2016 30.7% of Estonian workers aged 15-64 were employed in a different field than they studied in (field of study mismatch) compared to 33.1% in the OECD.[65] Additionally, 38% of Estonian workers aged 15-64 had a higher level of educational attainment that that required for their job (qualification mismatch) compared to the EU average of 18.7%.[66] Indeed, in 2019 Estonia was raked in the bottom 40% of EU countries in the alignment between skills supply and labour market demand, and there are ongoing cognitive and other transversal skills shortages and technical skills surpluses in Estonia.[67]

[54] OECD, 2019. "PISA Results 2018 – Country Report Estonia". Available at: https://www.oecd.org/pisa/publications/PISA2018_CN_EST.pdf

[55] OECD (2019), *PISA 2018 Results (Volume I): What Students Know and Can Do*, PISA, OECD Publishing, Paris, https://dx.doi.org/10.1787/5f07c754-en.

[56] OECD Reviews of School Resources: Estonia 2016 https://www.oecd-ilibrary.org/docserver/9789264251731-5-en.pdf?expires=1587044077&id=id&accname=guest&checksum=0B22A7F04F66986FF8B478697E3F1657

[57] E-estonia (2019), *We have built a digital society and so can you*, https://e-estonia.com/

[58] Cedefop, 2020. "Strengthening skills anticipation and matching in Estonia Capitalising on OSKA's potential to realise national ambitions".

[59] https://skillspanorama.cedefop.europa.eu/en/indicators/skills-obsolescence

[60] Cedefop, 2020. "Estonia Country Fact Sheet: Adult population with potential for upskilling and reskilling". Available at: https://www.cedefop.europa.eu/files/estonia_country_factsheet.pdf . This is based on the Cedefop study: *Empowering Adults through Upskilling and Reskilling Pathways. Volume 1: Adult Population with Potential for Upskilling and Reskilling*

[61] https://www.cedefop.europa.eu/files/esjinsight_no_7_underskilling_il_final.pdf

[62] https://skillspanorama.cedefop.europa.eu/en/indicators/future-vet-occupations

[63] Cedefop, 2020. "Strengthening skills anticipation and matching in Estonia Capitalising on OSKA's potential to realise national ambitions".

[64] Over-qualification is based on comparing an individual's highest education qualification level with their self-perceived level of education qualification actually needed to undertake their current job. https://skillspanorama.cedefop.europa.eu/en/indicators/over-qualification-rate-tertiary-graduates

[65] https://stats.oecd.org/Index.aspx?DataSetCode=MISMATCH#

[66] https://stats.oecd.org/Index.aspx?DataSetCode=MISMATCH#

[67] OECD, 2019. "2019 OECD Skills Strategy; Estonia". Available at: https://www.oecd.org/estonia/Skills-Strategy-Estonia-EN.pdf

Overview of Policy Responses

One example of Estonia's policy response in the area of skills, relevant to this study, is its system of forecasting future labour market skill requirements. Estonia has updated its system of forecasting future labour market skill requirements through the OSKA (Oskuste Arendamise koordinatsioonisüsteem) analytical tool. It collates information using a mixed methods approach from sectoral surveys assessing the labour/skill needs of each sector using a combination of qualitative and quantitative research methods.[68] This is used in conjunction with quantitative data is collected from relevant registers and surveys (e.g., the Labour Force Survey, the Population and Housing, sectoral surveys, EKOMAR), the Ministry of Economic Affairs and Communications' labour market forecasts and qualitative data from stakeholder and sectoral expert interviews and group discussions on future economic trends, changes in worker and skill supply needs and the provision of education and training in each sector. The following figure outlines the OSKA survey process. OSKA's goal is for educational provision to be better aligned with labour market needs.[69] OSKA is governed by a Coordination Council with representatives from government and various stakeholder organisations to ensure there is diverse input in the analysis and anticipation of future skill requirements. This Council chooses five or six sectors on which in-depth sectoral reports are produced by OSKA annually – in 2020 so far, the banking and insurance, personal services and public administration sectors have been examined. An additional general annual OSKA report is also produced, predicting changes in labour requirements, labour market developments and trends over the next ten years.[70] OSKA Forecasts are developed by Sectoral Expert Panels of 20-30 representatives of employers and professions, education providers and the public service, which provide input into the educational policy discussion and development, to reflect the views of industry. Cedefop and the Estonian National Skills Council believe OSKA needs further improvement of OSKA, with the use of more updated data and currently unused data in forecasts and better dissemination of OSKA analyses' results, via the online Estonian Education Portal, especially to young people and parents, so they can make informed decisions on study fields so skills are better matched to demand.[71]

Figure 2.1: Overview of OSKA Survey Process

Source: OSKA presentation by the Estonian Qualification Framework, Milan, 2019

[68] https://oska.kutsekoda.ee/en/oska-management-methodology/oska-methodology/

[69] https://www.cedefop.europa.eu/en/tools/matching-skills/all-instruments/development-oska-system-labour-market-monitoring-and-future-skills-forecasting

[70] https://www.cedefop.europa.eu/en/tools/matching-skills/all-instruments/development-oska-system-labour-market-monitoring-and-future-skills-forecasting

[71] Cedefop, 2020. "Strengthening skills anticipation and matching in Estonia Capitalising on OSKA's potential to realise national ambitions".

The Estonian Parliament amended the Vocational Educational Institutions Act in 2018 to better link vocational programmes with the labour market, to have more flexible ways of accessing vocational training and an updated quality assessment.[72] Among the provisions were that schools could open study programmes not connected to specific vocational studies but which prepare students for selecting their speciality. This is aimed at increasing access to vocational education to those who do not have the ability to select a speciality after basic schooling or who have dropped out of education. To ensure that courses practically related to the wider labour market, when HE institutions are opening new courses, it must be demonstrated that they are supported and needed by employers.[73]

The 2014 Estonian Lifelong Learning Strategy contains commitments to improve lifelong learning opportunities and to align them with the labour market, taking into account the changing nature of employment due to digitalisation. The draft Education and Research Strategy 2021-2035 contains commitments that lifelong learning opportunities must match labour market needs and that there is smooth transition between different types of education, and will support the broader aims of the Estonia 2035 wider socio economic strategy.[74] A key challenge in Estonia is in improving the status of VET which is perceived to be of less worth than higher education, and is dominated by males from lower socioeconomic groups. Apprenticeships were established in Estonia (2006) and though numbers have increased over time it is difficult to attract younger apprentices.[75] The government responded using European Social Funding to support 4,600 additional apprenticeships between 2015 and 2018, and new apprenticeships commenced in areas such as aviation.[76] Pilot work-based learning programmes with higher education institutions have begun also to make such apprenticeships more attractive.[77]

To respond to increasing technological advancement, the Estonian government laid out a roadmap for the future labour market in its Work and Skills 2025 report, with focus placed on nurturing transversal skills, including the ability to adapt to rapidly changing job content and environments, effective teamwork and networking, and analytical, understanding, problem solving, and decision making skills.[78] It also recommends economic packages of better working conditions, job flexibility and healthcare access, to deal with the shorter life cycle of jobs.

Higher educational institutions can legally recognise prior learning and work experience legally via the Estonian Higher Education Standard.[79] In some cases VET graduates can progress to HE via relaxed entry requirements provided they are studying the same area in which they studied in in VET.[80] This is the case with graduates from agricultural, horticultural or forestry VET, who can continue to study in the same field in the University of Life Sciences in Tartu. To assist in the transition between VET and HE, HE educational institutions offer preparatory courses for possible VET entrants, with some having additional customised courses in their subject areas.

Ireland, like Estonia, is a small open economy that is heavily dependent on external factors for economic growth. It is also subject to variations in demographics, with Ireland, like Estonia, experiencing outward migration at times in its history when economic downturns occurred. Data based skills anticipation systems for Ireland would have to be linked into projections for demographics and the general economy, to effectively determine where future skills are needed. It

[72] https://www.cedefop.europa.eu/es/news-and-press/news/estonia-vet-law-amendments-bring-better-vocational-training-and-labour-market-links
[73] Correspondence with the Estonian Ministry of Education and Research
[74] https://www.riigikantselei.ee/et/Eesti2035
[75] Musset, P., et al. (2019), Vocational Education and Training in Estonia, OECD Reviews of Vocational Education and Training, OECD Publishing, Paris. https://doi.org/10.1787/g2g9fac9-en. Available at: https://www.oecd-ilibrary.org/docserver/053683c4-en.pdf?expires=1587729495&id=id&accname=guest&checksum=D63AA95F2B6123FA972C2C912CBE1492
[76] https://www.baltictimes.com/estonian_s_very_first_apprenticeship_program_for_aircraft_mechanics_celebrates_student_graduation/
[77] https://www.hm.ee/sites/default/files/htm_aruanne_2018_en.pdf
[78] Pärna, O. 2016 "Töö ja Oskused 2025". Available at: https://oska.kutsekoda.ee/wp-content/uploads/2016/04/Tulevikutrendid-1.pdf
[79] The Estonian Higher Education Standard 2019: https://www.riigiteataja.ee/akt/112072019017
[80] Correspondence with the Estonian Ministry of Education and Research

is also important that the findings of skills anticipation systems such as OSKA be effectively communicated and disseminated to the general population, and students, parents, and labour force. Effective dissemination can mean that that data collected can be used to better guide and influence the behaviour of those choosing careers and which tracks in the education system to follow.

Case Study 2: Canada

Canadian educational provision is the responsibility of each of the 13 provincial and territorial governments, with pan-Canadian policy issues being discussed in the Council of Ministers of Education, Canada (CMEC).[81] Canada has a highly educated workforce with 62% of Canadians having a tertiary degree in 2018, compared to 44% in the OECD generally.[82] However, graduate skills were found to be lower in comparison with their similarly educated peers in other OECD countries.[83] In general, Canadian adults had strong literacy and numeracy skills, scoring above the OECD average, and only 4.5% no computer experience, in comparison to 11.7% in the OECD.[84] While Canada ranked one of the highest in the OECD in successfully aligning the supply of skills with labour market demand for skills,[85] there was still persistent skill mismatch, in terms of skills and qualifications. Canada had the 15th and 12th highest rate of over qualification and under qualification at 16.2% and 21.7%, respectively. In terms of literacy mismatch, Canada had the third lowest rate of over-skilled workers at 6.54% (OECD average: 10.78%) and the fifth lowest rate of under-skilled workers at 3.63% (OECD average: 3.8%). In 2019 it was estimated that in total around 13% of Canada's workers have skills mismatched to their jobs.[86] It is difficult to assess where skills gaps exist in Canada and where they will arise in the future as it lacks an open credible database containing information on skills, despite efforts being made by the Canadian Labour Market Information Council (LMIC) to create one.

Overview of Policy Responses

To enhance the education systems, learning opportunities, and overall outcomes and to ensure quality lifelong learning opportunities for all Canada wide, the CMEC developed the *Learn Canada 2020* education framework, with four pillars of enhancing early childhood learning and development, elementary to high school systems, postsecondary education and adult learning and skills development.[87] The CMEC outlined five key areas to increase the numbers pursuing post-secondary education, including addressing post-secondary education's accessibility and affordability (e.g., finding a balance between tuition costs and financial aid), assessing the role of employers to encourage their participation in preparing students for employment, examining the most relevant learning outcomes to postsecondary education and developing instruments to measure these outcomes, to manage and understand key factors that may affect higher education's sustainability (e.g., increasing costs, changing demographics, fiscal context, tuition or debt levels) and to assess the success of students' transition from secondary to postsecondary education.[88]

[81] Education Policy Outlook: Canada (2015) OECD http://www.oecd.org/education/EDUCATION%20POLICY%20OUTLOOK%20CANADA.pdf

[82] Education at a Glance (2019) Canada Country Specific Note <http://www.oecd.org/education/education-at-a-glance/EAG2019_CN_CAN.pdf>

[83] OECD Skill Strategy: Canada https://www.oecd.org/canada/Skills-Strategy-Canada-EN.pdf

84 Survey of Adult Skills (PIAAC) indicators.

[85] https://www.oecd.org/canada/Skills-Strategy-Canada-EN.pdf

[86] Mahboubi, P., 2019. "C.D. Howe Commentary No.552: Bad Fits: The Causes, Extent and Costs of Job Skills Mismatch in Canada".

[87] http://cmec.ca/Publications/Lists/Publications/Attachments/187/CMEC-2020-DECLARATION.en.pdf

[88] https://www.cmec.ca/158/Postsecondary_Education.html

Some initiatives have been undertaken by Employment and Social Development Canada (ESDC), a department of the federal government dealing with social programmes and the labour market.[89] Its predecessor funded the development in 1998 of the Test of Workplace Essential Skills (TOWES) to measure individuals' skill performance in response to the needs of employers in nine essential skills of reading, document use, numeracy, writing, oral communication, working with others, thinking skills, digital technology, continuous learning.[90] ESDC has also developed an Essential Skills Profile Database containing 350 essential skills profiles (linked to occupations/occupational groups in National Occupational Classification) with information on how workers in particular occupations use the nine aforementioned essential skills in their work and describing the complexity of the skills needed.[91] ESDC also established the Office of Literacy and Essential Skills to assist Canadians developing such skills by working with provincial/territorial governments in designing employment and training programmes incorporating essential skill components. Emphasis is placed on supporting those with limited skillsets from disadvantaged groups such as Indigenous people, youth, and Official Language Minority Communities (OLMCs), with the ESDC running various programmes for these.[92]

The Forum of Labour Market Ministers, a policy forum for federal and provincial/territorial ministers responsible for creating labour market policies and programmes, have developed a Strategic Plan for 2017-2020 with five priority focus areas outlined in Figure 2.2 to ensure the better alignment of skills with labour market needs.[93]

Figure 2.2: Canada – Priority Areas of Forum of Labour Market Ministers Strategic Plan 2017-2020

- Ensuring the next generation of Labour Market Transfer Agreements (LMTAs) are focused on outcomes and are inclusive, flexible and responsive to citizen's needs; and are based on reliable evidence.
- Optimizing the mobility of certified workers and apprentices across the labour market; as well as ensuring the smooth integration of internationally trained workers into the Canadian labour market.
- Promoting employer involvement and creating demand-led training initiatives which meet employers' needs.
- Strengthening knowledge transfer and engagement between stakeholders.
- Promoting the sharing of best practices and innovative practices across Canada.

Source: Forum of Labour Market Ministers – Strategic Plan 2017-2020

In terms of labour market information on skills shortages and gaps, the not-for-profit Labour Market Information Council (LMIC) was set up in 2017 to improve the reliability and accessibility of labour market information in facilitating decision-making by employers, workers, job seekers, academics, policy makers, educators, career practitioners, students, parents and under-represented populations.[94] The LMIC collects, analyses and disseminates labour market information, thorough its website and through reports such as "The Future Work Annotated Bibliography" and "LMI Insights", which define labour shortages (a lack of candidates for a specific job in a specific labour market), skills shortages (lack of candidates with the skills required by particular employers) and skill mismatches (where an employee's current skills are not well suited to their current job). The LMI have noted that labour market changes are occurring at an unprecedented pace, driven by technology, business

[89] https://www.canada.ca/en/employment-social-development.html

[90] http://www.towes.com/en/about-towes/our-history

[91] https://www.canada.ca/en/employment-social-development/programs/essential-skills/profiles/guide.html

[92] https://www.canada.ca/en/employment-social-development/programs/literacy-essential-skills.html

[93] http://flmm-fmmt.ca/about-us/

[94] https://lmic-cimt.ca/about

model innovations, population gaining, evolving global trading patterns, and climate change.[95] These create uncertainty around employment, job quality, skill requirements, and the ability to form, attract, and retain talent. Additionally, the LMIC has collated information from various reports on the future world of work, finding that skills will need to change due to technological change and automation, climate change, demographic change, online platforms and the future workers will be in non-traditional working environments, shorter-term jobs and a greater focus will be placed on soft skills, such as communicative and emotional skills.[96] The LMIC, ESDC and Statistics Canada are currently developing a pan-Canadian mapping system that links skills to occupations, with a proposed five-phased plan to assess, develop, and maintain a mapping between the ESDC's recently developed Skills and Competencies Taxonomy and the National Occupational Classification (NOC) system.[97]

Future Skills, launched in 2018, is part of the Federal Government's plan to ensure Canada's skills development policies and programs respond to meet changing needs, by examining major trends impacting national and regional economies and workers, identifying current and future emerging skills demanded, developing, testing and evaluating new skills development approaches, as well as though the sharing of results and best practices across the public, private and not-for-profit sectors, to support broader use of innovative approaches. A Future Skills Council, staffed by relevant cross-sectoral experts, will be established to consult and gather perspectives on how technologies and other rends are creating new opportunities, so it can advise the Minister of Employment, Workforce Development and Labour on national and regional skills development and training priorities. A Future Skills Centre will partner with and fund projects led by groups such as provincial/territorial and Indigenous governments, for-profit and not-for-profit bodies to help people make informed training decisions by identifying emerging in-demand skills required now and in future.[98]

On a provincial level, from 1998 the government of Ontario has required publicly funded colleges to report on the five key performance areas of employment and graduation rates, student and graduate satisfaction rates, and employers' satisfaction rate with graduates annually.[99] Measuring performance in these areas supports skills development by communicating the benefits of lifelong learning to individuals and firms.[100] To improve tertiary graduates' skills, the Ontarian government has committed to improved development of transversal and job-specific skills in tertiary education, via the roll-out of the Essential Adult Skills Initiative (EASI) and the Postsecondary and Workplace Skills (PAWS), for trial at 20 universities and colleges across Ontario. These assessments measure the literacy, numeracy and critical-thinking skills among students entering tertiary education and students graduating from university, to improve information on skills gaps in post-secondary graduates and to assess whether post-secondary education is successful at providing graduates with the transversal, non-disciplinary skills necessary to be successful in the labour market. [101] Ontario's Ministry of Training, Colleges and Universities requires a Programme Advisory Committee, made up of various social partners including college staff, students and external personnel who are leaders in their fields, be established for each college programme or cluster of programmes to ensure its relevance to the needs of industry, business and society.[102]

The experience of Canada is also of relevance in considering the pathways between further education and higher education. In Canada, those that undertake vocational pathways in post-

[95] https://lmic-cimt.ca/wp-content/uploads/2018/10/LMI-Insights-No.-1.pdf

[96] https://lmic-cimt.ca/wp-content/uploads/2020/02/LMIC_Future_of_Work-Annotated_Bibliography_Feb20.pdf

[97] https://lmic-cimt.ca/wp-content/uploads/2019/08/LMI-Insights-No-16.pdf

[98] https://www.canada.ca/en/employment-social-development/programs/future-skills.html

[99] https://www.collegesontario.org/en/resources/2019-kpi-results

[100] OECD 2019 Skills Strategy

[101] OECD 2019 Skills Strategy

[102] https://www.senecacollege.ca/about/advisory/

secondary colleges can attend university upon receiving a college diploma.[103] Bridging courses are available for those that do not have all the knowledge necessary to undertake a university course and for VET students who did not finish high school.[104] An interesting example of approaches to pathways is the Trade to Degrees programme, developed by the Northern Alberta Institute of Technology. This allows recognised trade professionals the opportunity to progress from an apprenticeship credential, to the third year of their four-year Bachelor of Business Administration Programme.[105]

Case Study 3: New Zealand

New Zealand is characterised by low unemployment levels (between 4% and 7% since 2010)[106] with a consequent shortage of skills in certain areas, such as construction, which New Zealand has traditionally turned to immigration to fill. Occupational shortages are evidenced by almost 6 in 10 managers in New Zealand finding it difficult to fill jobs (in Ireland this is only 2 in 10).[107] The proportion of New Zealanders in jobs they are under-skilled for (in terms of literacy skills) being higher than the OECD average (10% compared to 7%), with proportion of over-skilled New Zealanders being similar to the OECD average (18%).[108] Further analysis has revealed that much of the mismatch in New Zealand is concentrated at lower skill levels, with 67% of the underqualified having no qualification or a school-level qualification.[109] Additionally, younger New Zealanders aged 16-24 were most likely to be overqualified for their job compared to those at older ages, possibly because these are in jobs they are too qualified for to gain more experience starting their careers. Older age groups more likely to be underqualified while those aged 35-24 were the most likely to be matched to the qualification level needed to obtain their job. [110] The OECD estimated in 2017 that New Zealand's productivity growth could be 2.25% higher if mismatch in the labour force was addressed and it has also been estimated that New Zealand's labour productivity would increase by 7% in gains in allocative efficiency if literacy skills mismatch was reduced to best practice minimum.[111] While it is estimated that 24% of jobs are at risk from automation in New Zealand,[112] 39% of jobs for those with low education levels are at risk in contrast to 11% for the highly educated, underscoring the importance of re-orientating the education and training to cope with the challenges posed by technology.

[103] https://www.sram.qc.ca/international-student/curricula-and-levels

[104] For an example of a bridging programme at the University of Toronto see: http://sites.utoronto.ca/typ/faq.html

[105] https://www.nait.ca/nait/admissions/transfer-and-credit-options/pathways/trades-to-degrees

[106] Statistics New Zealand – Unemployment Rates: https://www.stats.govt.nz/indicators/unemployment-rate

[107] OECD, 2016. "Getting Skills Right: Assessing and Anticipating Changing Skill Needs", OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264252073-en

[108] Adalet McGowan, M. and D. Andrews (2017), "Skills Mismatch, Productivity and Policies in New Zealand: Evidence from PIAAC", OECD Economics Department Working Papers; OECD calculations based on the Survey of Adult Skills (PIAAC) (2012 and 2015).

[109] Earle, D. 2020. "Qualification level match and mismatch in New Zealand Analysis from the Survey of Adult Skills". Available at: https://www.educationcounts.govt.nz/__data/assets/pdf_file/0006/198843/Qualification-match-and-mis-match-in-New-Zealand.pdf

[110] Earle, D. 2020. "Qualification level match and mismatch in New Zealand Analysis from the Survey of Adult Skills". See: https://www.educationcounts.govt.nz/__data/assets/pdf_file/0006/198843/Qualification-match-and-mis-match-in-New-Zealand.pdf

[111] Adalet McGowan, M. and D. Andrews (2017), "Skills Mismatch, Productivity and Policies in New Zealand: Evidence from PIAAC", OECD Economics Department Working Papers; Calculations based on the OECD Survey of Adult Skills (PIAAC) (2012 and 2015).

[112] PWC, 2018. "Will robots really steal our jobs? An international analysis of the potential long term impact of automation".

Overview of Policy Responses

Skills anticipation in New Zealand is largely based around using occupational shortages as a proxy of skills shortages. The Ministry of Business, Innovation and Employment (MBIE) uses Computable General Equilibrium Model to develop yearly employment forecasts for industries, broad occupational and skills groups, underpinned by the macroeconomic outlook in the Consensus Forecasts of the New Zealand Institute of Economic Research.[113] These forecasts set priorities for tertiary education, training for industry and the MBIE's medium- to long-term employment outlook.[114] Occupational shortages are identified via vacancy surveys, such as the Manpower Talent Shortage Survey[115] and New Zealand Quarterly Survey of Business Opinion,[116] wage pressure analyses and employer and stakeholder consultation.[117] Information is used to update occupational standards, and to design vocational education and training programmes, such as apprenticeships. Vacancy surveys are used in part to generate the long-term (occupations with sustained shortages New Zealand wide), region (regions with immediate skills shortages) and construction and infrastructure (immediate skills shortages) lists, advertising skills shortage areas to migrants.[118] Stakeholders (e.g., employer groups, industry training organisations and trade unions) propose areas with skills shortages needs, which are put on the relevant list if the MBIE finds sufficient evidence (from surveys, etc.) for inclusion.[119]

In 2008, the New Zealand Skills Strategy Action Plan was launched to improve use and retention of skills to transform workplaces, make education and training more responsive to skills, increase employer and worker awareness of skills needs and develop a unified approach to defining, valuing and measuring skills.[120] A number of initiatives were introduced, such as the joint Australian and New Zealand Standard Classification of Occupations (ANZSCO), enabling better definition, measurement and comparison of skills and occupations.[121] The public Labour Market Dashboard was developed as a one-stop-shop for data labour market and skills data bringing together 76 datasets.[122] Skills shortages in specific areas were targeted, such as the Engineering e2e programme, which achieved its initial target of 500 extra engineering graduates per year by 2017.[123] University places and tuition fees were reduced in STEM-related and other highly skilled professions, to meet skills shortages in these areas.[124] The Vocational Pathways programme was initiated in secondary schools which assists students' to prepare students for employment in six industries, namely primary industries, services industries, social and community services, manufacturing and technology, construction and

[113] These forecasts cover exports, imports and consumption growth. See OECD, 2017. "OECD Skills Strategy Diagnostic Report: Slovenia 2017."

[114] Ministry of Business, Innovation and Employment, 2019. "Medium to long-term employment projections: Looking ahead to 2028". Available at: https://www.mbie.govt.nz/assets/medium-to-long-term-employment-outlook-looking-ahead-to-2028.pdf

[115] http://downloads.manpowergroup.co.nz/talent-shortage-2018

[116] A New Zealand Institute of Economic Research survey of manufacturers, builders, architects, wholesalers and retailers, and service sector firms on general labour market and business conditions, including the difficulty in finding skilled and unskilled labour – https://nzier.org.nz/ABout%20QSBO/

[117] OECD, 2016. "Getting Skills Right: Assessing and Anticipating Changing Skill Needs", OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264252073-en

[118] OECD (2016), Getting Skills Right: Assessing and Anticipating Changing Skill Needs, OECD Publishing,

Paris. http://dx.doi.org/10.1787/9789264252073-en

[119] https://www.immigration.govt.nz/employ-migrants/explore-your-options/before-you-start-hiring-migrants/skill-shortages

[120] New Zealand Skills Strategy Action Plan 2018 - https://www.beehive.govt.nz/sites/default/files/NZ-Skills-Strategy-Action-Plan-2008_0.pdf

[121] https://www.abs.gov.au/ausstats/abs@.nsf/0/8B1F5DDDD46033ABCA2575DF002DA75E?opendocument

[122] https://mbienz.shinyapps.io/labour-market-dashboard_prod/

[123] http://engineeringe2e.org.nz/about/background-and-issues/

[124] OECD, 2016. "Getting Skills Right: Assessing and Anticipating Changing Skill Needs", OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264252073-en

infrastructure, and creative industries.[125] Students can input skills or standards into an online "Profile Builder" to evaluate and plan the programme they are currently in or are interested in doing, and teachers can use "Profile Builder" to plan a student's pathway of programmes. Employers can view the vocational profile of a student to identify the student's pathway and award, and to determine if their skills align with those they require. VET in New Zealand is currently undergoing major reform, providing a stronger focus on employers to ensure the skills they require are delivered. Figure 2.3 outlines its key elements.

Figure 2.3: Key Elements in the Reform of the Vocational Education and Training System in New Zealand

- Creation of 4-6 industry governed Workforce Development Councils (WDCs) to provide greater leadership across vocational education;
- Establishment of Regional Skills Leadership Groups to give advice concerning regional skills needs to the Tertiary Education Commission (TEC), WDCs, and local VET providers;
- Establishment of Te Taumata Aronui to ensure that reform of vocational education reflects the Government's commitment to Māori Crown partnerships;
- The New Zealand Institute of Skills & Technology (NZIST) will merge the existing 16 Institutes of Technology and Polytechnics into one national body that is unified, sustainable, public network of regionally accessible vocational education.
- The role of supporting workplace learning will shift from ITOs to providers, with the NZIST and providers supporting workplace based, on-job training to ensure seamless integration between settings and industry needs.
- Centres of Vocational Excellence (CoVEs) will be established, bringing together the NZIST, providers, WDCs, industry experts and leading researchers to advance excellent provision of vocational education and share high-quality curriculum and programme design across the system.
- A unified funding for vocational education will be established and will involve all provider-based and work-integrated education at certificate and diploma qualification Levels 3 to 7 (the latter excluding degree study) as well as the entirety of industry training.

Source: https://conversation.education.govt.nz/conversations/reform-of-vocational-education/
Note: A number of other reform changes are being designed with engagement and input from stakeholders.

The New Zealand Productivity Commission has recommended that the tertiary education funding system be more reflective of student demand, rewarding providers that perform well in adding value to students, with funding extended to providers for students not perusing full qualifications. This should further the uptake of training schemes and micro-credentials, with a lifting of restrictions on loan applications for students in part-time/small courses (e.g., micro-credentials). Shorter courses in the form of training schemes, learning or training worth up to 40 credits leading to an award but not a qualification on the NZQF, and micro-credentials, certificates of achieving a set of currently unmet skills and knowledge worth 5-40 credits and an NZQF award, were formally introduced by the New Zealand Qualifications Authority in 2018.[126] To create a micro-credential, an education/training providers proposal with evidence that it is required or supported by industries, employers and communities, that it meets specific unmet skill needs and does not supplicate an existing NZQF

[125] Education Review Office, 2016. "Vocational Pathways: Authentic and Relevant Learning". Available at: https://www.ero.govt.nz/assets/Uploads/Vocational-Pathways-PDF2.pdf

[126] https://www.nzqa.govt.nz/providers-partners/approval-accreditation-and-registration/micro-credentials/guidelines-training-scheme-micro-credential/

qualification.[127] They are reviewed annually to see if the skills shortage they address have been met. Micro-credentials are intended to provide workers' greater incentives to workers to upskill, though some universities are concerned they affect foreign students' ability to discern between full degrees and micro-credit courses, something that needs to be considered if such formal recognition of micro-credentials occurs in Ireland. [128]

2.3 Summary of Key Findings and Implications

Our analysis of policy approaches to skills provision in Ireland and in other case studies examined suggests that:

- Ireland has a well-developed policy system to align educational and training provision with skill requirements, but there are areas of skill intelligence and in pathways to higher education which can be enhanced.
- Review of international practice indicates potential areas which merit additional emphasis in Ireland including:
  - Development of pathways between further education and higher education.
  - Approaches to forecasting of further educational and skills requirements should also be strengthened. One issue of note is that there are inevitable challenges in any forecasting it is critical that the educational and training system has the flexibility to respond to changing skill requirements and that the focus is on future rather than historical skill needs.

[127] NZQA, 2020. "Guidelines for applying for approval of a training scheme or a micro-credential".

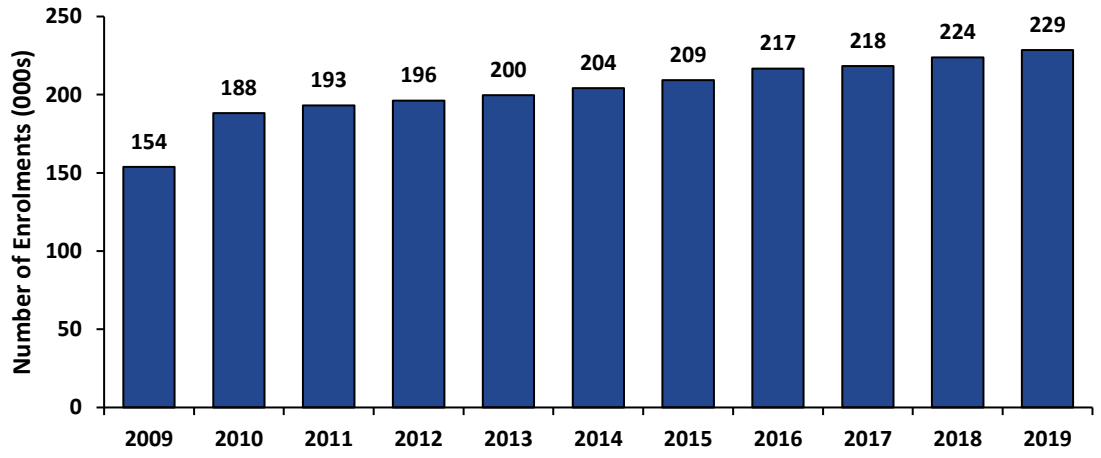
[128] https://www.stuff.co.nz/national/education/109497958/nzqa-wants-to-make-microcredentials-official-what-are-these-nanodegrees-worth

3 HE and FET Participation

3.1 Higher Education Participation

Figure 3.1 shows the total number of enrolments for courses in Higher-Level Education Institutions from 2009 to 2019. Over recent years there has been a steady increase in enrolment in higher-level education. This, in part, reflects population growth and the highly skilled nature of the Irish economy and is also likely to reflect societal preferences and the historically underdeveloped nature of apprenticeship programmes.

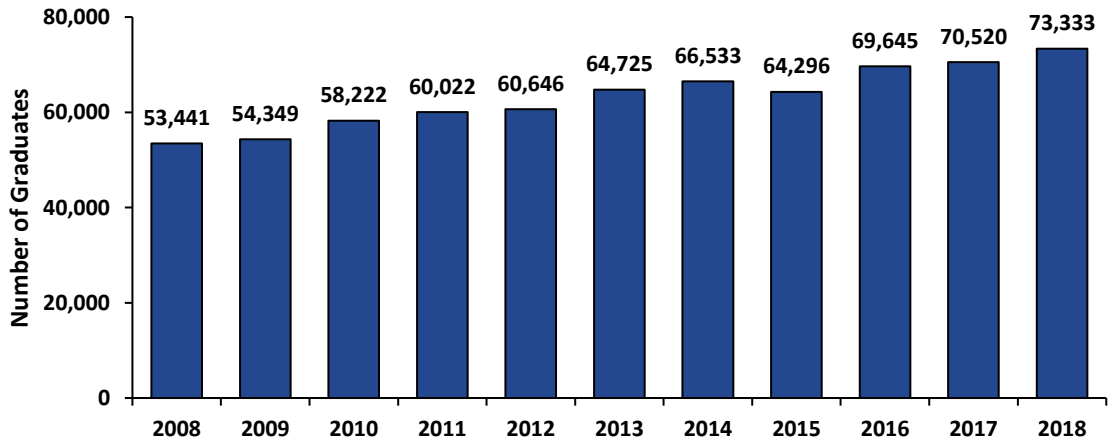
Figure 3.1: Total Higher Education Enrolments 2009-2019



Source: HEA
Note: Figures do not include enrolments in private institutions.

The number of graduates who were awarded qualifications ranging from NFQ Level 6-10 between 2008 and 2018 are shown Figure 3.2. Since 2008, the number of students graduating from HEA-funded institutions has increased by over 37%. These individuals represent an important source of high skills for the Irish economy. However, the rate of growth has implications for the financial sustainability of the HE sector.

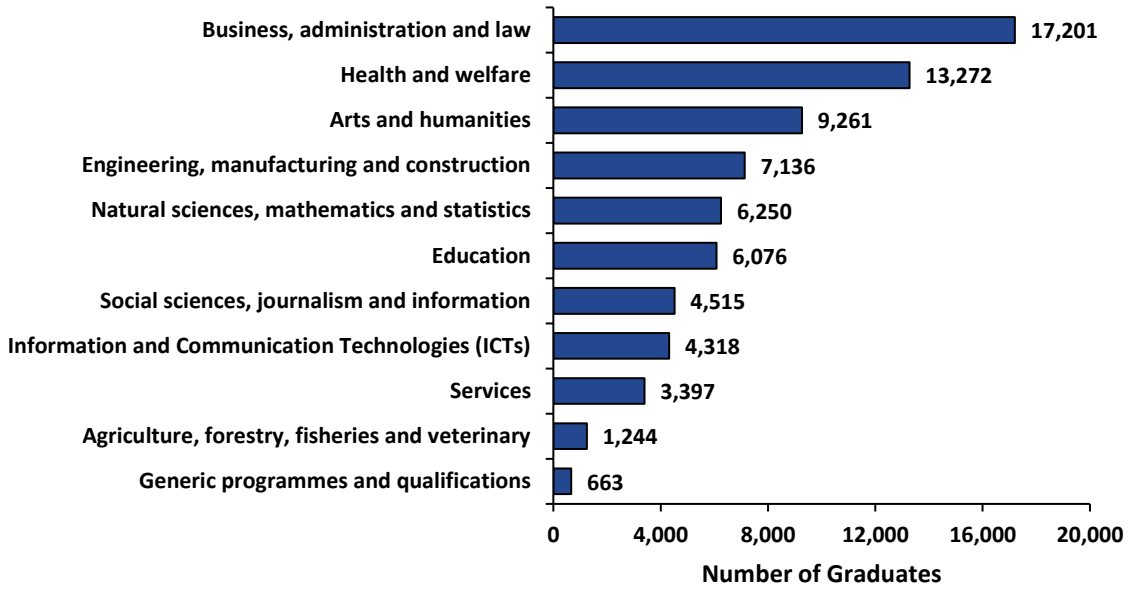
Figure 3.2: Trends in Total Number of Higher Education Graduates (All HEA-funded Institutions), 2008-2018



Source: HEA
Note: Figures do not include enrolments in private institutions.

Figure 3.3 shows the total number of qualifications awarded by field of study in 2018. It highlights the difference in supply of higher-level graduates by field of study. Business, administration and law had the highest number of graduates at 17,201. Other major areas of field of study include health and welfare, arts and humanities, engineering, manufacture and construction, natural sciences, mathematics and statistics and education.

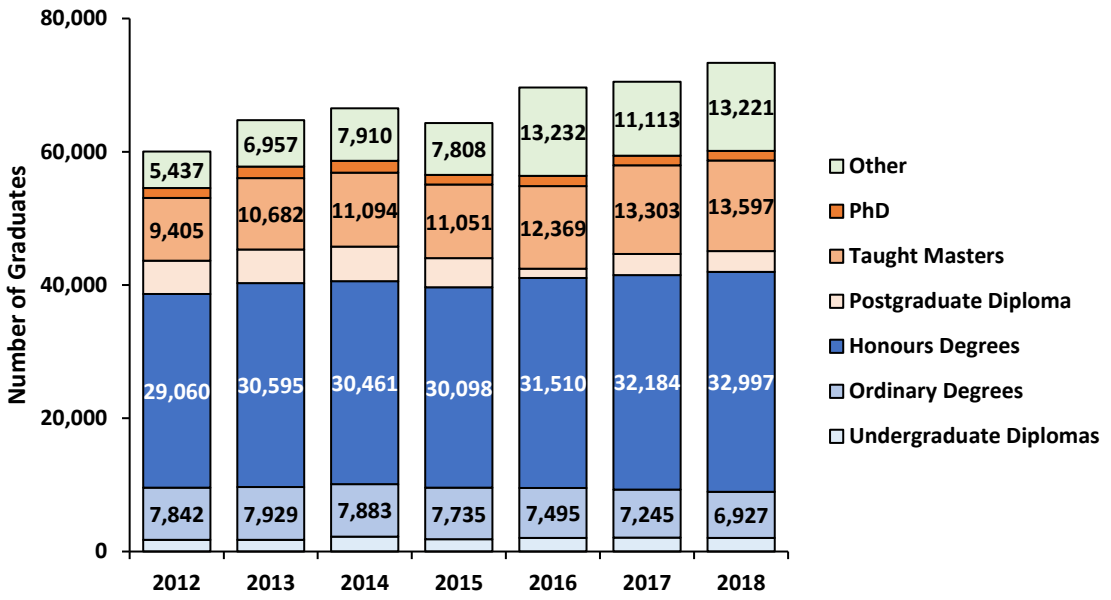
Figure 3.3 Total Number of Levels Awarded by Field of Study in 2018



Source: HEA
Note: Figures do not include enrolments in private institutions.

Figure 3.4 illustrates the different qualifications that are awarded under NFQ Levels 6- 10. The most awarded qualification between 2012 and 2018 was the honours bachelor's degrees, with the total number of graduates with this degree steadily increasing since 2012. Taught master's degrees are the second-most awarded qualification with numbers again steadily increasing since 2012. This coincides with an increase in the percentage of students graduating with a master's degree from 16% in 2012 to 19% in 2018, with more students now graduating at that level. The increase in students graduating with a master's degree (NFQ Level 9) is most likely due to the ongoing increase in the number of students gaining an honours bachelor's degree (NFQ Level 8). As more and more students graduate with Level 8 qualifications, this increases the amount of people applicable to pursue further educational qualifications such as a master's degree or a postgraduate diploma.

Figure 3.4 Total Number of HEA Levels Awarded by Degree Type, 2012-2018



Source: HEA
Note: Figures do not include enrolments in private institutions.

*Other: Undergrad Certificate; Certificate; Higher Certificate; Postgraduate Certificate; Higher Diploma; Research Master's

3.2 Further Education and Training Provision

Further education and training ('FET') in Ireland is education and training that occurs after second-level education that is not part of the third-level system.[129] FET is of critical importance in meeting the skills needs of the economy. The three main categories of FET include those focused on employment outcomes, progression training and the development of transversal skills.[130] Employment outcome courses/training are programmes that are aimed at improving employment outcomes for participants. The goal is to assist learners to progress directly into the labour market and into employment. Progression focused courses/training are programmes that have an objective to progress learners to higher level FET or higher education. These are important in meeting the overall targets for tertiary education and in enhancing social inclusion. Transversal skills development courses/training are programmes intended to help learners develop transversal skills, which are skills that can be used in a wide range of situations and employment settings and are not usually considered to be specifically related to a particular job, sector or area of knowledge. Data on the types of programmes focused on the three main areas of further education and training are presented in the next table.

[129] Department of Education and Skills

[130] SOLAS 2019, "Future Ready Learning – Strategic Performance Agreements: Developing the Further Education and Training System 2018 – 2020". Available at: http://www.solas.ie/SolasPdfLibrary/Final%20system%20report.pdf

Table 3.1: FET Programmes in Ireland		
Employment Outcomes	**Progression**	**Transversal Skills Development**
Apprenticeship Training	Bridging and Foundation Training	Adult Literacy
Blended Training	BTEI Groups	ESOL
Evening Training	Community Training Centres	FET Co-operation Hours
Post Leaving Certificate	Specialist Training Programmes	ITABE
Specific Skills Training	Youthreach	Refugee Resettlement
Traineeships Training		Voluntary Literacy Tuition
VTOS		Community Education
Source: SOLAS		

Table 3.2 shows the change in the number of beneficiaries[131] and new entrants to further education and training between 2014 and 2019. 2018 experienced the highest number of new entrants to FET over the six-year period, with the 2019 figure slightly lower than the previous year.

Table 3.2: Further Education and Training Beneficiaries and New Entrants (2014-2019)		
	Beneficiaries	**New Entrants**
2014	341,726	215,929
2015	369,523	231,234
2016	339,283	245,400
2017	323,308	230,641
2018	337,966	251,391
2019	329,293	247,855
Source: Presentation of SOLAS data		

Generic programmes and qualifications were the most popular field of study for FET learners in 2018, accounting for almost half of learners as per the following table. Business and administration and law; health and welfare; and services each had around 10% of learners.

Table 3.3: Field of Study of Further Education and Training Learners in 2018		
	Number of FET Learners	**Percentage of Total**
Generic programmes and qualifications	81,488	46.6%
Business and administration and law	18,136	10.4%
Health and welfare	17,691	10.1%
Services	17,476	10.0%
Arts and humanities	9,803	5.6%
Education	9,261	5.3%
Information and communication technology	8,718	5.0%
Engineering, manufacturing and construction	7,369	4.2%
Agriculture, forestry, fisheries and veterinary	3,521	2.0%
Natural sciences, mathematics and statistics	978	0.6%
Social sciences, journalism and information	613	0.4%
Total	**175,054**	**100%**
Source: Presentation of SOLAS data		

[131] Defined as individuals who will benefit from interventions provided through FET funding in a given year, irrespective of whether they are present at the start of the year or join a course during the year, as per the SOLAS FET Services Plan.

Given that more FET learners were attending Level 5 certificate courses than any other type of course it is unsurprising that there are more graduates from Level 5 certificate courses than any other type of course. There was a large fall in the number of graduates overall, from 69,214 in 2018 to 51,969 in 2019 driven mostly by falls in graduates in Level 5 certificate courses and advanced certificate and higher certificate courses.

Table 3.4: Breakdown of Further Education and Training Graduates by Highest Award Level Achieved – 2018 and 2019

Highest Award Achieved	Award Level	No. of Graduates – 2018*	No. of Graduates - 2019* **
Level 1 Certificate	NFQ 1	429	605
Level 2 Certificate	NFQ 2	2,037	2,706
Level 3 Certificate	NFQ 3	7,794	5,573
Level 4 Certificate	NFQ 4	8,034	9,111
Level 4/5 Certificate	NFQ 4.5	738	386
Level 5 Certificate	NFQ 5	33,800	22,278
Advanced Certificate/Higher Certificate	NFQ 6	10,244	4,113
Honours Bachelor's Degree/Higher Diploma	NFQ 8	102	7
Non-NFQ assigned Industry Awards	Non-NFQ assigned Industry Awards	6,036	7,190
Total		**69,214**	**51,969**

Source: Analysis of SOLAS PLSS data
Notes:
* Figures relate to number of unique learners in each period who complete their education and achieve a certified NFQ-assigned or other industry award/qualification, and is based on the highest level of award achieved in that period.
** 2019 figures are preliminary

As shown in the following table, generic programmes and qualifications had the highest number of graduates amongst any of the fields of study. However, whilst they accounted for 27.7% of graduates in 2018 almost half of FET learners in 2018 were undertaking courses in this field. As was the case with the FET learners, business and administration and law, services, and health and welfare were the three next main fields of study for FET graduates.

Table 3.5: Breakdown of Further Education and Training Graduates by Field of Study/Education – 2018 and 2019				
Education Field (ISCED)	**2018**		**2019**	
	Number	***Percentage***	**Number**	***Percentage***
Generic programmes and qualifications	15,609	*22.6%*	14,417	*27.7%*
Business and administration and law	10,913	*15.8%*	7,941	*15.3%*
Services	10,002	*14.5%*	7,560	*14.5%*
Health and welfare	10,223	*14.8%*	6,239	*12.0%*
Education	5,448	*7.9%*	3,985	*7.7%*
Engineering, manufacturing and construction	3,891	*5.6%*	3,965	*7.6%*
Information and Communication Technologies (ICTs)	5,002	*7.2%*	3,761	*7.2%*
Arts and humanities	5,492	*7.9%*	2,264	*4.4%*
Agriculture, forestry, fisheries and veterinary	1,795	*2.6%*	1,354	*2.6%*
Natural sciences, mathematics and statistics	486	*0.7%*	338	*0.7%*
Social sciences, journalism and information	353	*0.5%*	145	*0.3%*
Total	**69,214**	***100%***	**51,969**	***100%***

Source: Analysis of SOLAS PLSS data
Notes:
* Figures relate to number of unique learners in each period who complete their education and achieve a certified NFQ-assigned or other industry award/qualification, and is based on the highest level of award achieved in that period.
** 2019 figures are preliminary

3.3 Apprenticeship Training

An important element of FET which has been given increased attention is apprenticeship training. This area of FET provision has historically been less developed in Ireland than in some other countries. Apprenticeships are industry-led programmes which offer learners training in both the workplace and in education and training centres (such as ETB (Education and Training Board) centres, IOTs (Institutes of Technology) or colleges of further education). The programmes are focussed on employment outcomes and on meeting specific skills needs. The main apprenticeships are in the areas of construction, electrical industries and engineering. A QQI Level 6 Advanced Certificate Craft was awarded those who successfully completed an apprenticeship in the years before 2016.[132] Apprenticeships differ from traineeships, which are shorter (generally 40 weeks in duration) work-based learning (usually a minimum of 30% of time is allocated to workplace learning) programmes which are offered in partnership with employers.[133]

Table 3.6 displays the number of new registrations in apprenticeships from 2014 up to September 2019, by the area of the apprenticeship. The annual number of registrations in apprenticeships between 2014 and 2019 have increased from 2,698 to almost 5,648, an increase of 109%. In 2018, 2,249 or 40% of apprenticeship registrations were in electrical, while 1,486 were in construction. Registrations for apprenticeships in the areas of electrical and construction have grown by 114% and 155% respectively between 2014 and 2018, reflecting the resurgence of the construction sector as the Irish economy recovered in those years. Engineering and motor apprentices accounted for the next largest share of registrations in 2018, at 13% each.

[132] CSO Further Education Outcomes - Graduation Years 2010-2016, 2019. Available at: https://www.cso.ie/en/releasesandpublications/ep/p-feo/furthereducationoutcomes-graduationyears2010-2016/apprenticeships/
[133] Department of Education and Skills, 2016. "Action Plan to Expand Apprenticeship and Traineeship in Ireland". Available at: https://www.education.ie/en/Publications/Policy-Reports/Action-Plan-Expand-Apprenticeship-Traineeship-in-Ireland-2016-2020.pdf

In recent years new industry led consortia apprenticeships leading to an award between Levels 5 and 10 on the NFQ have been created, both in the areas traditionally covered by craft apprenticeships and in new areas.[134] New apprenticeships have been established in the areas of finance in 2016, hospitality and food in 2017 and auctioneering, biopharma, ICT and Logistics in 2018, as Table 3.6 demonstrates, and more new apprenticeships are to begin soon in areas such as hairdressing and retail. Meanwhile, registrations in the area of printing declined to zero in 2018 from 8 in 2014, with no registrations up to September 2019 also, reflecting the decline of the printing industry more generally and the rise of digital publications.

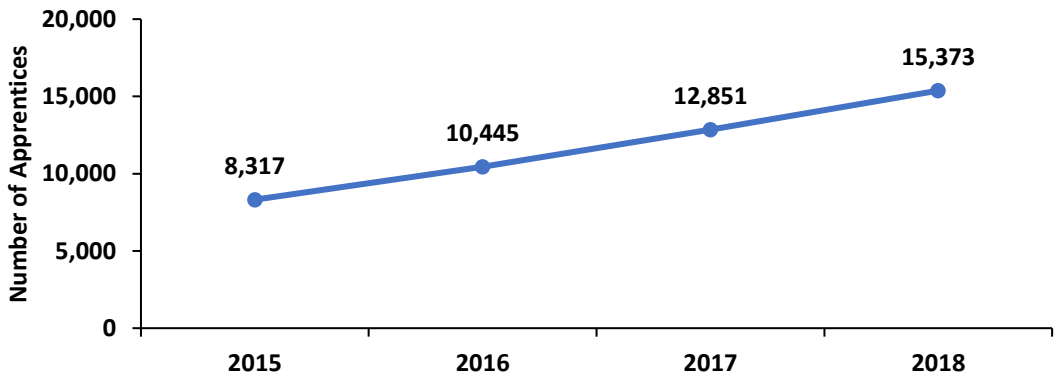
Table 3.6: Number of Apprentice Registrations 2014-2019

	2014	2015	2016	2017	2018	2019*
Auctioneering					53	82
Biopharma					16	23
Construction	582	693	914	1,180	1,486	1,100
Electrical	1,051	1,184	1,617	2,095	2,249	1,773
Engineering	453	508	503	678	709	535
Finance			67	190	189	166
Hospitality & Food				25	150	101
ICT					61	103
Logistics					27	30
Motor	604	760	716	673	708	538
Printing	8	8	4	2	0	0
Total	**2,698**	**3,153**	**3,821**	**4,843**	**5,648**	**4,451**

Source: SOLAS submission to the Joint Oireachtas Committee on Education on Skills 2019.[135]
Note: *Registrations for 2019 are up to September 2019 and are not for the full year like the figures for the other years displayed. Apprenticeships are to be established in Hairdressing and Retail.

Figure 3.5 provides the total numbers in apprenticeship programmes between 2015 and 2018. From 2015 to 2018 there was in increase in the number undertaking apprenticeships of 85%, from 8,371 to 15,373.

Figure 3.5: Numbers in Apprenticeships, 2015-2018



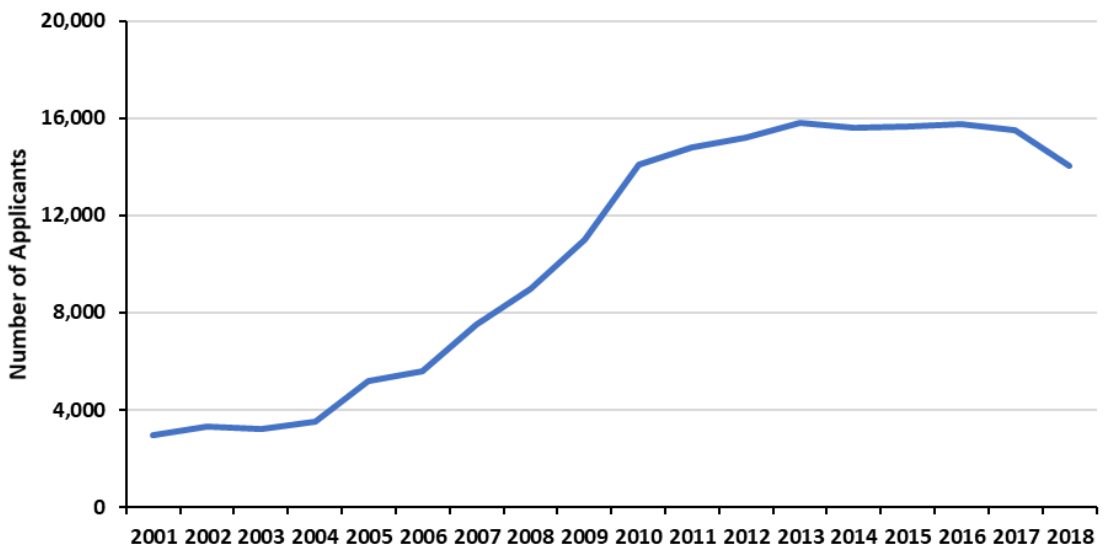
Source: Analysis of SOLAS Data[136]

[134] Citizens Information - https://www.citizensinformation.ie/en/education/vocational_education_and_training/apprenticeships.html
[135]https://data.oireachtas.ie/ie/oireachtas/committee/dail/32/joint_committee_on_education_and_skills/submissions/2019/2019-10-22_opening-statement-andrew-brownlee-ceo-solas_en.pdf
[136] DES Press Release 3 June 2019: https://www.education.ie/en/Press-Events/Press-Releases/2019-press-releases/PR19-06-03.html#:~:text=An%20apprenticeship%20prepares%20participants%20for,population%20now%20stands%20at%2016%2C000.

3.4 Pathways Between FET and HE

Of relevance to this study is the relationship between FET and HE, as well as the pathways that exist between the two. The following graph shows that there was a steady increase between 2004 and 2010 in the number of CAO applicants who had a FET QQI award. Since 2010 there have been between 14,000 and 16,000 applicants a year with a noticeable decline in the number of applicants in 2018.

Figure 3.6: Trends in CAO Demand from Applicants with FET QQI Awards



Source: Transitions Reform Sub-Group – confidential data from working paper

Of the 14,059 candidates with QQI FET awards who applied through the CAO over half of these (54.8%) accepted their CAO offer. However, this acceptance rate was lower than the acceptance rate amongst the population of CAO candidates, indicating that those with FET QQI awards were less likely to take up a position on a HE course. The acceptance rate amongst those with QQI FET awards was higher for Level 8 courses than it was for Level 6/7 courses. It is possible that some applicants applied to both Level 7 and 8 courses, with them more likely to accept the Level 8 course if they were successful in their application for both.

Table 3.7: CAO Offers and Acceptances relating to Applicants with QQI Awards				
Category	**2017**		**2018**	
Total Number of CAO Candidates	81,091	-	77,785	
Total Net CAO Acceptances	47,997	59.2%	46,624	59.9%
Total Number of candidates with QQI FET (CAO Applicants who mention QQI/FET)	15,435	-	14,059	
Total NET QQI FET Candidate Acceptances	8,382	54.3%	7,707	54.8%
Level 8 offers to candidates with QQI FET awards	9,184	-	8,677	-
Level 8 net acceptances by candidates with QQI FET awards	5,629	61.3%	5,322	61.3%
Level 7/6 offers to candidates with QQI FET awards	8,124	-	7,108	-
Level 7/6 net acceptances by candidates with QQI FET awards	2,753	33.9%	2,385	33.6%
Candidates with QQI FET awards who were offered a course on the basis of QQI FET score	5,343	-	5,160	-
Acceptances based on QQI FET awards Scores	3,517	-	3,457	-
Applicants with Both QQI FET award and Leaving Cert	11,999	-	11,513	-
Applicants with QQI FET awards who are Mature (over 23)	5,274	-	4,870	-
Applicants with QQI FET Result awards and Leaving Cert who are Mature (over 23)	3,216	-	3,020	-
Source: Transitions Reform Sub-Group – confidential data from working paper				

The following table analysis the rates of retention of PLC graduates within HEIs, which allows an understanding of whether FET graduates are likely to complete their course following acceptance of their place. The data suggests that FET graduates attending universities have a higher retention rate than those attending Institutes of Technology.

Table 3.8: Retention of PLC Graduates within HEIs			
Year of PLC Graduation	**HE Year 1**	**HE Year 2**	**HE Year 3**
Class of 2017	100%	-	-
Class of 2016	100%	80.0%	-
Class of 2015	100%	81.6%	65.1%
Class of 2014	100%	84.6%	70.7%
Multi-annual Average Retention Rate	100%	83.1%	68.8%
IoTs Average Retention Rate 2013 & 2014 PLC Grads	100%	80.9%	64.3%
Universities Average Retention Rate 2013 & 2014 PLC Grads	100%	89.5%	78.5%
Source: Transitions Reform Sub-Group – confidential data from working paper			

Whilst the previous analysis investigates the pathway from FET to HE, there is also a cohort of FET students who we previously enrolled in higher education. The following table shows that just under 10% of PLC enrolments between 2012 and 2015 were previously enrolled in higher education. This suggests a degree of reskilling and continual learning amongst those who had previously enrolled in higher education.

Table 3.9: PLC Students with Previous HE Experience		
Year of PLC Enrolment	**Previously Enrolled in HE**	**% of all PLC Enrolments**
2012	2,078	8.1%
2013	2,095	8.3%
2014	1,989	8.0%
2015	2,450	9.9%
Source: Transitions Reform Sub-Group – confidential data from working paper		

Table 3.10 shows that just over half of those who completed remained in education with 18% of completers moving into higher education and 34% continuing with another FET course. Over two-fifths (41%) of completers were in sustainable employment, for at least 12 fulltime weeks' work, after the data of course completion.

Table 3.10: High Level Outcomes from 2017 PLC Completer Cohort		
	Number of Completers	**Percentage of Completers**
Higher Education	5,132	18%
Other FET Courses	9,676	34%
Sustainable Employment	16,322	58%
Sustainable Employment (post course)	11,591	41%
Source: Transitions Reform Sub-Group – confidential data from working paper		

3.5 Summary of Key Findings

Our analysis of HE and FET participation indicates that:

- Ireland has supported very high levels of participation in higher education and there has been a dramatic growth in enrolments in HE over the decade to 2019.
- Largest number of qualifications are in honours degrees but there has been a significant increase in postgraduate qualifications.
- Largest fields of study by numbers for HE graduates is business, administration and law; followed by health and welfare; and arts and humanities.
- Within the FET sector, the largest field of study is generic programmes and qualifications. Generic qualifications may subsequently provide a foundation for more specific employment-related training and can support life-long training programmes.
- Largest number of FET qualifications are in Level 5 certificates and very few graduates in honours bachelor's degrees/higher diplomas.
- Apprenticeship registrations have grown significantly but remain small at 5,648 in 2018.
- Numbers of applicants to HE from FET has grown significantly but remains relatively low. 40% of apprenticeship registrations were in electrical, while 1,486 were in construction.

4 Labour Demand for Graduates by Sector

4.1 Educational Attainment in Irish Labour Force

Participation rates in higher education in Ireland are very high in the EU and this is reflected in the levels of educational attainment in the Irish labour force. The figures presented in Table 4.1 also show that there has been steady growth in the percentage of the labour force with primary degrees or higher.

Table 4.1: Education Level of Those in Labour Force in Q4 of Year (2014-2019)

	2014	2015	2016	2017	2018	2019
Primary or below	3.1%	3.2%	2.7%	2.6%	2.4%	2.8%
Lower secondary	11.0%	10.3%	10.3%	9.5%	9.1%	8.7%
Higher secondary	24.2%	23.9%	23.5%	23.8%	23.1%	23.5%
Post-secondary non-tertiary	13.6%	13.0%	13.8%	14.3%	14.8%	14.6%
Third-level non-honours degree	11.9%	12.1%	11.8%	11.3%	11.3%	10.6%
Third-level honours degree or higher	32.9%	34.3%	34.6%	35.8%	36.7%	37.2%
Other/not stated	3.4%	3.3%	3.4%	2.7%	2.6%	2.7%
Total Number in Labour Force (000s)	**2,203**	**2,229**	**2,264**	**2,297**	**2,332**	**2,379**

Source: Analysis of CSO LFS data

There is a correlation between education and employment which is evident from the data on the labour market status by educational attainment. Approximately half of those had a bachelor's degree or higher. When including those who have attained a higher certificate/PLC and above, the cohort accounts for almost two-thirds of those in employment. A much higher percentage of those with low levels of education were unemployed.

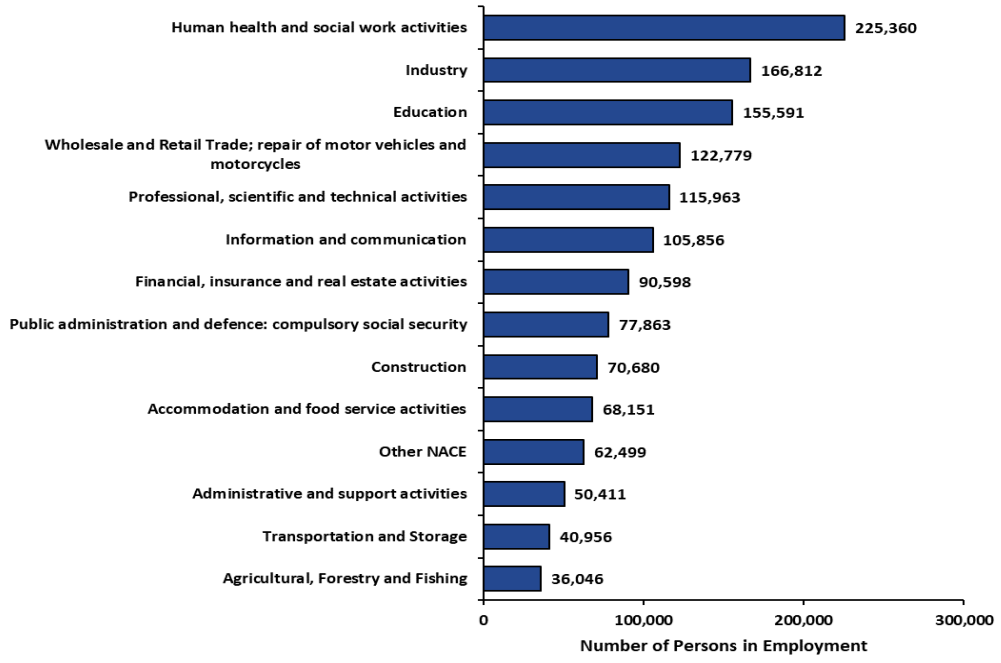
Table 4.2: Current Labour Market Status in Persons aged 15+ by Education Level - 2019 - Persons

Highest Education Level Attained	Employed	Unemployed	Student	Retired	Unable to work	On Home Duties	Other
Primary	71,653	16,600	70,061	186,530	54,241	60,321	2,774
Lower secondary	187,893	29,318	150,293	93,215	43,144	61,469	2,279
Upper secondary	478,672	43,339	149,853	105,589	35,681	81,483	4,724
Higher certificate/PLC	317,453	24,631	17,173	47,532	20,657	45,386	2,627
Ordinary Bachelor's degree	143,363	7,438	5,190	31,015	7,109	16,600	997
Honours Bachelor's degree	636,693	26,675	24,454	85,103	14,922	48,049	4,102
Postgraduate diploma/degree or Doctorate (Ph.D.)	298,342	10,012	6,420	25,483	3,515	13,974	1,967
Total	**2,134,069**	**158,013**	**423,443**	**574,467**	**179,268**	**327,282**	**19,470**

Source: Analysis of CSO, Labour Force Survey data

A sectoral analysis of those with a higher certificate or above is presented in Figure 4.1 overleaf. This shows that health and social work was the single largest sector of those with a higher certificate or above, followed by industry and education.

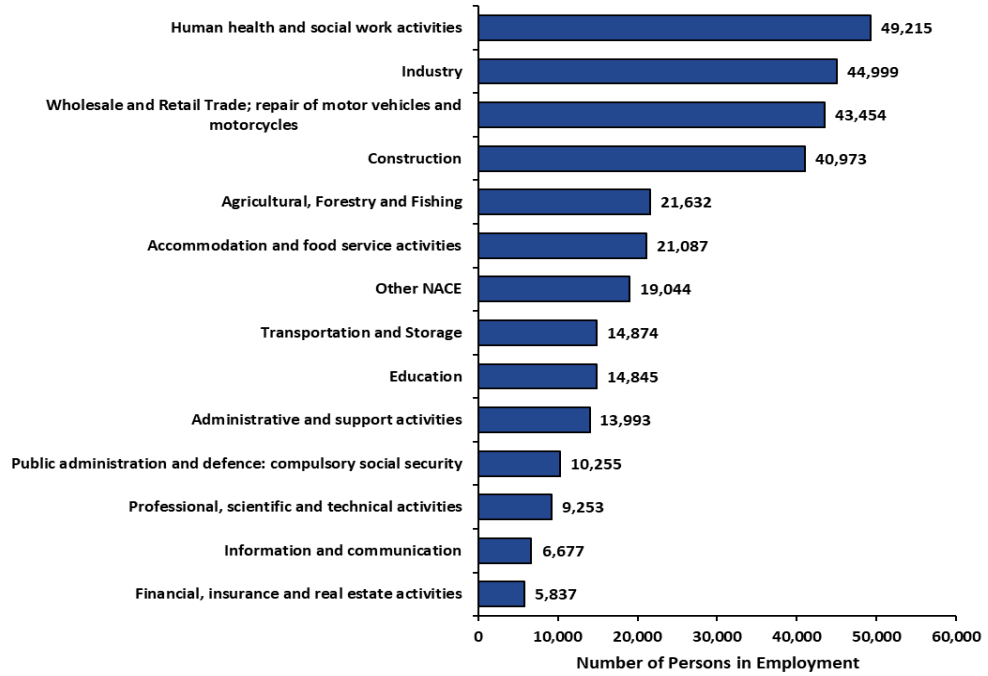
Figure 4.2: Persons with Higher Certificate or Above in Employment by Sector (2019)



Source: Analysis of LFS data

When restricting the cohort to those with a higher certificate/PLC, health and social work remains the largest sector for those in employment, with industry the second largest. Education however is a much smaller sector of employment for those with a higher certificate/PLC. Wholesale and retail trade and construction are the third- and fourth-largest employers of those with a higher certification/PLC.

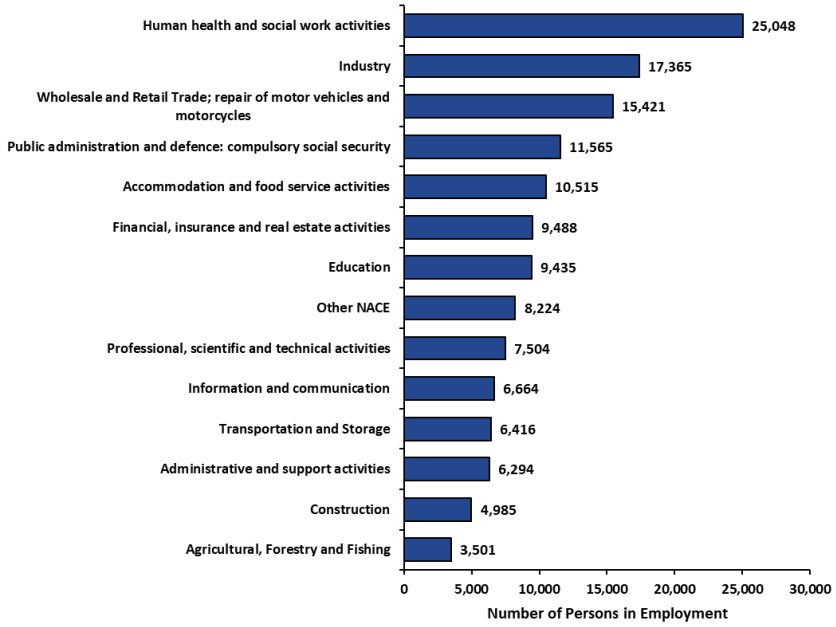
Figure 4.3: Persons with Higher Certificate/PLC in Employment by Sector (2019)



Source: Analysis of LFS data

Amongst those with ordinary bachelor's degrees, health and social work remains the largest sector of employment, with almost 8,000 more employees in 2019 than the next largest sector, industry. It is noticeable that construction is amongst the smallest of the sectors, compared to the cohort with higher certificates/PLC which had a significant proportion in construction.

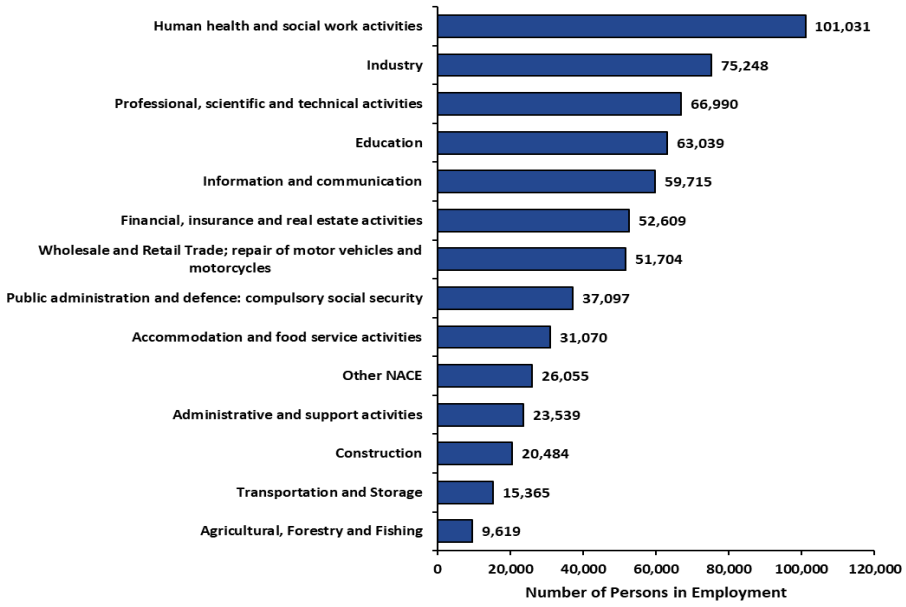
Figure 4.4: Persons with Ordinary Bachelor's Degree in Employment by Sector (2019)



Source: Analysis of LFS data

Health and social work activities is the largest single sector amongst those with an honours bachelor's degree, employing over 100,000 in 2019. Industry was the second-largest sector of employment for those with ordinary degrees followed by professional, scientific and technical activities.

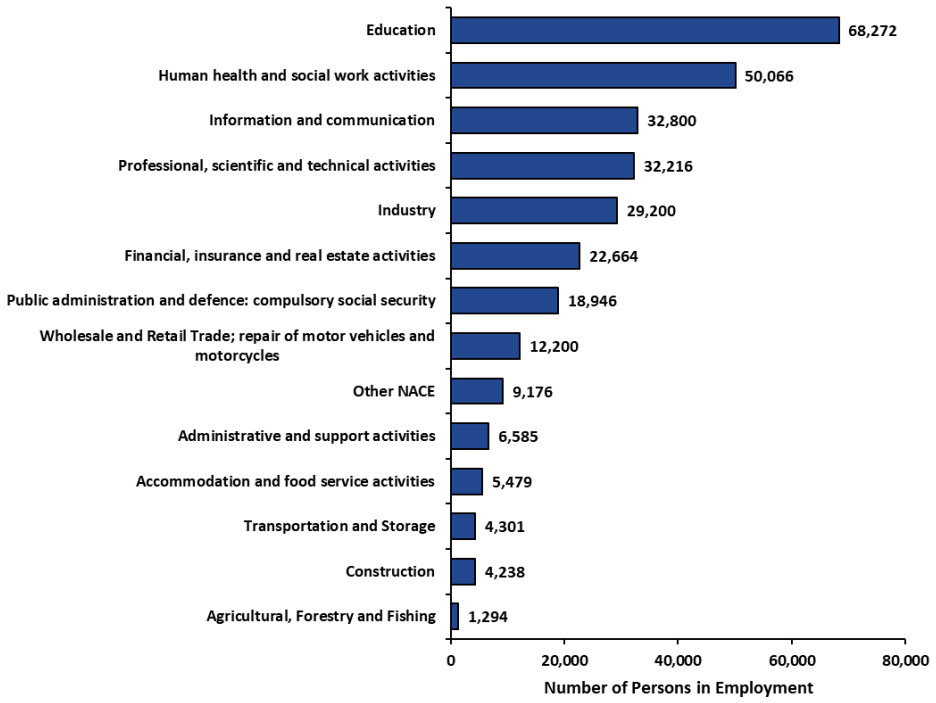
Figure 4.5: Persons with Honours Bachelor's Degree in Employment by Sector (2019)



Source: Analysis of LFS data

Amongst those with a postgraduate degree/diploma or above, education is the single largest sector of employment, followed by health and social work. Information and communications, and professional scientific and technical activities, and industry are also major employers of those with postgraduate degrees.

Figure 4.6: Persons with postgraduate Degree/Diploma or Above in Employment by Sector (2019)



Source: Analysis of LFS data

4.2 Sector Employment Breakdown by Education Level

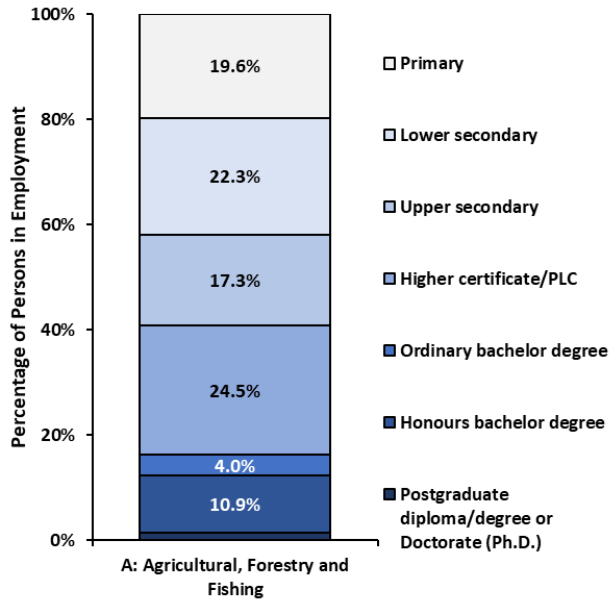
To further inform the analysis it is useful to examine sectoral employment by education level for each of the NACE Rev 2 classifications. NACE provides the framework for collecting and presenting a large range of statistical data according to economic activity.[137] As an evaluation of this, it is useful to consider two very different sectors which are major employers in the Irish economy, namely the wholesale and retail trade and information and communications.

Just under 60% of those employed in agriculture, forestry and fishing have upper secondary degrees or lower as their highest level of education attained. However, the single largest individual cohort is those is higher certificates/PLC, who account for almost one quarter of employment in the sector, higher than the percentage of sector accounted for by those with a higher education qualification (approximately 16%).

[137] Eurostat methodologies and working papers- NACE Rev.2 Statistical Classification of economic activities in the European Community. https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF

Figure 4.7: Education Breakdown of Persons in Employment in Agriculture, Forestry and Fishing Sector (2019)

Level of Education	Number of Persons
Primary	17,350
Lower secondary	19,667
Upper secondary	15,238
Higher certificate/PLC	21,632
Ordinary Bachelor's degree	3,501
Honours Bachelor's degree	9,619
Postgraduate diploma/degree or Doctorate (Ph.D.)	1,294
Total	**88,301**

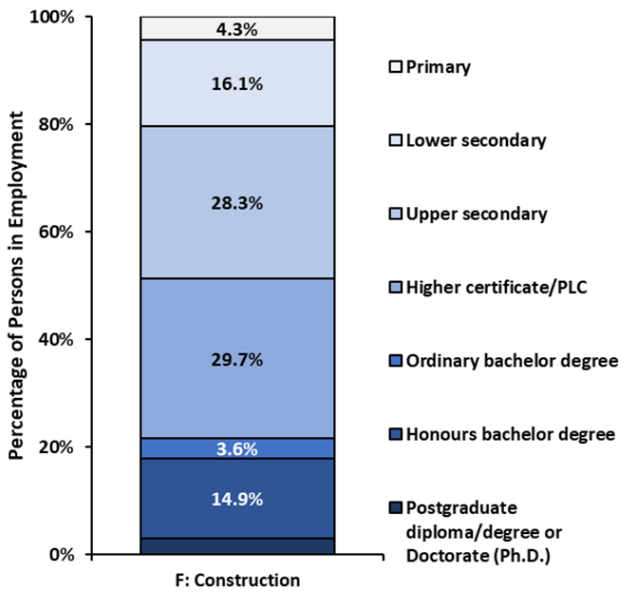


Source: Analysis of CSO LFS data

The following figure shows that the majority (58%) of those in the construction industry have either an upper secondary education or a higher certificate/PLC as their highest level of education attainment. Just over 20% of the employees in construction have attained some form of higher education.

Figure 4.8: Education Breakdown of Persons in Employment in Construction (2019)

Level of Education	Number of Persons
Primary	5,933
Lower secondary	22,133
Upper secondary	39,017
Higher certificate/PLC	40,973
Ordinary Bachelor's degree	4,985
Honours Bachelor's degree	20,484
Postgraduate diploma/degree or Doctorate (Ph.D.)	4,238
Total	**137,763**

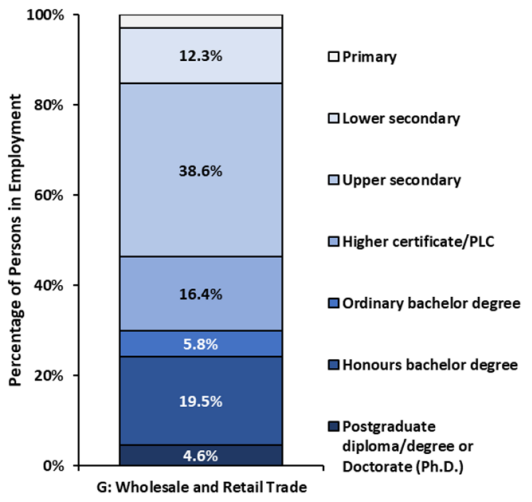


Source: Analysis of CSO LFS data

The wholesale and retail trade sector is composed primarily of those with a Higher Certificate/PLC or lower, with those with upper secondary as their highest level of education the largest cohort. However, a significant minority (almost one-third) of employees in the sector have and ordinary bachelor's degree or above.

Figure 4.9: Education Breakdown of Persons in Employment in Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles (2019)

Level of Education	Number of Persons
Primary	7,686
Lower secondary	32,548
Upper secondary	102,275
Higher certificate/PLC	43,454
Ordinary Bachelor's degree	15,421
Honours Bachelor's degree	51,704
Postgraduate diploma/degree or Doctorate (Ph.D.)	12,200
Total	**265,288**

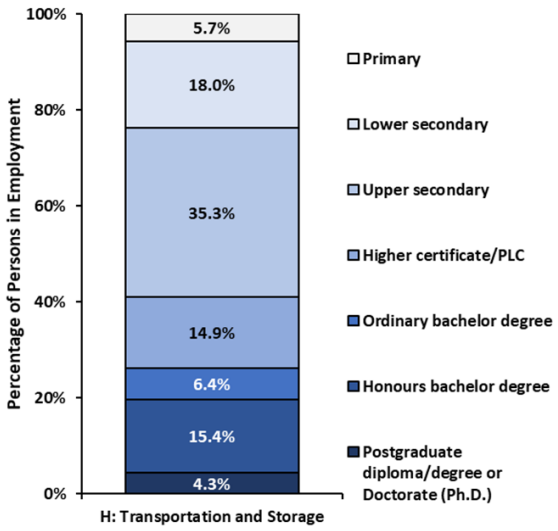


Source: Analysis of CSO LFS data

The education level breakdown of the transportation and storage sector is not too dissimilar from that of the wholesale and retail trade sector, with the majority having an upper secondary level or below. Just under 15% have a higher certificate/PLC, whilst just over one quarter have achieved some level of higher education.

Figure 4.10: Education Breakdown of Persons in Employment in Transportation and Storage (2019)

Level of Education	Number of Persons
Primary	5,705
Lower secondary	18,047
Upper secondary	35,279
Higher certificate/PLC	14,874
Ordinary Bachelor's degree	6,416
Honours Bachelor's degree	15,365
Postgraduate diploma/degree or Doctorate (Ph.D.)	4,301
Total	**99,988**

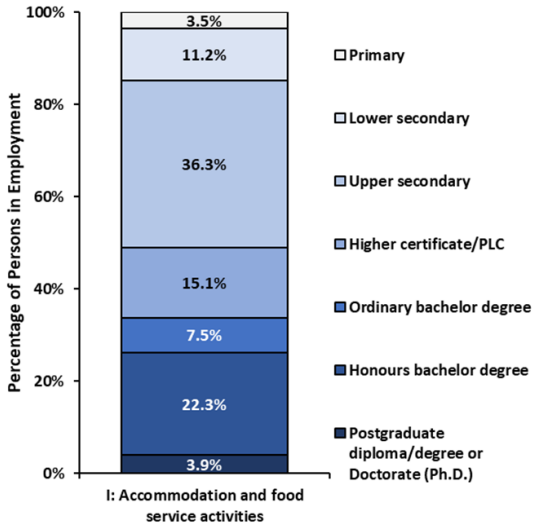


Source: Analysis of CSO LFS data

Accommodation and food service activities had almost 140,000 employees in 2019, when average over the four quarters of the year. Approximately half of these had an upper secondary level or below as their highest level of educational attainment. Thus, half of the employees of the sector had some form of FET or HE qualification.

Figure 4.11: Education Breakdown of Persons in Employment in Accommodation and Food Service Activities (2019)

Level of Education	Number of Persons
Primary	4,943
Lower secondary	15,624
Upper secondary	50,623
Higher certificate/PLC	21,087
Ordinary Bachelor's degree	10,515
Honours Bachelor's degree	31,070
Postgraduate diploma/degree or Doctorate (Ph.D.)	5,479
Total	**139,341**

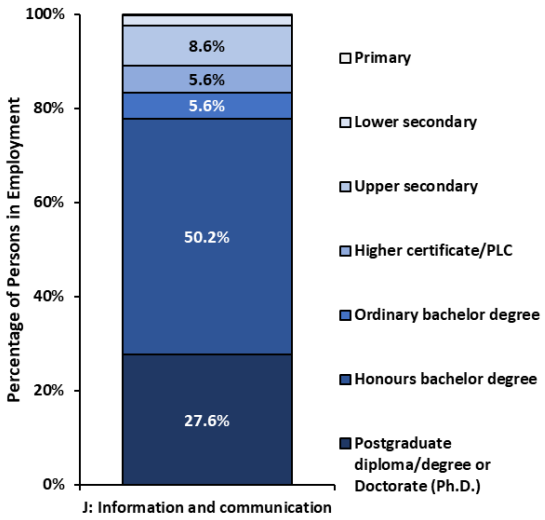


Source: Analysis of CSO LFS data

The information and communication sector contrasts with the wholesale and retail sector, mostly comprised of individuals who have some form of higher education. Over 50% of employees in the sector in 2019 had attained an honours bachelor's degree with a further 27.6% achieving some form of postgraduate qualification. Thus, approximately 83% of the employees in the sector had attained a higher education qualification.

Figure 4.12: Education Breakdown of Persons in Employment in Information and Communication (2019)

Level of Education	Number of Persons
Primary	391
Lower secondary	2,439
Upper secondary	10,244
Higher certificate/PLC	6,677
Ordinary Bachelor's degree	6,664
Honours Bachelor's degree	59,715
Postgraduate diploma/degree or Doctorate (Ph.D.)	32,800
Total	**118,929**

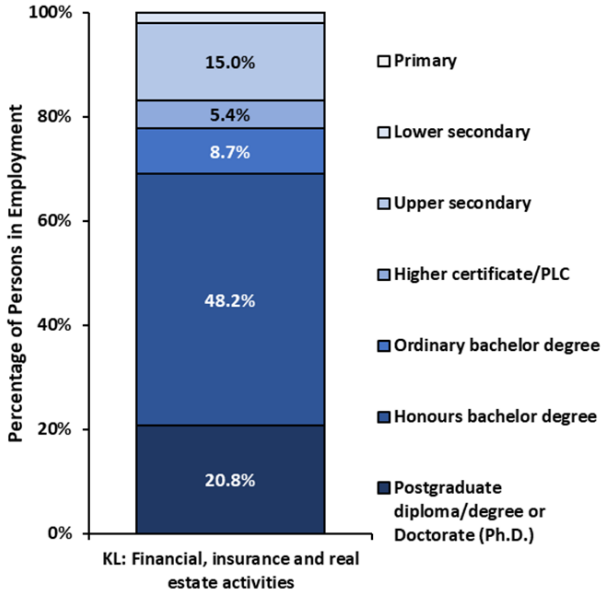


Source: Analysis of CSO LFS data

The financial, insurance and real estate activities sector had a similar composition as the information and communication sector in 2019, with the majority (almost 80%) of the employees in the sector having some form of higher education qualification.

Figure 4.13: Education Breakdown of Persons in Employment in Financial, Insurance and Real Estate Activities (2019)

Level of Education	Number of Persons
Primary	125
Lower secondary	2,026
Upper secondary	16,315
Higher certificate/PLC	5,837
Ordinary Bachelor's degree	9,488
Honours Bachelor's degree	52,609
Postgraduate diploma/degree or Doctorate (Ph.D.)	22,664
Total	**109,063**

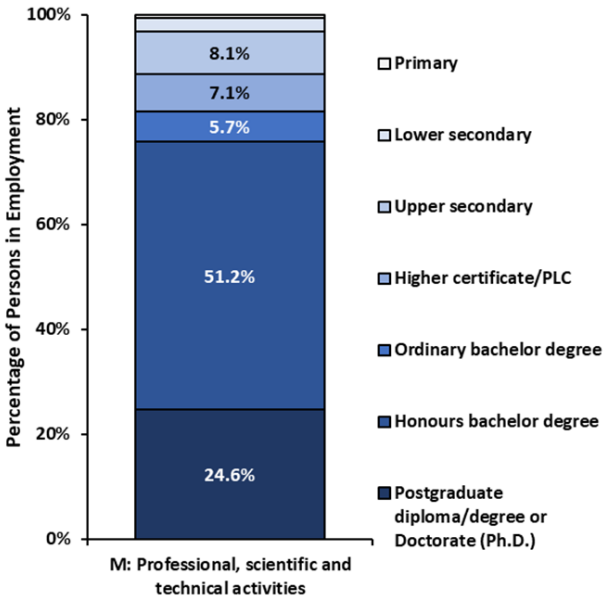


Source: Analysis of CSO LFS data

Many graduates are also employed in professional, scientific and technical activities with over 80% of the employees holding a degree.

Figure 4.14: Education Breakdown of Persons in Employment in Professional, Scientific and Techinical Activites (2019)

Level of Education	Number of Persons
Primary	743
Lower secondary	3,505
Upper secondary	10,542
Higher certificate/PLC	9,253
Ordinary Bachelor's degree	7,504
Honours Bachelor's degree	66,990
Postgraduate diploma/degree or Doctorate (Ph.D.)	32,216
Total	**130,753**

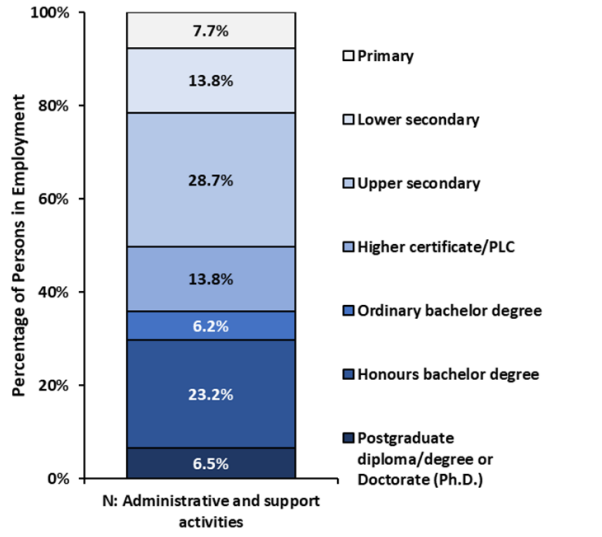


Source: Analysis of CSO LFS data

The administrative and support activities sector has a relatively more even spread of education levels when compared to the previous sectors. Approximately one third of the employees have a higher education qualification, whilst those with upper secondary or a higher certificate/PLC account for just over 40% of the sector.

Figure 4.15: Education Breakdown of Persons in Employment in Administrative and Support Activities (2019)

Level of Education	Number of Persons
Primary	7,756
Lower secondary	13,997
Upper secondary	29,100
Higher certificate/PLC	13,993
Ordinary Bachelor's degree	6,294
Honours Bachelor's degree	23,539
Postgraduate diploma/degree or Doctorate (Ph.D.)	6,585
Total	**101,265**

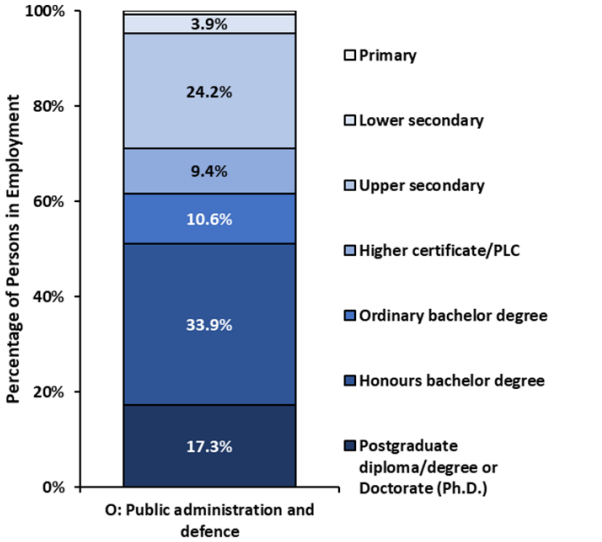


Source: Analysis of CSO LFS data

Of the 109,545 employees in the public administration and defence sector, over half of them have an honours bachelor's degree or higher. A further 10.6% have an ordinary bachelor's degree, indicating that the sector is comprised of mostly those with a higher education qualification.

Figure 4.16: Education Breakdown of Persons in Employment in Public Administration and Defence; Compulsory Social Security (2019)

Level of Education	Number of Persons
Primary	804
Lower secondary	4,318
Upper secondary	26,560
Higher certificate/PLC	10,255
Ordinary Bachelor's degree	11,565
Honours Bachelor's degree	37,097
Postgraduate diploma/degree or Doctorate (Ph.D.)	18,946
Total	**109,545**

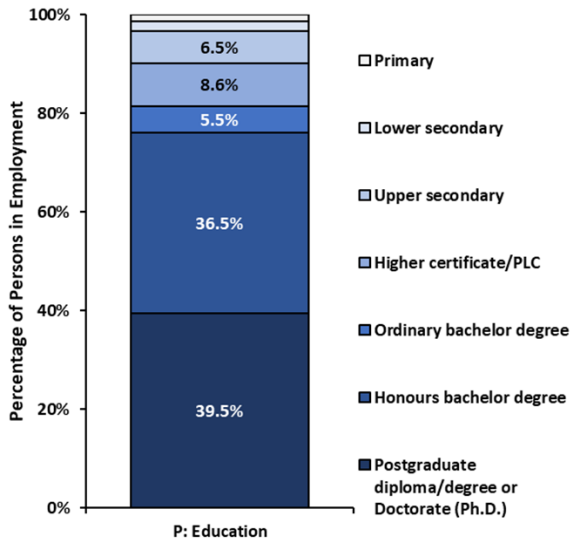


Source: Analysis of CSO LFS data

Education is the only sector in which the percentage of those with a postgraduate degree/diploma or higher outnumber any other individual sector, with the cohort accounting for almost 40% of the total employment in the sector. Overall, those with a higher education qualification make up over 80% of the sector, with 8.6% having a higher certificate/PLC.

Figure 4.17: Education Breakdown of Persons in Employment in Education (2019)

Level of Education	Number of Persons
Primary	2,307
Lower secondary	3,588
Upper secondary	11,185
Higher certificate/PLC	14,845
Ordinary Bachelor's degree	9,435
Honours Bachelor's degree	63,039
Postgraduate diploma/degree or Doctorate (Ph.D.)	68,272
Total	**172,671**

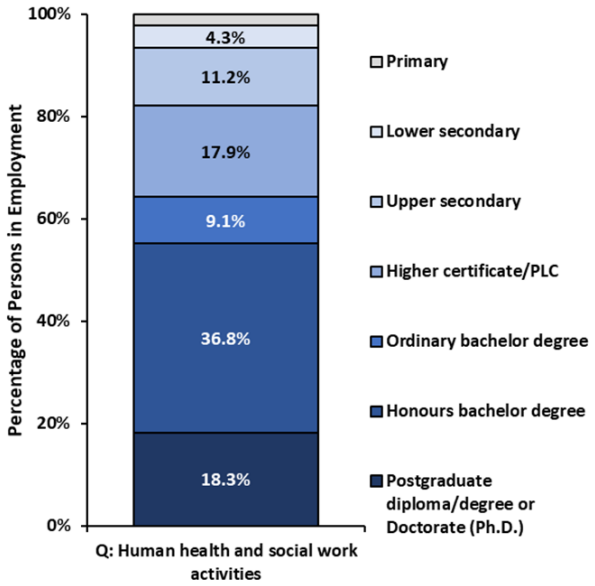


Source: Analysis of CSO LFS data

The health and social work activities is the single largest sector of employment, and whilst the majority of employees have a higher education qualification of some sort, there are almost 50,000 employees in the sector with a higher certificate/PLC as their highest level of qualification achieved.

Figure 4.18: Education Breakdown of Persons in Employment in Human Health and Social Work Activities (2019)

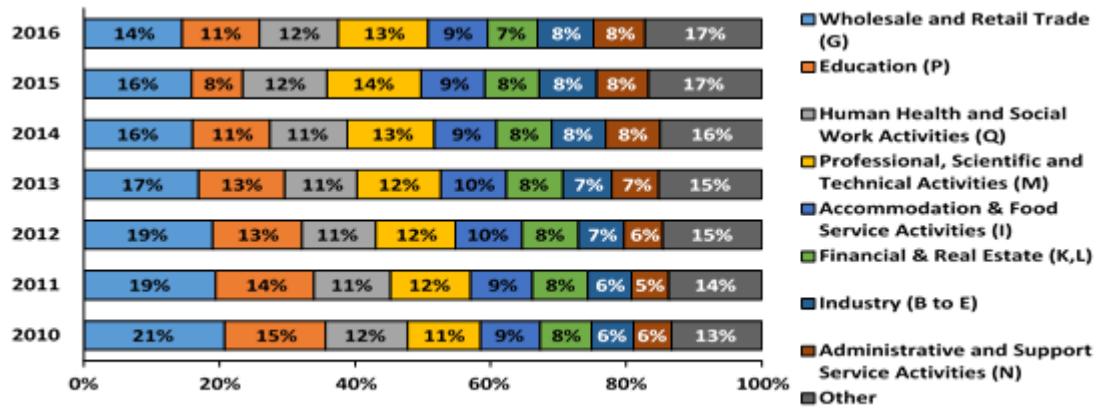
Level of Education	Number of Persons
Primary	6,384
Lower secondary	11,826
Upper secondary	30,681
Higher certificate/PLC	49,215
Ordinary Bachelor's degree	25,048
Honours Bachelor's degree	101,031
Postgraduate diploma/degree or Doctorate (Ph.D.)	50,066
Total	**274,250**



Source: Analysis of CSO LFS data

An analysis of economic sectors entered by graduates one year after education shows that a wide range of sectors in the Irish economy employ graduates. However, the percentage of employees in each of the sectors who are graduates varies significantly.

Figure 4.19: Economic Sectors Entered by Graduates 1 Year since Graduation



Source: CSO
Note: Other – Agriculture, Forestry and Fishing (A), Construction (F), Transportation and Storage (H), Information and Communication (J), Public Administration and Defence (O), Other NACE Activities (R-U), Unknown

4.3 Employment by Sector and Field of Study

European-wide economic activities are organized under NACE Rev.2 classifications. NACE provides the framework for collecting and presenting a large range of statistical data according to economic activity.[138] Table 4.3 lists NACE Rev 2 sectors according to their classifications A-U.

Table 4.3: NACE Rev. 2 Classifications

A-	Agriculture, forestry and fishing
B-E	Industry
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food storage activities
J	Information and communication
K-L	Financial, insurance and real estate activities
M	Professional, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R-U	Other NACE activities

Source: CSO

[138] Eurostat methodologies and working papers- NACE Rev.2 Statistical Classification of economic activities in the European Community. https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF

The following table contains data on the number of employed persons (aged between 15 and 64) with high qualifications by their field of study and sector of work. Social sciences/business was the largest field of study amongst those with high levels of qualification. The largest sectors of employment for those with high levels of qualifications, are health and social work and education.

Table 4.4: Total Employed Persons (aged 15-64) with High Qualification by Educational Field and Industry, 2019

	A	BCDE	F	G	H	I	J	KL	M	N	0	P	Q	RSTU	Total
General Programmes	65	2,134	426	2,011	566	1,206	2,182	1,519	2,040	661	1,879	1,037	1,781	1,728	**19,234**
Education	382	2,209	297	2,775	166	2,176	974	951	1,310	1,103	1,255	72,898	5,558	2,069	**94,124**
Arts and Humanities	318	3,987	912	7,577	1,566	5,345	8,150	4,980	6,294	3,300	5,942	14,463	6,237	9,099	**78,169**
Social Sciences/Business	2,566	32,999	5,664	28,179	9,635	13,911	27,947	53,133	45,902	14,987	26,271	14,185	20,015	8,954	**304,347**
Natural Sciences and Math	1,029	17,003	760	4,163	809	1,781	5,070	3,114	7,791	1,230	4,441	8,538	4,732	1,202	**61,663**
ICT	160	7,984	842	5,509	1,768	1,494	36,555	8,342	3,409	2,653	3,360	4,386	1,653	1,639	**79,754**
Engineering	1,082	30,814	15,396	7,489	4,237	2,243	7,766	3,103	20,816	3,566	4,450	3,057	1,783	1,734	**107,535**
Agriculture	5,986	3,534	510	1,695	926	780	290	412	2,417	1,156	1,829	445	738	1,349	**22,066**
Health/Welfare	830	6,333	804	7,151	1,249	3,353	1,764	1,434	3,150	1,962	6,355	7,950	113,037	4,919	**160,291**
Services	356	4,593	1,116	4,949	2,467	10,454	1,425	1,539	1,625	2,554	5,366	1,961	3,553	4,839	**46,796**
Unknown	92	765	110	703	258	468	686	524	418	349	568	358	337	228	**5,865**
Total	**12,865**	**112,354**	**26,838**	**72,201**	**23,645**	**43,210**	**92,809**	**79,052**	**95,171**	**33,520**	**61,717**	**129,278**	**159,425**	**37,760**	**979,845**

Source: Analysis of Labour Force Survey data

The following table shows that in some sectors there was a high level of concentration of persons from individual fields of study. Over 70% of employees in health and social with high qualifications studied health or welfare, whilst 67% of those employed in financial, real estate or insurance activities studied the social sciences or business.

Table 4.5: % Employed Persons (aged 15-64) with High Qualification by Field of Study in Top 6 Economic Sectors, 2019

	P	Q	BCDE	M	J	KL
Agriculture	0%	0%	3%	3%	0%	1%
Arts and Humanities	11%	4%	4%	7%	9%	6%
Education	56%	3%	2%	1%	1%	1%
Engineering	2%	1%	27%	22%	8%	4%
General Programme	1%	1%	2%	2%	2%	2%
Health/Welfare	6%	71%	6%	3%	2%	2%
ICT	3%	1%	7%	4%	39%	11%
Natural Sciences and Math	7%	3%	15%	8%	5%	4%
Services	2%	2%	4%	2%	2%	2%
Social Sciences/Business	11%	13%	29%	48%	30%	67%
Unknown	0%	0%	1%	0%	1%	1%

Source: Analysis of Labour Force Survey data

Of the 714,437 persons in employment with medium qualifications in 2019, the majority of these studied general programmes. Engineering was the second largest field of study for this cohort. The largest individual sectors were wholesale and retail trade (G) and industry (BCDE).

Table 4.6: Total Employed Persons (aged 15-64) with Medium Qualification by Educational Field and Industry, 2019

	A	BCDE	F	G	H	I	J	KL	M	N	0	P	Q	RSTU	Total
General Programmes	11,960	67,076	37,114	96,717	33,708	48,979	9,886	15,327	9,751	28,168	24,212	10,174	28,747	25,690	**447,510**
Education	120	931	439	1,391	669	1,434	82	114	196	556	509	5,121	3,360	616	**15,538**
Arts and Humanities	104	455	310	1,006	298	1,104	441	347	223	299	216	361	299	833	**6,296**
Social Sciences/Business	634	5,293	1,728	7,429	1,855	2,953	1,380	2,679	3,133	2,163	3,302	2,277	5,297	1,509	**41,632**
Natural Sciences and Math	143	441	*	383	47	262	*	61	89	37	32	61	203	*	**1,786**
ICT	204	1,496	961	1,802	620	539	1,892	540	432	843	888	271	306	279	**11,073**
Engineering	1,561	21,324	25,034	8,011	4,351	1,297	765	247	2,156	2,798	1,068	269	941	1,074	**70,896**
Agriculture	13,636	1,968	1,337	1,369	848	245	*	100	283	1,051	578	115	135	744	**22,410**
Health/Welfare	88	1,770	361	4,719	531	2,795	196	328	90	469	1,385	3,061	28,110	3,065	**46,968**
Services	1,084	5,184	5,888	8,581	2,012	6,259	702	520	735	2,735	817	1,506	4,551	7,754	**48,330**
Unknown	42	331	206	382	173	149	33	37	217	60	127	*	153	*	**1,908**
Total	**29,577**	**106,269**	**73,378**	**131,790**	**45,111**	**66,015**	**15,377**	**20,299**	**17,304**	**39,181**	**33,135**	**23,217**	**72,102**	**41,591**	**714,347**

Source: Analysis of Labour Force Survey data
Note: As per CSO guidelines values of less than 30 have been replaced by * as these are likely to be unreliable. Values of less than 50 should be treated with caution as there may be a wide margin of error

Across the six largest sectors of employment for those with medium qualifications there more were students from general programmes than any other field of study. In the human health and welfare activities sector 39% studied in the field of health/welfare, just below the 40% who studied a general programme.

Table 4.7: % Employed Persons (aged 15-64) with Medium Qualification by Field of Study in Top 6 Economic Sectors, 2019

	G	BCDE	F	Q	I	H
Agriculture	1%	2%	2%	0%	0%	2%
Arts and Humanities	1%	0%	0%	0%	2%	1%
Education	1%	1%	1%	5%	2%	1%
Engineering	6%	20%	34%	1%	2%	10%
General Programme	73%	63%	51%	40%	74%	75%
Health/Welfare	4%	2%	0%	39%	4%	1%
ICT	1%	1%	1%	0%	1%	1%
Natural Sciences and Math	0%	0%	0%	0%	0%	0%
Services	7%	5%	8%	6%	9%	4%
Social Sciences/Business	6%	5%	2%	7%	4%	4%
Unknown	0%	0%	0%	0%	0%	0%

Source: Analysis of Labour Force Survey data

When examining those with ISCED3 (Upper Secondary) as their highest level of study it is clear that the two largest sectors of employment are wholesale and retail trade (G) and industry (BCDE), as shown in the following table.

Table 4.8: Total Employed Persons (aged 15-64) with Upper Secondary (ISCED3) by Field of Study in Top 6 Sectors, 2019						
	G	BCDE	I	F	H	Q
General Programme	92,569	65,109	46,818	36,055	31,765	27,739
Source: Analysis of Labour Force Survey data						

The following table shows that for those with higher certificates (ISCED Level 4) working in agriculture, 75% studied agriculture for their qualification. The majority of those in human wealth and social work activities studied health/welfare.

Table 4.9: % Employed Persons (aged 15-64) with Higher Certificate (ISCED4) by Field of Study in Top 6 Sectors, 2019						
	Q	BCDE	G	F	I	A
Agriculture	0%	5%	3%	4%	1%	75%
Arts and Humanities	1%	1%	3%	1%	6%	1%
Education	8%	2%	4%	1%	7%	1%
Engineering	2%	52%	20%	67%	7%	9%
General Programme	2%	5%	11%	3%	11%	3%
Health/Welfare	63%	4%	12%	1%	15%	0%
ICT	1%	4%	5%	3%	3%	1%
Natural Sciences and Math	0%	1%	1%	0%	1%	1%
Services	10%	13%	22%	16%	33%	6%
Social Sciences/Business	12%	13%	19%	5%	15%	3%
Unknown	0%	1%	1%	1%	1%	0%
Total Employed Persons	**44,364**	**41,160**	**39,221**	**37,323**	**19,197**	**18,171**
Source: Analysis of Labour Force Survey data						

Amongst those with ordinary bachelor's degrees in the largest sectors of employment there is a high degree of alignment between sector of employment and field of study. Almost two-thirds of those employed in human health and social work activities had health or welfare as their field of study. Social Sciences and Business were the most common fields of study amongst those in employment in financial, insurance and real estate activities, and wholesale and retail trade amongst other sectors.

Table 4.10: % Employed Persons (aged 15-64) with Ordinary Bachelor's Degree (ISCED5) by Field of Study in Top 6 Sectors, 2019						
	Q	BCDE	G	O	I	KL
Agriculture	2%	5%	4%	4%	1%	2%
Arts and Humanities	4%	2%	7%	1%	3%	0%
Education	4%	2%	2%	2%	1%	0%
Engineering	2%	34%	12%	4%	4%	5%
General Programme	1%	4%	3%	5%	4%	3%
Health/Welfare	63%	9%	11%	12%	5%	2%
ICT	1%	8%	8%	4%	4%	9%
Natural Sciences and Math	1%	3%	4%	4%	2%	0%
Services	7%	11%	15%	18%	44%	3%
Social Sciences/Business	15%	23%	32%	47%	31%	74%
Unknown	0%	0%	1%	1%	1%	0%
Total Employed Persons	**22,292**	**15,451**	**13,658**	**10,569**	**9,728**	**8,732**
Source: Analysis of Labour Force Survey data						

The degree of alignment between human health and social work activities and the health and welfare field of study is higher for those with an honours bachelor's degree. Over 70% of those in employment in the sector had an ISCED Level 6 qualification in health/welfare.

Table 4.11: % Employed Persons (aged 15-64) with Honours Bachelor's Degree (ISCED6) by Field of Study in Top 6 Sectors, 2019

	Q	BCDE	M	P	J	KL
Agriculture	0%	4%	3%	0%	0%	0%
Arts and Humanities	4%	4%	8%	11%	9%	8%
Education	4%	2%	2%	63%	1%	1%
Engineering	1%	30%	23%	2%	8%	5%
General Programme	1%	2%	3%	1%	2%	2%
Health/Welfare	72%	5%	3%	4%	3%	2%
ICT	1%	7%	3%	2%	43%	9%
Natural Sciences and Math	3%	15%	6%	3%	4%	4%
Services	2%	4%	2%	2%	1%	3%
Social Sciences/Business	13%	27%	49%	12%	27%	65%
Unknown	0%	1%	1%	0%	1%	1%
Total Employed Persons	**91,333**	**69,349**	**59,958**	**58,499**	**56,612**	**49,038**

Source: Analysis of Labour Force Survey data

The following table shows the strong links between the largest sectors of employment for those with postgraduate Degrees and their field of study. Almost two thirds of those working in education studied education, and over 70% of those in human health and social work activities studied health or welfare.

Table 4.12: % Employed Persons (aged 15-64) with postgraduate Degree (ISCED7) by Field of Study in Top 6 Sectors, 2019

	P	Q	J	M	BCDE	KL
Agriculture	0%	0%	0%	2%	1%	0%
Arts and Humanities	11%	4%	9%	6%	3%	6%
Education	64%	4%	1%	1%	3%	2%
Engineering	3%	1%	8%	20%	18%	1%
General Programme	1%	1%	3%	0%	1%	1%
Health/Welfare	4%	71%	1%	3%	6%	1%
ICT	3%	1%	32%	4%	8%	14%
Natural Sciences and Math	4%	5%	7%	12%	18%	3%
Services	1%	1%	2%	1%	1%	0%
Social Sciences/Business	9%	12%	37%	51%	42%	71%
Unknown	0%	1%	0%	0%	0%	1%
Total Employed Persons	**48,644**	**40,150**	**28,572**	**26,614**	**25,259**	**20,512**

Source: Analysis of Labour Force Survey data

The two largest sectors of employment for those with PhDs were education and human health and social work activities. The vast majority of those in human health and social work activities studied health or welfare. Whilst there was a greater spread of fields of study for those in education the largest field of study was natural sciences and math, which was the largest field of study for three of the other four sectors included in the following table.

Table 4.13: % Employed Persons (aged 15-64) with PhD (ISCED8) by Field of Study in Top 6 Sectors, 2019						
	P	Q	BCDE	M	O	J
Agriculture	1%	0%	3%	12%	4%	0%
Arts and Humanities	15%	5%	0%	7%	15%	3%
Education	9%	0%	0%	0%	0%	0%
Engineering	5%	1%	16%	19%	3%	19%
General Programme	0%	1%	0%	0%	0%	0%
Health/Welfare	13%	83%	7%	0%	11%	2%
ICT	6%	0%	8%	4%	0%	38%
Natural Sciences and Math	36%	6%	66%	49%	51%	30%
Services	0%	0%	0%	1%	0%	0%
Social Sciences/Business	15%	4%	0%	8%	16%	9%
Unknown	0%	0%	0%	0%	0%	0%
Total Employed Persons	**13,470**	**5,650**	**2,295**	**2,191**	**2,168**	**1,793**
Source: Analysis of Labour Force Survey data						

4.4 Summary of Key Findings

Our analysis of labour demand for graduate by sector indicates that:

- There are marked differences in employment of graduates by sector. The most important sectors for employment of graduates are wholesale and retail trade; professional, scientific and technical activities; health and social work; education; and accommodation and food services.
- Graduates with degrees or higher certificates have lower levels of unemployment than other groups in labour market. Over 89,000 persons with education levels below higher certificate/PLC are unemployed. Individuals with lower than higher certificates/PLC accounted for 34% of those unemployed in the labour market.
- Our analysis suggests that in addition to the need to meet high skill requirements, there is an important role for FET in addressing under-education in certain groups in the labour force.

5 Sectoral Employment of HE Graduates by Field of Study

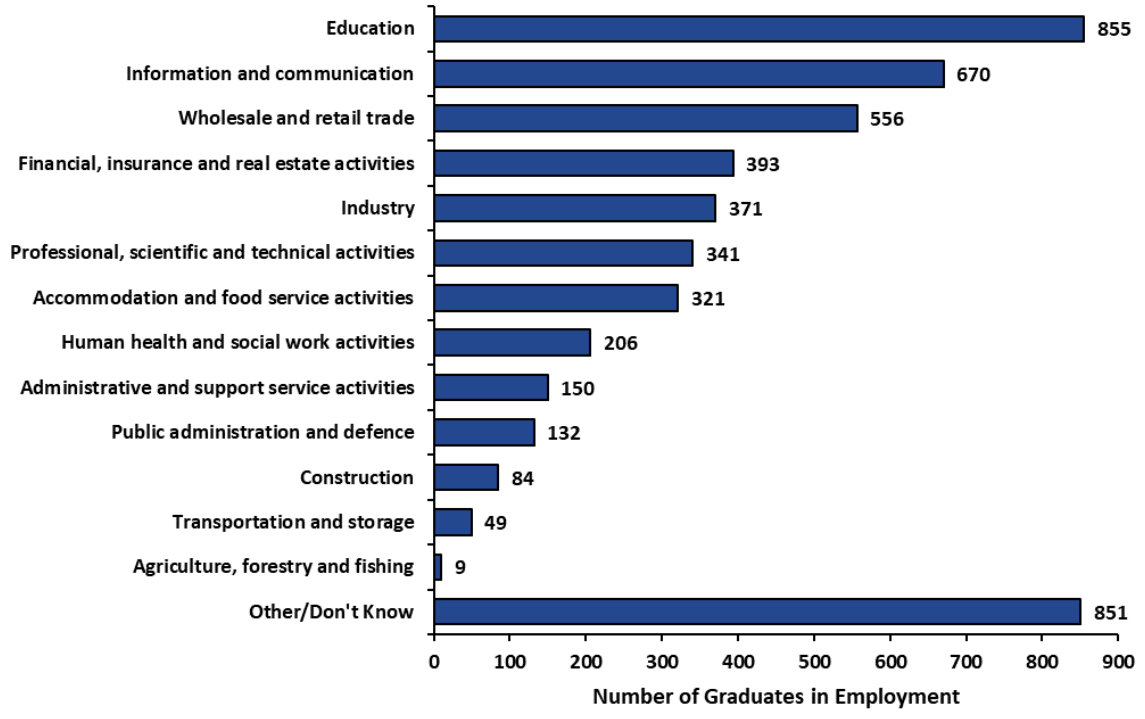
5.1 Introduction

A breakdown of the sectoral employment of higher education (HE) graduates by their fields of study allows an assessment of alignment of fields of study with sector of employment. To highlight the issues, it is useful to consider the examples of arts and humanities graduates, business administration and law graduates and ICT graduates.

5.2 Sectoral Breakdown by Field of Study

An analysis of employment for graduates who studied arts and humanities is presented in Figure 5.1. Whilst education was the largest destination of graduates who studied arts and humanities, there were a number of other sectors which accounted for significant employment, including information and communication, and wholesale and retail trade. This suggests that graduates from arts and humanities are in demand across a number of different sectors in the economy.

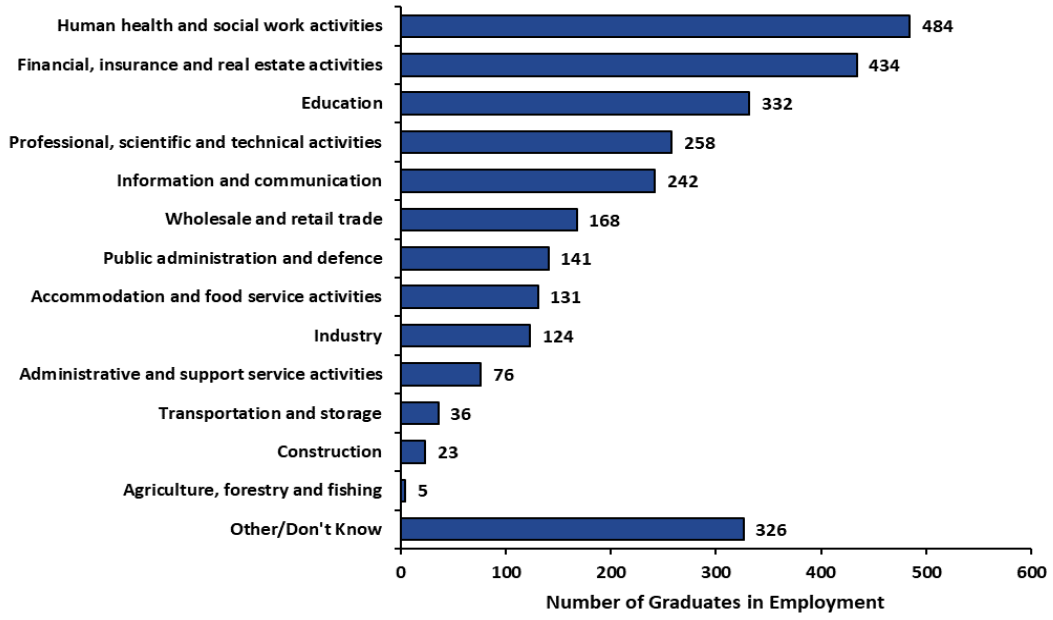
Figure 5.1: Arts and Humanities HE Graduates by Sector of Employment



Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

The following table shows that graduates from social science, journalism and information courses were employed across a range of sectors with human health and social work activities, and financial, insurance and real estate activities the two largest.

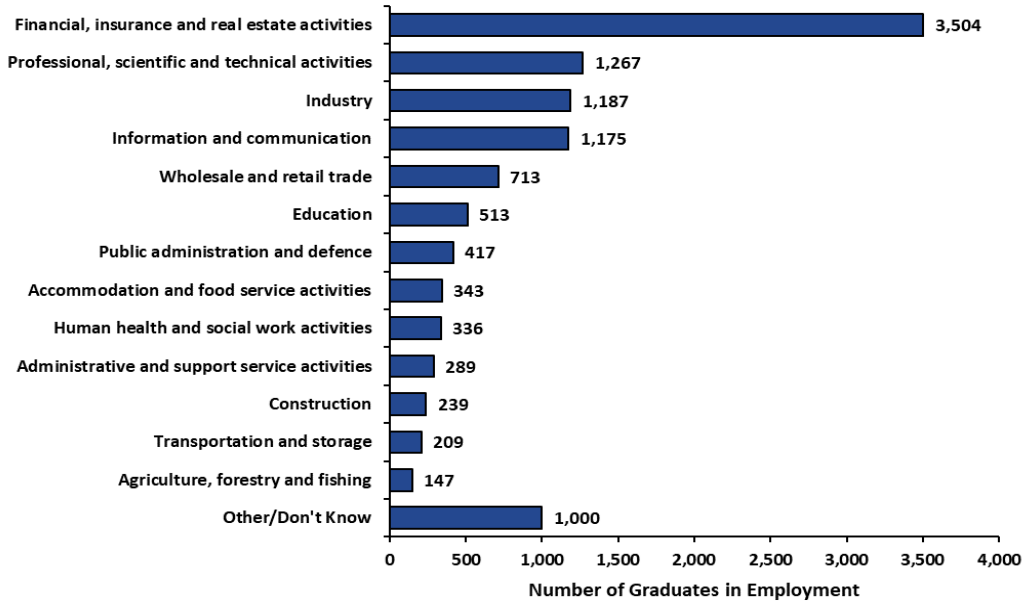
Figure 5.2: Social Science, Journalism and Information HE Graduates by Sector of Employment



Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

It is clear from the following figure that a large portion of graduates from HE business, administration and law courses obtained employment in the financial, insurance and real estate activities sector. However, over 1,000 graduates also obtained employment in each of the professional, scientific and technical activities, industry, and information and communication sectors. Whilst this suggests a degree of alignment between the field of study and these sectors, there are still significant numbers of graduates entering employment in other sectors in the economy.

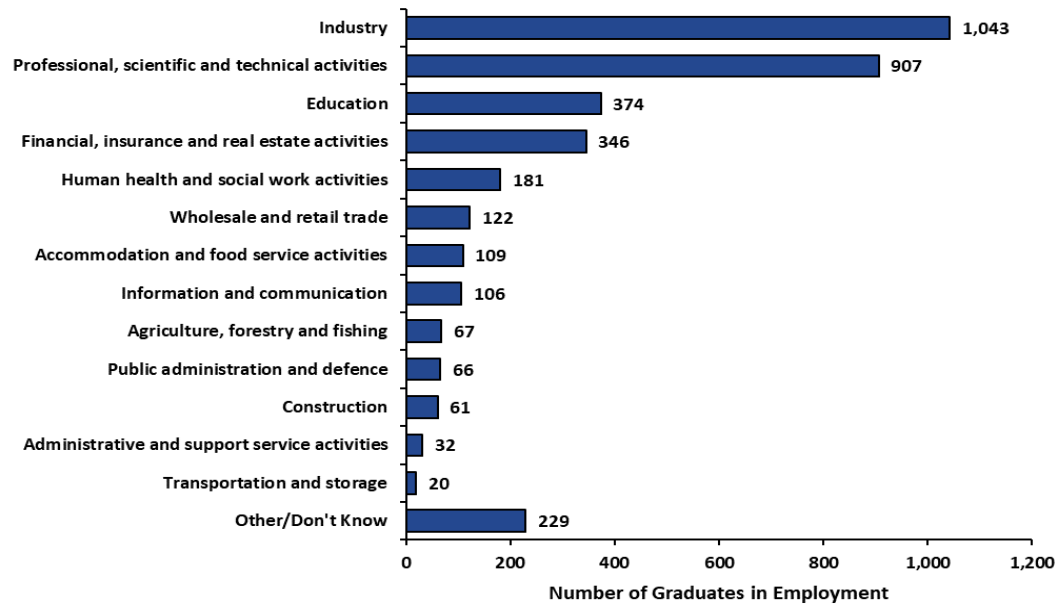
Figure 5.3: Business, Administration and Law HE Graduates by Sector of Employment



Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

Over half (53%) of the graduates of the class of 2018 who studied natural sciences, mathematics and statistics entered employment in either industry or professional, scientific and technical activities.

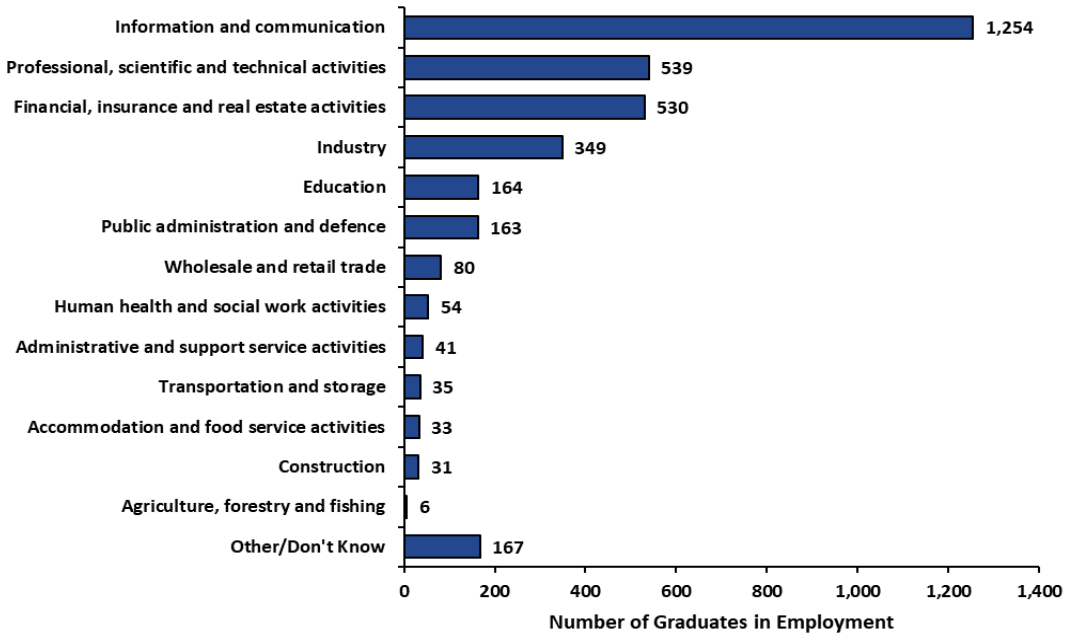
Figure 5.4: Natural Sciences, Mathematics and Statistics HE Graduates by Sector of Employment



Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

The following table shows the clear alignment of the ICT field of study with the information and communication sector. The sector employed more than twice the number of graduates of any other individual sector. There were significant numbers of ICT graduates employed in the professional, scientific and technical activities, and financial, insurance and real estate activities sectors.

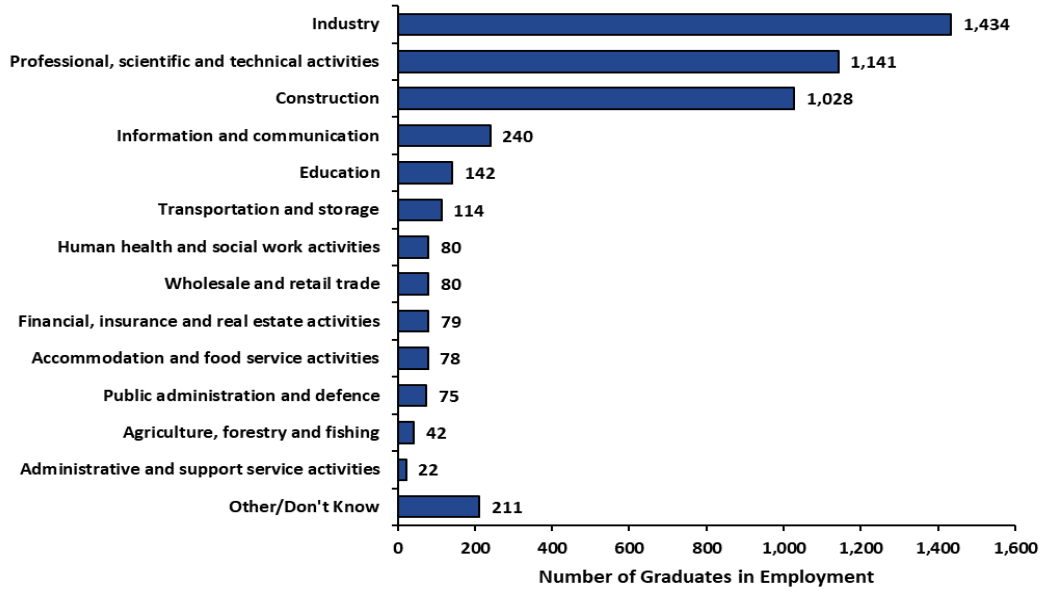
Figure 5.5: Information and Communication Technologies HE Graduates by Sector of Employment



Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

The three main destinations for the 2018 class of HE graduates of engineering, manufacturing and construction were in Industry; Professional, scientific and technical activities; and Construction. These three sectors accounted for over 75% of the graduates from engineering, manufacturing and construction in 2018.

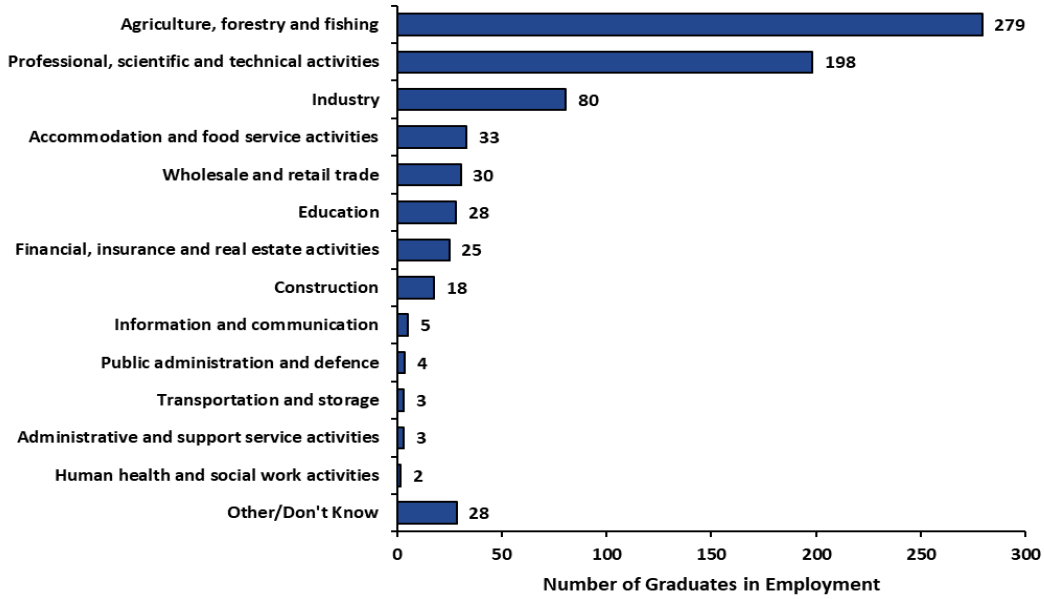
Figure 5.6: Engineering, Manufacturing and Construction HE Graduates by Sector of Employment



Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

There were relatively few graduates from agriculture, forestry, fisheries and veterinary studies in 2018, but the majority of these who found employment did so in agriculture, forestry and fishing; professional, scientific and technical activities; and industry, suggesting that these sectors are aligned with the field of study at a HE level.

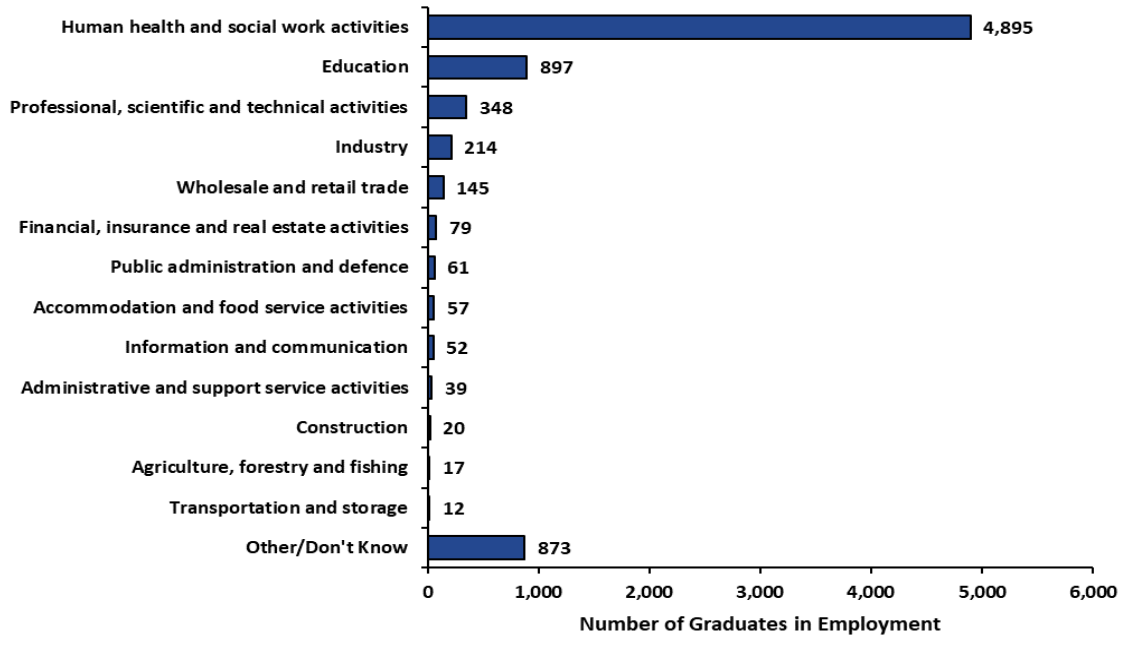
Figure 5.7: Agriculture, Forestry, Fisheries and Veterinary HE Graduates by Sector of Employment



Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

It is evident from the following figure that the majority of those who studied health and welfare, and graduated in 2018 in employment were employed in health and social work activities. The next largest sector of employment for this cohort was education, but education had less than a fifth of the number of graduates employed than the human health and social work activities sector.

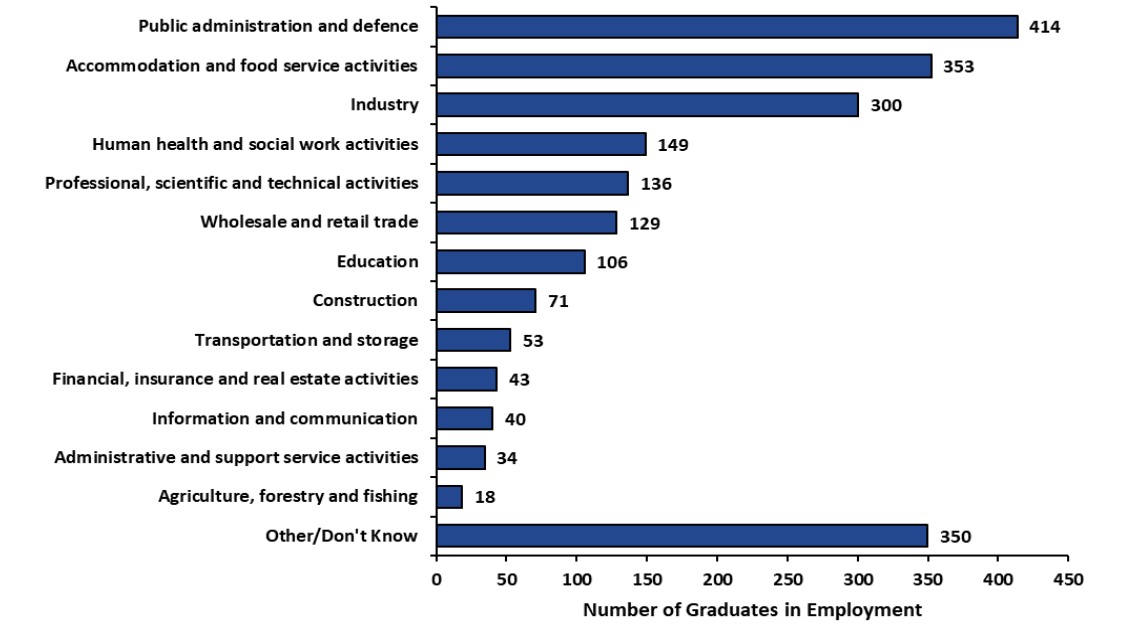
Figure 5.8: Health and Welfare HE Graduates by Sector of Employment



Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

Unlike the health and welfare field of study there is a wide spread of employment destinations amongst HE services graduates from 2018. Public administration and defence are the largest single sector, following by accommodation and food service activities, and industry.

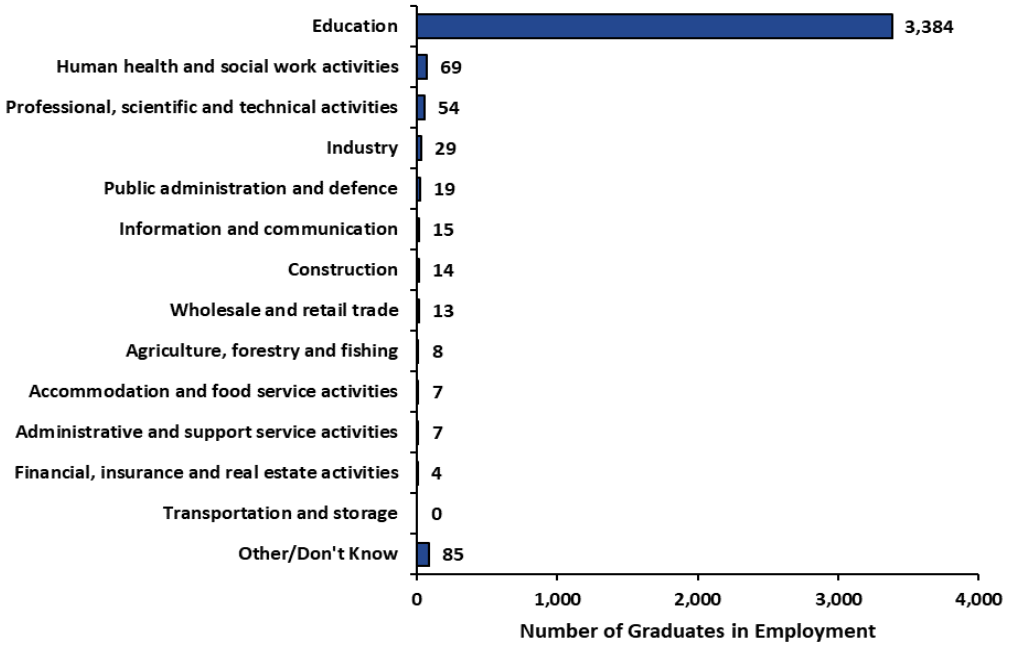
Figure 5.9: Services HE Graduates by Sector of Employment



Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

The following figure shows clear alignment between the education field of study at the HE level and the education sector. There were 3,384 graduates from the class of 2018 employed in the education sector, compared to 69 in the next largest sector, human health and social work activities.

Figure 5.10: Education HE Graduates by Sector of Employment



Source: HEA Class of 2018 Graduate Outcomes Survey (2020)

5.3 Summary of Key Findings

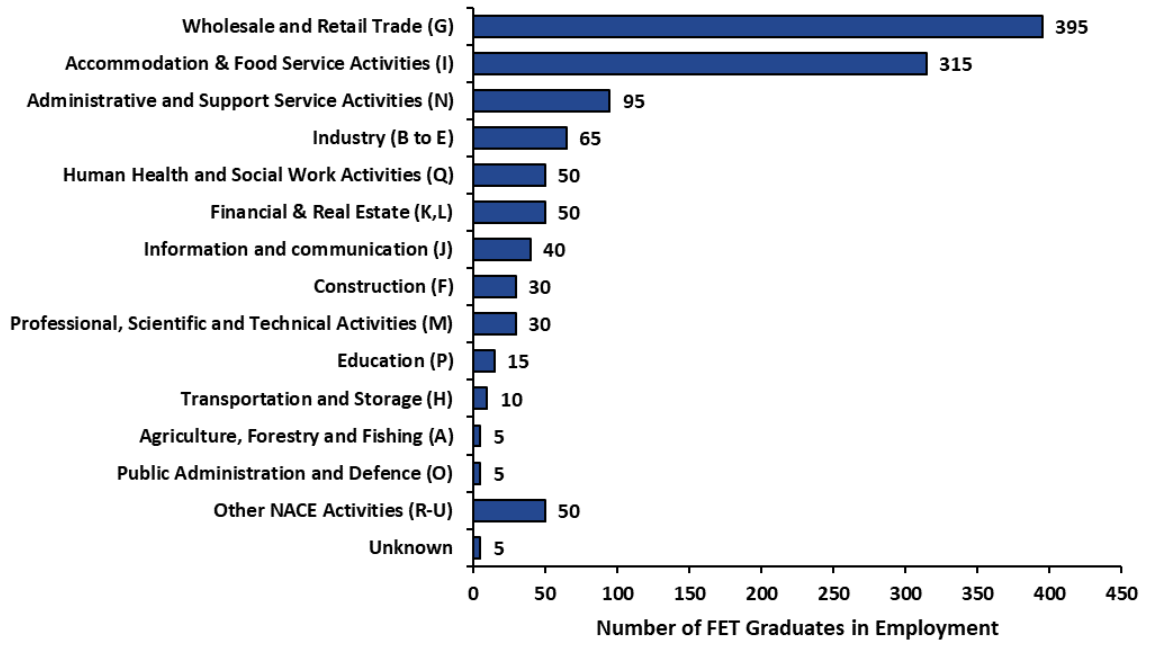
- There are very significant differences in the sectoral employment of HE graduates in terms of outcomes by field of study.
- For business administration and law graduates, main sectors of employment were financial, insurance and real estate; professional scientific and technical activities; industry; and information and communications.
- For HE graduates in natural sciences, mathematics and statistics, the main sectors of employment were industry; professional scientific and technical activities; and education.
- For ICT technologies graduates, main sectors of employment were information and communications; professional and technical activities; and financial, insurance and real estate.
- The main sectors of employment for HE graduates in arts and business were education; information and communication; and wholesale and retail trade.
- Health and welfare graduates were primarily employed in health and social work followed by education.
- Majority of education graduates were employed in education.

6 Sectoral Employment of FET Graduates by Field of Study

6.1 Sectoral Breakdown by Field of Study

As can be seen in the following table the majority of arts and humanities FET graduates (class of 2016) who were employed one year after graduation were employed in either the wholesale and retail trade sector, or in accommodation and food service activities.[139]

Figure 6.1: Arts and Humanities FET Graduates by Sector of Employment

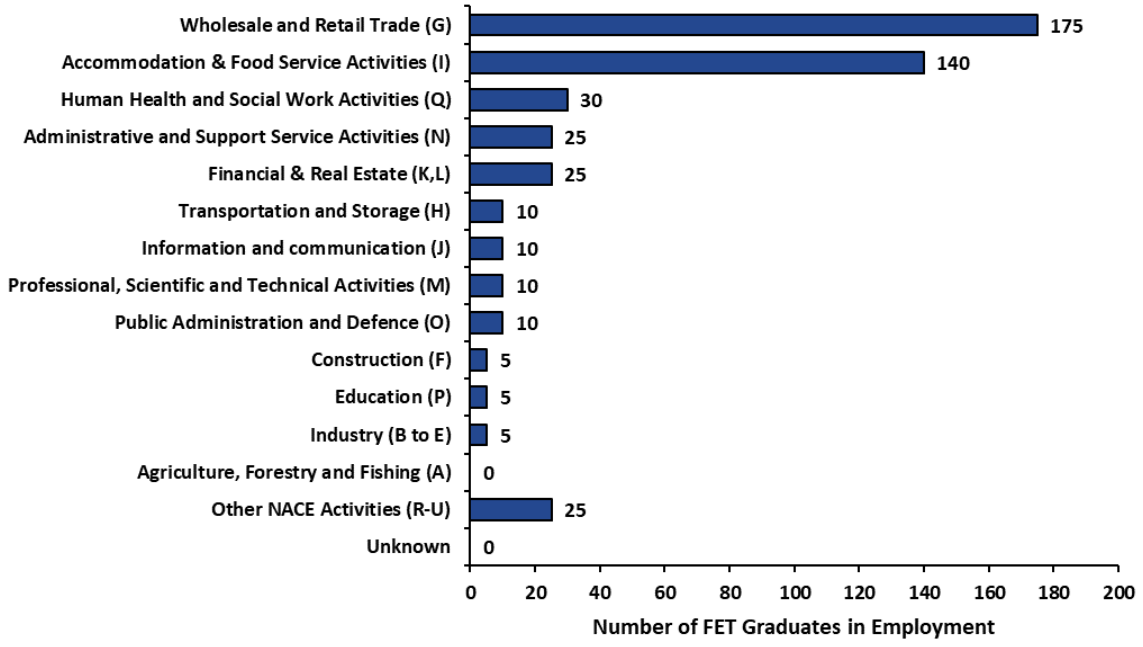


Source: CSO FET Graduate Outcomes Data (Class of 2016 - 1 Year from Graduation)

The wholesale and retail trade, and accommodation and food service activities sectors were also the most common sectors of employment for graduates of social sciences, journalism and information, as per the following figure.

[139] It is important to note that for each of the economic sectors the number of graduates in employment has been rounded to the nearest five to maintain anonymity.

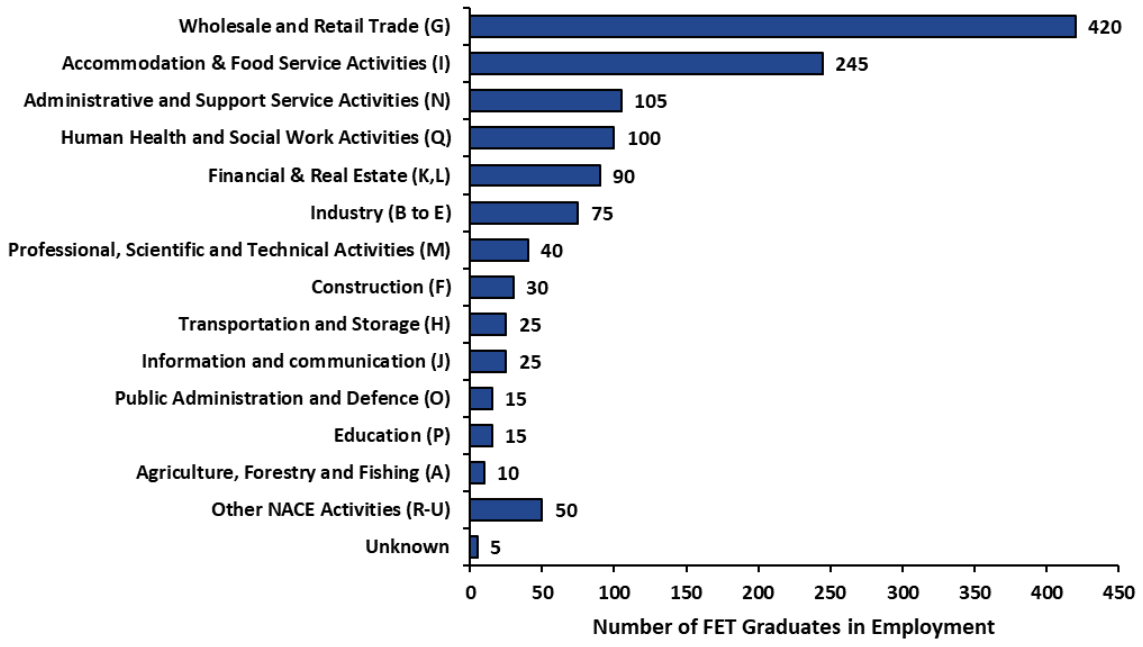
Figure 6.2: Social Science, Journalism and Information FET Graduates by Sector of Employment



Source: CSO FET Graduate Outcomes Data (Class of 2016 - 1 Year from Graduation)

Figure 6.3 shows that the main sector of employment for graduates from FET courses in business, administration and law was the wholesale and retail trade sector. This contrasts with HE graduates for whom financial, insurance and real estate activities was the most common sector of employment.

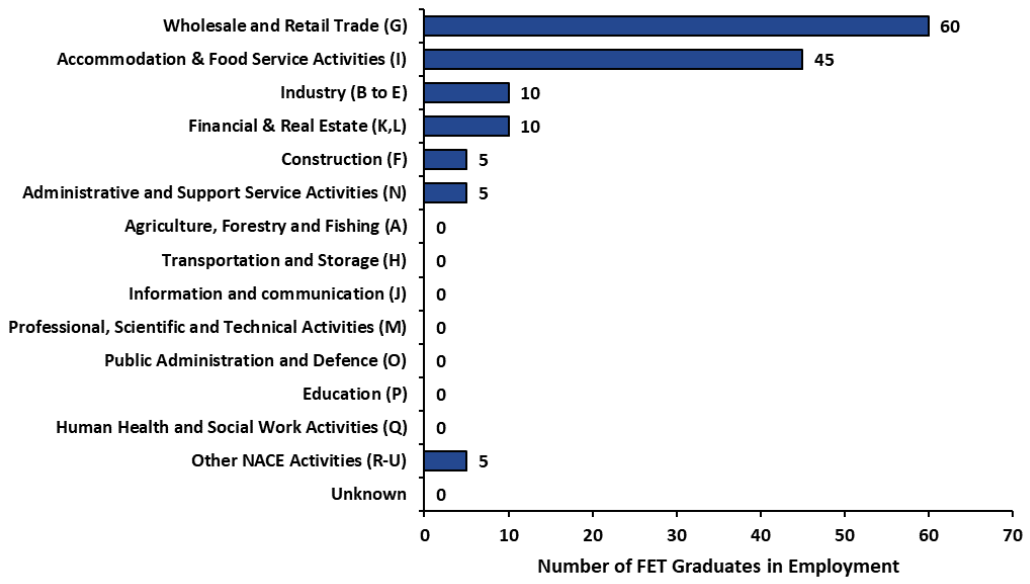
Figure 6.3: Business, Administration and Law FET Graduates by Sector of Employment



Source: CSO FET Graduate Outcomes Data (Class of 2016 - 1 Year from Graduation)

Whilst there were relatively few FET graduates from natural sciences, mathematics and statistics when compared to business, administration and law; wholesale and retail trade, and accommodation and food service activities remained the two most common sectors of employment.

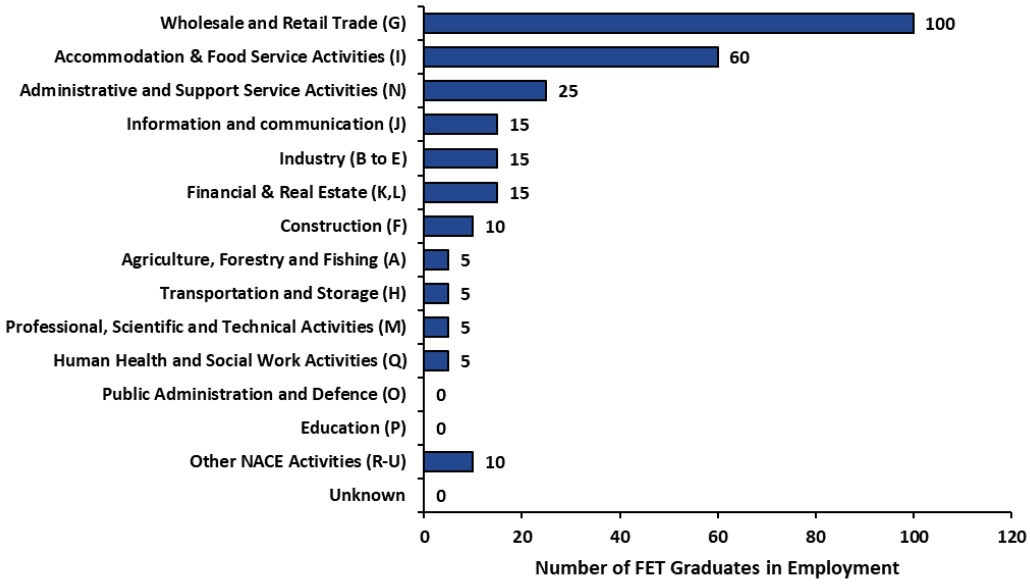
Figure 6.4: Natural Sciences, Mathematics and Statistics FET Graduates by Sector of Employment



Source: CSO FET Graduate Outcomes Data (Class of 2016 - 1 Year from Graduation)

The following figure contains a breakdown of the sector of employment amongst FET graduates from information and technology courses. Whilst there was a clear link between HE graduates in the field and the information and communication sector, the same link is not obvious for FET graduates with wholesale and retail trade, and accommodation and food service activities were again the most common sectors of employment for FET graduates from the class of 2016.

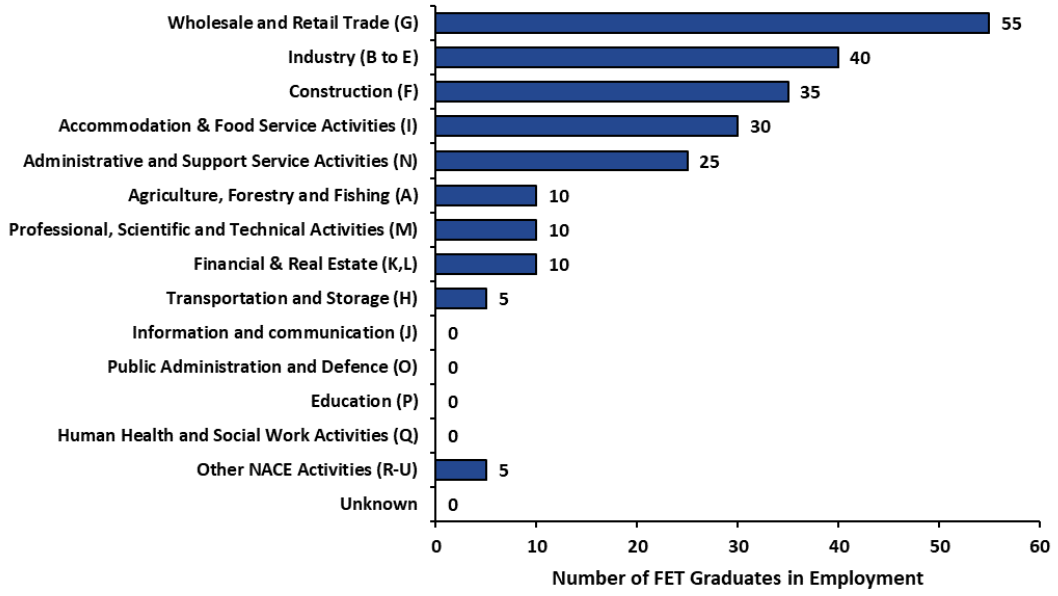
Figure 6.5: Information and Communication Technologies FET Graduates by Sector of Employment



Source: CSO FET Graduate Outcomes Data (Class of 2016 - 1 Year from Graduation)

Whilst wholesale and retail trade was the most common sector of employment for FET graduates who completed engineering, manufacturing and construction courses, industry and construction were the two next largest sectors of employment, unlike any of the fields of study previously shown.

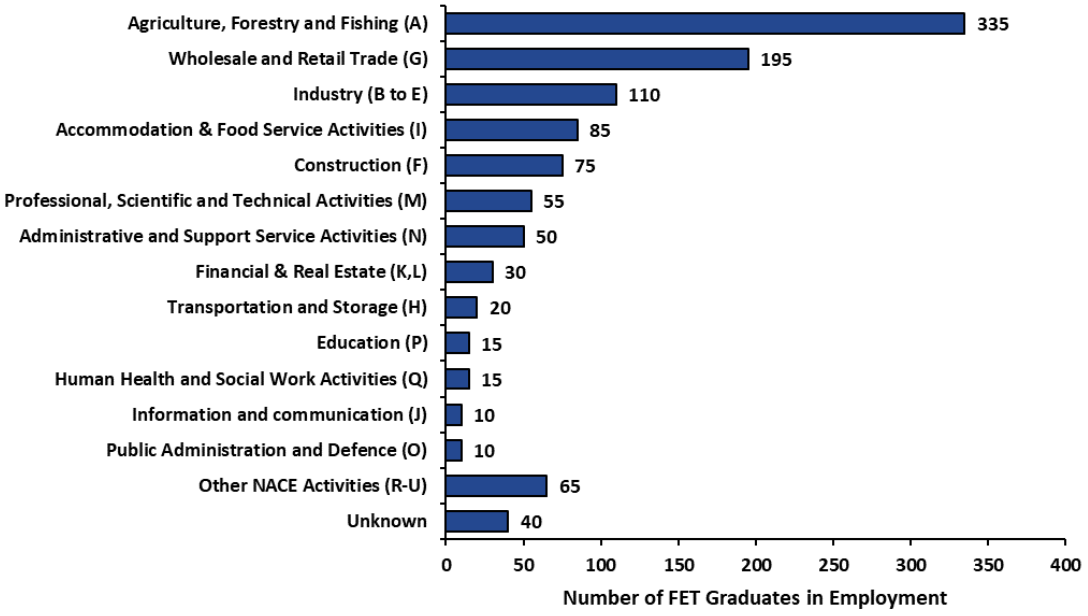
Figure 6.6: Engineering, Manufacturing and Construction FET Graduates by Sector of Employment



Source: CSO FET Graduate Outcomes Data (Class of 2016 - 1 Year from Graduation)

FET graduates from agriculture, forestry, fisheries and veterinary in 2016 were linked to the agriculture, forestry and fishing sector, with it being the largest sector of employment for the cohort as shown in the following figure. Wholesale and retail trade remained an important sector of employment however, as the second largest for this group of FET graduates.

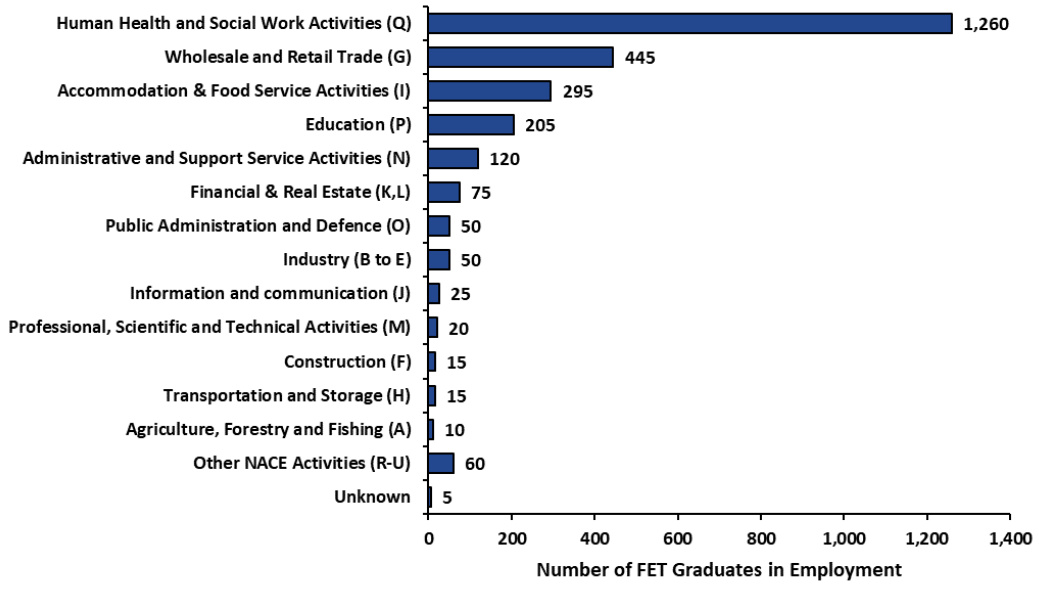
Figure 6.7: Agriculture, Forestry, Fisheries and Veterinary FET Graduates by Sector of Employment



Source: CSO FET Graduate Outcomes Data (Class of 2016 - 1 Year from Graduation)

As per the following graph it is evident that human health and social work activities was the main sector of employment for FET graduates from health and welfare courses. Whilst this link is not as pronounced as for HE graduates from health and welfare, it does indicate a degree of alignment between the field of study and the sector. As with each of the other fields of study, wholesale and retail trade was in the top two largest sectors.

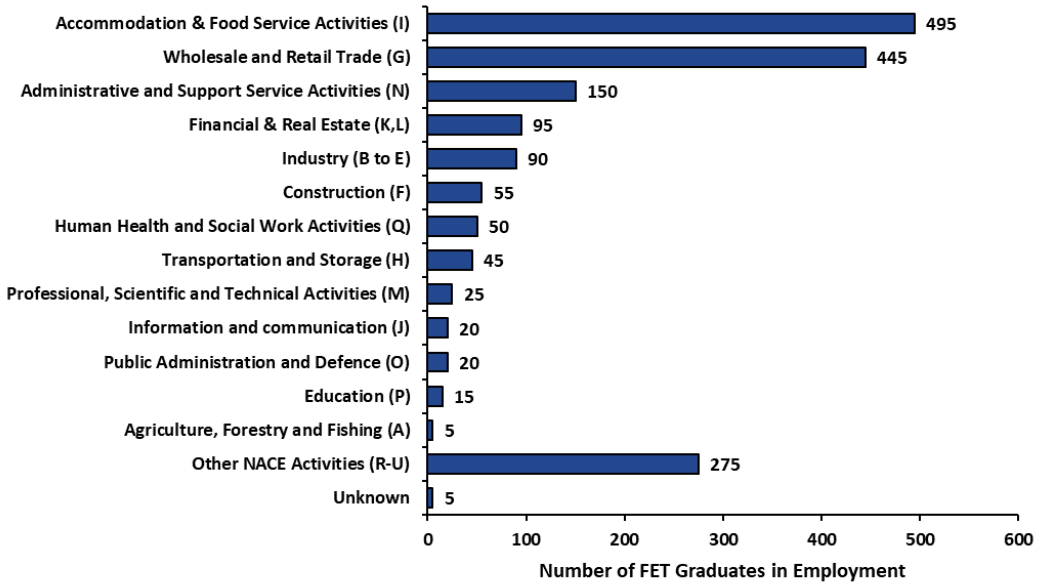
Figure 6.8: Health and Welfare FET Graduates by Sector of Employment



Source: CSO FET Graduate Outcomes Data (Class of 2016 - 1 Year from Graduation)

There were similar numbers of FET services graduates employed in accommodation and food service activities and in wholesale retail trade, as shown in the following figure. These two sectors accounted for the majority of FET services graduates in employment a year after graduation.

Figure 6.9: Services FET Graduates by Sector of Employment



Source: CSO FET Graduate Outcomes Data (Class of 2016 - 1 Year from Graduation)

6.2 Summary of Key Findings

- For FET graduates there are also very significant differences in sector of employment by field of study.
- The evidence also indicates significant differences in sectors where FET graduates are employed compared with HE graduates even when adjustments are made for field of study.
- For example, sectors where FET business administration and law graduates are mainly employed are in wholesale and retail trade, accommodation and food services, and administrative and support services. This contrasts with sectoral concentration of HE graduates.
- In some sectors FET graduates are directly related to field of study such as in health and welfare, and in agriculture, forestry and fishing.
- FET graduates' sectoral employment in a number of areas is less related to their field of study than HE graduates. For example, FET graduates in ICT are mainly employed in wholesale and retail trade, and in accommodation and food services.

7 Future Labour Demand and Implications for HE and FET

7.1 Intelligence on Future Skill Needs

In ensuring efficient and effective FET and higher education provision and in order to better match the provision of skills provision and the demand of the labour market, it is important to consider the future developments in employment in the Irish economy by levels of educational qualification for the next five years (up to 2025). This is aligned with the European Skills Agenda for sustainable competitiveness, social fairness and resilience. Specifically, our analysis is an example of the implementation of Action 2 of the European Commission's Skills Agenda which is designed to strength skills intelligence.

Our forecast analysis aims to project labour demand for individuals at different levels of education by looking at the responsiveness of labour demand to the Irish economy. Scenarios have been developed across industries as well as occupational groups, with the aim of highlighting the relationships between industries and fields of study and future demand.

Our projections of labour demand are based on the Labour Force Survey (LFS), a nationwide household survey implemented by the Central Statistics Office (CSO) and designed by the European Commission. The results presented in this chapter are based on self-reported data on the labour force status and socio-economic indicators of the total working age population of Ireland. It is important in strengthening skills intelligence to separate labour demand skills into three qualification levels: high, medium and low, based on the official ISCED classification system. The table below summarises the three qualification levels across the old and new ISCED classifications, and the correspondence between ISCED and Irish NFQ Levels.

Table 7.1: Distribution of Qualification Levels

Skill Level	ISCED 2011[140]	ISCED 1997	NFQ
Low Qualification	Levels 0-2	Levels 0-2	Levels 1-3
Medium Qualification	Levels 3-4	Levels 3-4	Level 4 – 6 (excl. Higher Certificate)
High Qualification	Levels 5-8	Levels 5-6	Level 6 (excl. QQI Advanced Certificate) - 10

Source: EUROSTAT

We compute our forecast analysis based on the quarterly estimates of the Anonymised Micro File (AMF) of the Labour Force Survey (LFS) from the CSO and we are very grateful to the CSO for access to this very detailed data. LFS is a private household-based sample survey, which spans from Quarter 1 1998 to Quarter 4 2019. The sample is a nationally representative sample of about 26,000 households. The sample is re-weighted to control totals from the Census to match totals by age, gender, region, sex and nationality. From the LFS, we use self-reported data on the labour force status and socio-economic indicators about the total working-age population of Ireland.

We use quarterly labour force estimates by highest education level achieved to create the three qualification (or education) aggregates. The three samples include individuals whose working age is between 20 to 64 years old.

[140] Both ISCED classifications (ISCED 1997 and 2011) are separately included in the LFS dataset. We construct the three aggregate levels of education based on the correspondence between the old and new ISCED classification.

The table below reports the number of observations (N) and time range (T) of our data for each of the three samples.

Table 7.2: Number of Observations and Time Series		
	N	T
High Qualification Sample	64	Quarter 1 2004 – Quarter 4 2019
Medium Qualification Sample	64	Quarter 1 2004 – Quarter 4 2019
Low Qualification Sample	64	Quarter 1 2004 – Quarter 4 2019
Source: Economic modelling by consultancy team.		

We consider a 5-year horizon for our labour demand projections. As the age bands in the detailed files for the LFS are only in 5-year groups, this enables us to focus on the next incoming age cohort for which we have data (for supply, which is in the next chapter) and also for our estimates of retirees, we focus on the next 5-year age group that will become of retirement age over the five year period (aged 60-64). Our out-of-sample forecast spans from Quarter 1 2020 to Quarter 4 2025. The labour demand forecast also requires GDP growth estimates until Quarter 4 2025. We use GDP in current prices from CSO for the within-sample estimation and forecast.

For the out-of-sample forecast, we use two different forecasts for GDP. First, we develop a BAU scenario using GDP in current prices from the European Commission's DG-ECFIN which covers the years 2019-2021. In order to extend the forecast, we apply the medium-term trend GDP growth rate estimated by ESRI for the years 2021-2025 to the GDP growth forecasts from DG-ECFIN. The figure below presents the trend of quarterly actual GDP in current prices (from CSO) and the forecasted GDP using the method previously outlined.

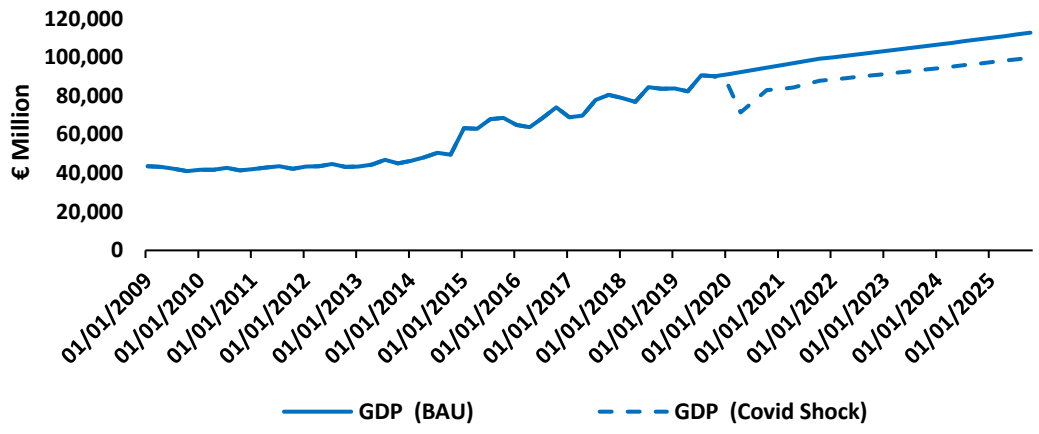
For the 2020-2021 period for the COVID-19 situation, we obtained data from the Department of Finance SPU data Chart-pack[141] which contained GDP forecasts for 2020 and 2021 under the COVID-19 crisis. We then applied these figures in terms of growth rates to the GDP levels from the last available years of actual national accounts data from CSO. For years after 2021, we returned GDP growth to the long-run predicted growth rates of the ESRI forecasts used in our BAU scenario.

The figure below shows both the historical series and the BAU and COVID-19 updated forecasts for GDP. Note that in 2015, GDP increased by 26%, mostly due to distortions related to multinationals in aircraft leasing and R&D. As described by CSO, relocations of intellectual property to Ireland as well as the increase in manufacturing activity boosted the balance of trade in goods and services as well as investment in capital stock of the Irish economy that eventually shifted the level of GDP in 2015.[142]

[141] Stability Programme Update (SPU) 2020, Department of Finance (https://www.gov.ie/en/publication/43a6dd-stability-programme-update-2020/)

[142] https://www.cso.ie/en/media/csoie/methods/nationalincomeandexpenditureannualresults/NIE_2016_FAQS.pdf

Figure 7.1: GDP (current prices), Q1 2009 – Q4 2025



Source: CSO, AMECO, ESRI and Authors' own calculations

To avoid these potential distortions, we also used an alternative measure of output net of such effects. We thus also redid the estimation employing CSO's modified total domestic demand (MTDD[143]) as a sensitivity check to our analysis.

According to CSO, total domestic demand is described as "*personal and government spending on goods and services plus capital stock additions and valuation changes*". However, a modified domestic demand was created to remove the effects of "*trade in aircraft by aircraft leasing companies and imports of R&D related to intellectual property imports from the additions to capital stocks*" responsible for the GDP increase of 26% in 2015.

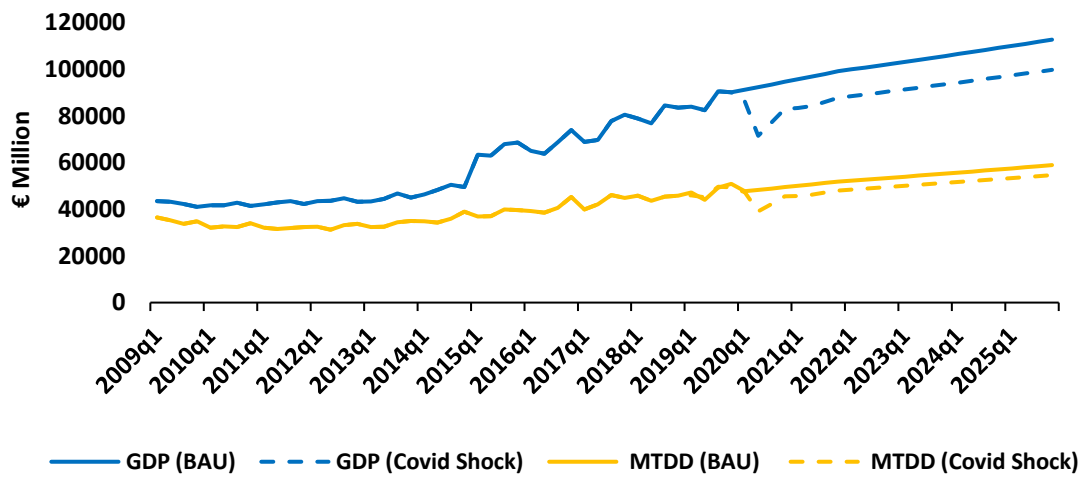
While use of MTDD may avoid potential output distortions due to the rigid need to apply the national income accounting rules to GDP calculations, MTDD has the added challenges that in general all our available forecasts from official sources are for GDP. MTDD's historical data from CSO are available up to 2020 Q1, and in the absence of a forecast, we let the MTDD grow out in-line (e.g., growth 1:1) with what previously described with GDP. However, before doing so, we investigated the relationship between GDP and MTDD aiming to forecast the latter using GDP as an explanatory variable. Our forecast models for MTDD (see Methodology section) yielded similar growth rates for MTDD to GDP over 2020-2025, and thus we concluded after this estimation that a 1:1 correspondence between the official GDP forecasts and MTDD was a valid assumption.

We therefore proceed with the application of the GDP growth rates to MTDD in the out-of-sample forecasts where i) we apply EC DG-ECFIN growth rates for year 2020-2021, and ii) medium-term trend GDP growth rate estimated by ESRI for year 2021-2025. As with the GDP-based forecasting, we developed two scenarios: BAU and COVID-19; for the latter, we apply GDP growth rates obtained by the SPU data chart-pack from the Department of Finance for year 2020-2021.

The figure overleaf compares the trends of GDP and MTDD for the years 2009-2025 under the BAU and COVID-19 scenario.

[143] CSO describes the data series as "Modified Total Domestic Demand and Components of Modified Gross Domestic Fixed Capital Formation".

Figure 7.2: GDP (current prices) and Modified Total Domestic Demand (current prices), Q1 2009 – Q4 2025



Source: CSO, AMECO, ESRI and Authors' own calculations

The next table below gives descriptive statistics for the high qualification sample of the main variables employed in the analysis. Health and Education are the largest sectors, followed by Industry, with professional and scientific activities and ICT both next and about equal with a maximum of 105 thousand jobs.

Table 7.3: Summary Statistics

High Qualification Sample					
Variable: Total Employed	**Mean**	**St. Dev.**	**Min**	**Max**	**N**
A: Agricultural, Forestry and Fishing	10,995	4,829	4,829	15,984	64
BCDE: Industry	95,074	60,848	60,848	125,785	64
F: Construction	17,550	5,848	5,848	30,883	64
G: Wholesale and Retail Trade; repair of motor vehicles and motorcycles	63,431	24,727	24,727	88,464	64
H: Transportation and Storage	15,981	8,463	8,463	26,788	64
I: Accommodation and food service activities	31,795	13,089	13,089	51,699	64
J: Information and communication	65,132	37,861	37,861	105,778	64
KL: Financial, insurance and real estate activities	64,647	29,632	29,632	84,821	64
M: Professional, scientific and technical activities	84,393	50,972	50,972	105,720	64
N: Administrative and support activities	24,358	11,077	11,077	38,491	64
O: Public administration and defence: compulsory social security	44,092	10,952	19,861	69,341	64
P: Education	106,700	18,153	70,598	145,279	64
Q: Human health and social work activities	133,456	32,867	56,917	178,593	64
RSTU: Other NACE	34,188	8,985	13,972	47,414	64
All Sectors	10,995	4,829	4,829	15,984	64

Source: Economic modelling by consultancy team.

Modelling framework

The basic underlying model of our labour demand forecast is derived from an econometric model regressing employment on GDP by type of employment-education level. We differentiate employment by highest level of education attained. Different models are then run for both the aggregate economy and each economic sector, as well as by educational field. To investigate the relationship between employment and skill demand, we specify the following model(s):

$$Y_{i,j,t} = \alpha_{i,j} + \beta_{i,j} GDP_t + \varepsilon_{i,j,t} \quad (1)$$

Where Y is employed individuals (working age 20-64) in industry *i,* qualification *j*, and at time *t*; GDP is at time *t* and in current prices, and represents skill demand of the Irish economy; ε_t is an error term at time *t,* and α is a constant; the specificity of the coefficients depends on the model estimated and we estimated models both aggregated over industry and specific to each industry, but always differentiated by qualification level: high, medium and low. The coefficients β estimate the responsiveness of employment across education levels to the requirement of skills within an economic sector. A number of different specifications were tested, including dummy variables for GDP-once off changes, seasonal dummies, ln GDP_2, but none of these models proved successful in both a) improving the forecasts (in terms of a sense check[144] and within-sample prediction MSE or the b) other general regression diagnostics.

In order to assess the sensitivity of the model to specifications, we specify four models based on the relationship shown in Equation 1. A different model is estimated for each of high, medium and low qualifications, but we suppress this subscripting notation in the exposition below.

As a first step, we estimate the following OLS version (Model 1):

$$y_t = \alpha + \beta gdp_t + \varepsilon_t \quad (2)$$

Where lower-case letters denote variables that are in natural logs.

A common problem with time-series economic models is autocorrelation of the error terms, which violates one of the assumptions of the classical linear model (OLS). After testing via the Durbin-Watson statistic, and in additional to visual inspection of the predictions and residuals, we determined that for most of all the models, autocorrelation was potentially a problem. Some of the standard models of AR1 error correction[145] proved to give poor results. Therefore, in order to address autocorrelation and further issues of error correction, we estimate a second model, Model 2, which includes a first order moving average term (MA1) in the error term:

$$y_t = \alpha + \beta gdp_t + \varepsilon_t + \delta \hat{\varepsilon}_{t-1} \quad (3)$$

[144] For example, GDP_2, improved the fit and within sample forecasts but extrapolation out to five years often led to implausible results, e.g., reversal of the overall direction of GDP causality on labour demand.

[145] Such as the Prais-Winsten estimator.

Where $\hat{\varepsilon}_{t-1}$ are the lagged estimated model residuals from the previous OLS regression (Model 1) that follow a linear autoregressive moving-average process; δ is their respective coefficient from the MA equation (3).

Similarly to Equation 3, we also estimate Model 3 using an iterative procedure implemented by STATA's ARIMA command (an ARIMA[146](0,0,1) process, i.e., with first-order moving average component). This model is the same as Model 2 but for the iterative estimation of the error term and coefficients.

Lastly, for Model 4, we use the Prais-Winsten regression model which follows another iterative procedure estimation of Model 1 (Equation 2), but with a correction for AR1 disturbances, implemented via our software STATA. The model uses generalized least-squares method and corrects for first-order autocorrelation.

Table 7.4 below reports mean-squared errors (MSE)[147] which are used to assess the forecast accuracy for each model specifications introduced in the previous Methodology subsection. We estimate mean-squared errors per the following:

$$MSE = \frac{1}{n}\sum_{t=1}^{n}(y_t - \widetilde{y_t})^2 \quad (4)$$

Where n is the number of data points; $\widetilde{y_t}$is the estimated predicted value; $y_t$is the actual value for data point at time t.

From the table below, we can see that the model with the highest forecast power (and lowest MSE) is Model 2 across each of the different levels of qualification.

Table 7.4: Mean Squared Errors (MSE) for Different Levels of Qualification

Model Specification	Low	Medium	High
Model 1 (OLS regression)	0.056	0.003	0.010
Model 2 (OLS regression with MA1 disturbance)	0.002	0.000	0.001
Model 3 (ARIMA with MA1 disturbance)	0.020	0.001	0.005
Model 4 (Prais-Winsten Regression)	0.099	0.004	0.025

Source: Economic modelling by consultancy team.

7.2 Labour Demand Projections for Higher-level Qualifications

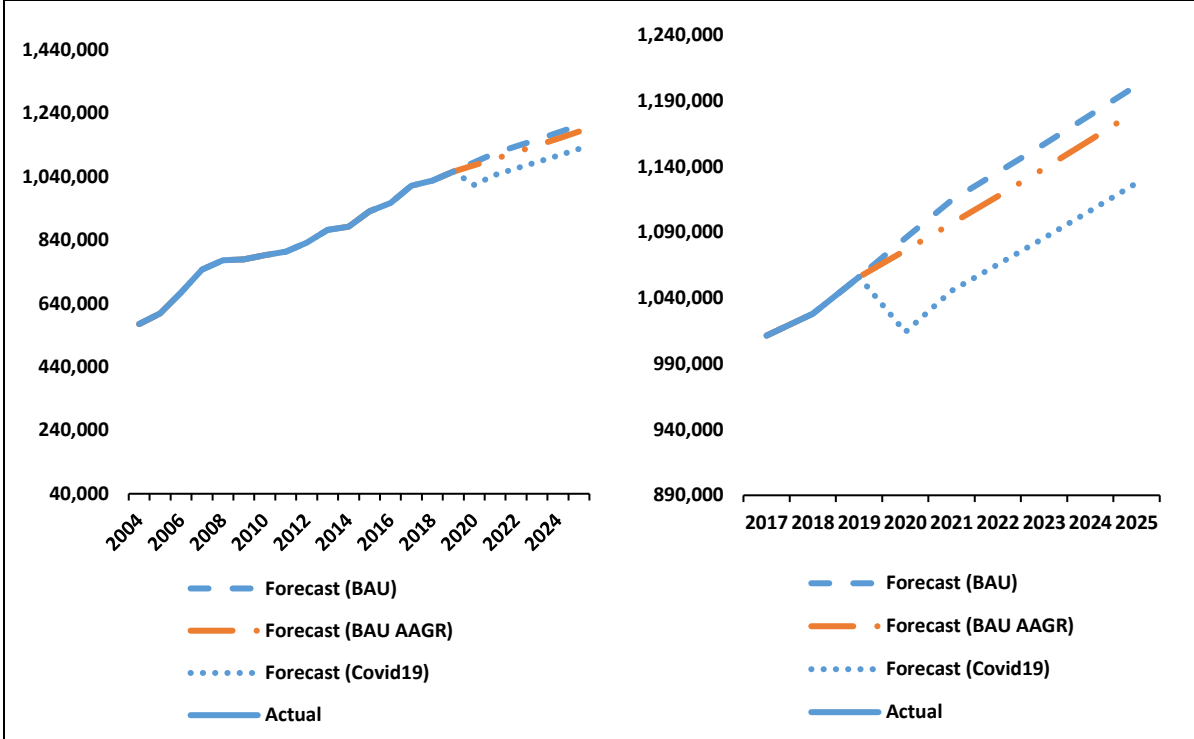
In developing projections of labour demand for high qualified workers, it is useful to consider a Business as Usual (BAU) scenario and a second scenario under which we account for the COVID-19 shock. A third scenario, BAU AAGR, has also been developed to show projections based on the estimated long-run growth rate for 2020-2025. Figure 7.3 graphically illustrates the forecasts for high qualification labour demand forecasts under the three scenarios: BAU, BAU AAGR and COVID-19. The figure on the left focuses on a longer time-period (2005-2025) that demonstrates an increasing requirement from the Irish economy to fulfil its economic growth via workers whose highest education level attained is between NFQ Levels 6 (excluding QQI Advanced Certificate) – 10. Under

[146] Autoregressive-Integrated-Moving-average (ARIMA).

[147] MSE is a generalized quadratic-loss prediction evaluation metric which puts increasing at an increasing rate weight (loss or error) on predictions as they move further from the actual value and is one of the most common forecasting evaluation metrics.

the COVID-19 scenario, the model predicts the aggregate demand for high qualification to drop in 2020 by nearly 4%. High qualification labour demand is expected to recover in 2021, in-line with predictions for a recovery of GDP, and increase at a long-run growth rate of around 2% in 2022. We estimate between 1,120,000 and 1,200,000 total employees with high qualification will be required in 2025.

Figure 7.3: Aggregate Labour Demand Forecast for High Qualification over 2004 – 2025 and 2017 - 2025.



Projections are based on the mid-range value of the growth rates reported in Table 7.5 under each scenario.
Source: Economic modelling by consultancy team.

Table 7.5 below reports labour demand forecast growth for high qualification over 2020-2025.

Since our labour demand scenarios are inevitable to a degree of forecast error, we decide to construct a range of growth rates for our forecast. The same methodology is applied across all three qualification levels (high, medium and low) and consists on the following:

- The lower bound (LB) of the range reports the % forecasted growth accountable to economic growth (GDP), according to the following equation:

$$g_{LB,Y,t} = \beta g_{GDP,t}$$ [148] (5)

Where $g_{LB,Y,t}$ is the growth rate of labour demand Y at year t, after having multiplied the coefficient β (estimated by using Model 2, Equation 3) by the growth rate of GDP at year

[148] More specifically, g_{GDP} is the sum of growth rates of gdp (note that lower-case letters denote logs) across quarters i at time t, $\sum_{i=1}^{4}(gdp_{i+1,t} - gdp_t)$; and β is the coefficient estimated by Indecon's model (Model 2, Equation 3).

t ($g_{GDP,t}$). Note that under BAU and COVID-19 we use the annual growth rate of GDP over the forecast period; under the BAU AAGR scenario, we use the annual long-run growth rate of GDP (3.2% as per ESRI forecast[149]).

- The upper bound (UB) of the range starts from the forecast growth accountable to GDP ($g_{LB,Y,t}$) and adds back the difference between the total growth estimated by our model and the total growth estimated in Equation 5 over 2020-2025 according to the following equation:

$$g_{UB,Y,t} = g_{LB,Y,t} + \frac{\sum_{t=1}^{6}(\hat{g}_{Y,t} - g_{LB,Y,t})}{6} \text{ [150] } (6)$$

Where $\hat{g}_{Y,t}$ is the predicted growth for labour demand Y estimated by our model (Model 2, Equation 3) at time t.

Overall, for the years 2020-2025, we estimate an expansion of between 11.58%-14.5% in the demand for high qualified workers in the BAU case. In the COVID-19 case, we estimate an initial reduction between -4.22% and -3.7% in high qualification labour demand, but then a rebound as the forecast is for GDP to similarly rebound. Overall, total labour demand forecast growth under COVID-19 is around 6 percentage points lower than in BAU case.

Table 7.5: Labour Demand Forecast Growth for High Qualification, 2020-2025

Independent Variable: GDP		2020	2021	2022	2023	2024	2025	Total
Forecasted Labour Demand Growth (BAU)	Variable Growth Rate	2.54%-3.03%	2.42%-2.91%	1.65%-2.14%	1.65%-2.14%	1.65%-2.14%	1.65%-2.14%	11.58%-14.5%
Forecasted Labour Demand Growth (BAU AAGR)	Average Growth Rate	1.65%-2.14%	1.65%-2.14%	1.65%-2.14%	1.65%-2.14%	1.65%-2.14%	1.65%-2.14%	9.93%-12.86%
Forecasted Labour Demand Growth under COVID-19	Variable Growth Rate	-4.22%- -3.7%	2.87%-3.36%	1.65%-2.14%	1.65%-2.14%	1.65%-2.14%	1.65%-2.14%	5.27%-8.20%

Source: Economic modelling by consultancy team.

It is important to note that the scenarios are based on modelled long-run relationships between aggregate high qualification labour demand, a moving average term and GDP; the forecasts are then a function of GDP forecasts under various scenarios. There are likely to be short-term impacts of the COVID-19 crisis on certain types of labour, but it is not possible as part of this study to differentiate these by qualification type. As a sensitivity check, the table below presents the labour demand forecast growth for high qualification using modified total domestic demand (MTDD) as a proxy for economic growth. Table 7.6 confirms the positive relationship between labour demand for high qualification and economic growth, whose predicted growth rates are within the range of the LD forecast growth presented in Table 7.5.

[149] See Data sources utilised under Methodology.

[150] Note that the same methodology applies to all qualification levels with the exception of medium qualification, calculated as $g_{UB,Y,t} = g_{LB,Y,t} + \frac{\sum_{t=1}^{6}\hat{g}_{Y,t}}{6}$. Also note that in case of low qualification, the bounds of the range will be inverted, meaning that the lower bound for high and medium will be the upper bound for low.

Table 7.6: Labour Demand Forecast Growth for High Qualification – MTDD Sensitivity Check, 2020-2025

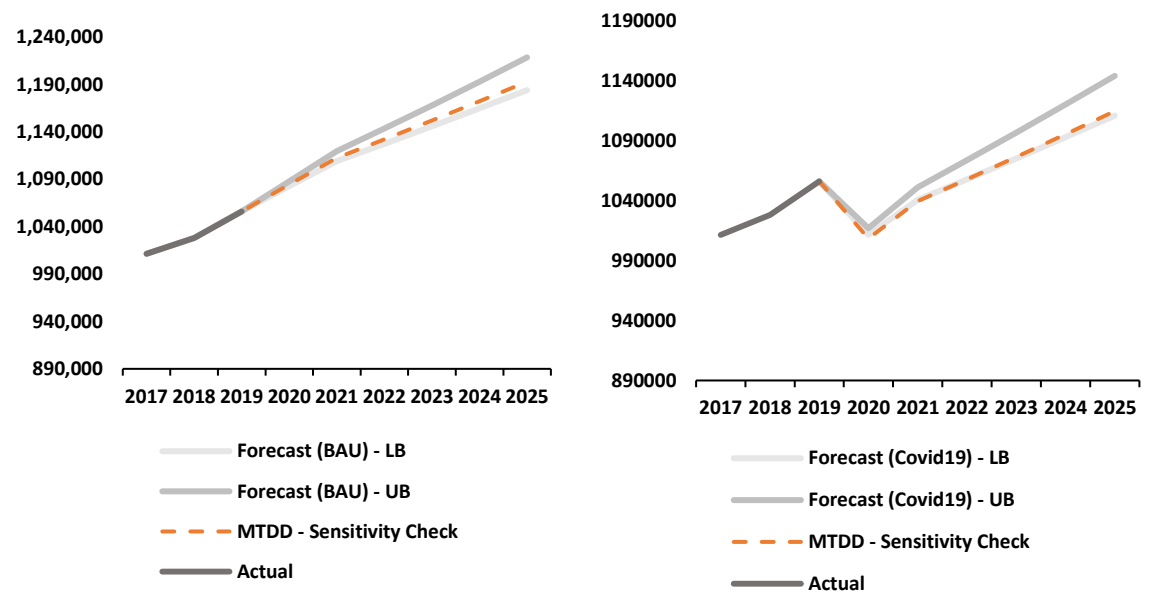
Independent Variable: MTDD		2020	2021	2022	2023	2024	2025	Total
Forecasted Labour Demand Growth (BAU)	Variable Growth Rate	2.70%	2.59%	1.76%	1.76%	1.76%	1.76%	12.33%
Forecasted Labour Demand Growth (BAU AAGR)	Average Growth Rate	1.76%	1.76%	1.76%	1.76%	1.76%	1.76%	10.57%
Forecasted Labour Demand Growth under COVID-19	Variable Growth Rate	-4.51%	3.08%	1.76%	1.76%	1.76%	1.76%	5.61%

Growth rates reported in this table are computed using $g_{Y,t} = \beta g_{MTDD,t}$, where $g_{,Y,t}$ *is the growth rate of labour demand Y at year t, after having multiplied the coefficient* β *(estimated by using Model 2, Equation 3) by the growth rate of MTDD at year t* ($g_{MTDD,t}$).

Source: Economic modelling by consultancy team.

We next present Figure 7.4, where we can visualise the aggregate high qualification labour demand forecast values using MTDD under the BAU and COVID-19 scenario. We further plot the range of growth rates, presented in Table 7.5, from which we can see that our sensitivity analysis is within the range, however closer to the lower bound of our previous forecast using GDP for both scenarios.

Figure 7.4: Aggregate Labour Demand Forecast for High Qualification under BAU and COVID-19– MTDD Sensitivity Check, 2017 – 2025



Source: Economic modelling by consultancy team.

We next investigate further forecasts across economic sectors again using the relationship between sectoral high qualification labour demand and GDP. To do so, we estimated the responsiveness[151] for jobs demanding high qualification by economic sector using the same modelling approach applied to

[151] In the baseline relationship between employment and skill demand (Equation 1, see subsection Modelling Framework), responsiveness is denoted by the coefficient β.

the aggregate economy. This exercise allows us to report which industry is more responsive to the skill needs embedded in economic growth. Table 7.8 shows the estimated β coefficient from the regression in Model 2 (Equation 3), which can be interpreted as the expected percentage change in labour demand for a certain qualification level within an economic sector given a 1% increase in GDP.

As we can see, for all industries, the estimated regression coefficients lie between 0.4 and 0.8, and all show a positive sign which is statistically significant, which confirms the positive relationship between economic activity proxied by GDP, and the achievement of a qualification level that falls under Higher Level Education or NFQ Levels 6 (excluding QQI Advanced Certificate) – 10.

The economic sectors of Accommodation and Food service activities (I), Construction (F) and ICT (J) show the highest estimated coefficients. In case of Accommodation and Food (sector I), β is estimated at 0.80, meaning that on average, if GDP increases by 1%, there would be an increase of 0.80% in high qualification labour demand in this sector. This result is in-line with our expectations which place Accommodation and Food services (I) as a pro-cyclical sector highly dependent on consumer spending. Construction (F) and ICT (J) also report, within the high qualification sample, the strongest link between higher education and GDP (with β coefficients estimated at 0.78 and 0.77 respectively). Industries with the highest number of high qualification jobs such as Education (P), Professional, Scientific and Technical Activities (M), along with Financial, Insurance and Real Estate activities (KL), report lower coefficients ranging between 0.40-0.45. The lowest responsiveness is reported by the Professional sector (0.40), where on average a 1% increase in GDP increases labour demand by 0.40%[152]. A lower regression coefficient for the Education (P) sector, might also be explained by labour market rigidities, but also the likelihood that education may be countercyclical or non-cyclical. In fact, the Education sector is in general recognised as a labour-intensive and possibly counter-cyclical industry, which might justify low responsiveness to GDP.

Table 7.7: Labour Demand Responsiveness by Economic Sector (High Qualification)

Independent Variable: gdp_t	(Model 2)
A: Agricultural, Forestry and Fishing	0.41***
BCDE: Industry	0.47***
F: Construction	0.78***
G: Wholesale and Retail Trade; repair of motor vehicles and motorcycles	0.52***
H: Transportation and Storage	0.70***
I: Accommodation and food service activities	0.80***
J: Information and communication	0.77***
KL: Financial, insurance and real estate activities	0.45***
M: Professional, scientific and technical activities	0.40***
N: Administrative and support activities	0.63***
O: Public administration and Defence: compulsory social security	0.63***
P: Education	0.43***
Q: Human health and social work activities	0.45***
RSTU: Other NACE	0.50***

Table 7.7 reports only the coefficient $\boldsymbol{\beta}$ of Equation 3.
The coefficients reported in this table were estimated using log-transformed variables (denoted by lower case letters).
**** p<0.01, ** p<0.05, * p<0.1*

Source: Economic modelling by consultancy team.

[152] Further investigation of the differences across sectors would require a much more detailed statistical analysis.

In the next table, we report labour demand forecast growth for high qualification over the years 2019-2025 under the BAU and COVID-19 scenario. In the BAU case, the economic sectors identified in our analysis that will exhibit the highest expansion are those found to be highly responsive to the Irish economy. Accommodation and Food service activities (I) is expected to grow by 28% (or 13,209 additional jobs for high qualified workers in sector I), followed by Retail (G), forecast to grow by 26%. We also expect the ICT sector (J) to considerably expand by 21% (or 21,088 additional workers). Economic sectors in which labour demand is expected to stagnate are Transportation (H) and Education (P), along with Construction (F). These sectors are expected to grow below the forecasted growth of total labour demand for high qualification (16%).

Under the COVID-19 scenario, the labour demand for high qualified workers within Accommodation and Food service activities (I) and the ICT sector (J) is expected to decrease by 12% and 11% percentage points respectively when compared to the BAU scenario. These two sectors were also found to have the strongest positive relationship with GDP which explains the largest decrease. Construction (F) is also shown to increase from 11% under the BAU scenario to only 1% under the COVID-19 scenario over 2019-2025.

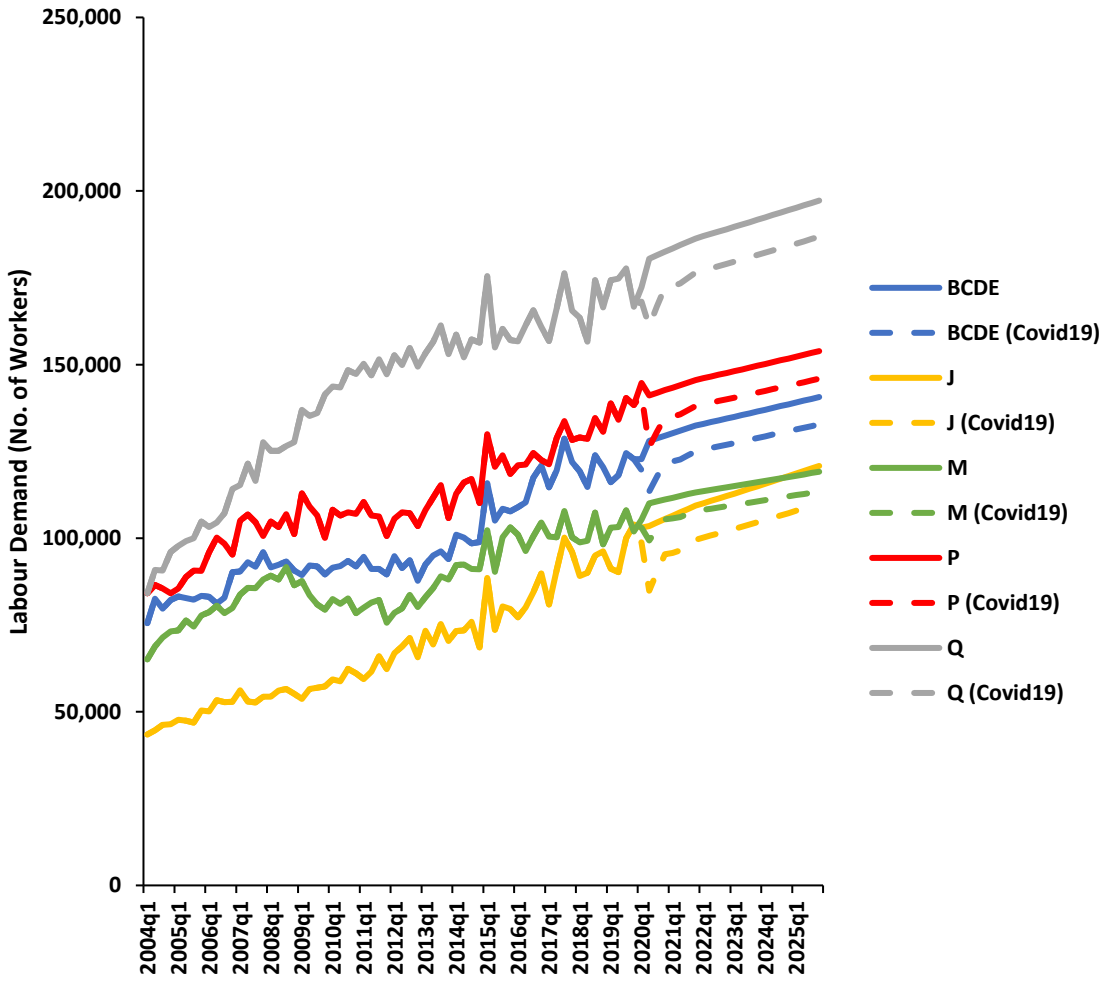
Table 7.8: Labour Demand Forecast Growth for High Qualification by Economic Sector, 2019-2025

	Forecasted Increase (BAU)	Growth 2019-2025	Forecasted Increase (COVID-19)	Growth 2019-2025
A: Agricultural, Forestry and Fishing	2,099	15%	1,334	10%
BCDE: Industry	18,942	16%	11,124	9%
F: Construction	3,242	11%	328	1%
G: Wholesale and Retail Trade; repair of motor vehicles and motorcycles	20,040	26%	14,056	18%
H: Transportation and Storage	2,479	10%	175	1%
I: Accommodation and food service activities	13,209	28%	7,657	16%
J: Information and communication	21,088	21%	10,297	10%
KL: Financial, insurance and real estate activities	11,507	14%	6,398	8%
M: Professional, scientific and technical activities	15,213	15%	9,577	9%
N: Administrative and support activities	5,061	14%	2,037	6%
O: Public administration and defence: compulsory social security	7,020	11%	1,602	2%
P: Education	14,559	11%	6,665	5%
Q: Human health and social work activities	22,977	13%	12,619	7%
RSTU: Other NACE	10,525	25%	7,420	18%

Source: Economic modelling by consultancy team.

The following figure shows the expected five largest sectors in terms of labour demand for high qualifications. Health and social work (Q) is expected to experience demand for almost 200,000 workers with high qualifications by 2025 under the BAU scenario.

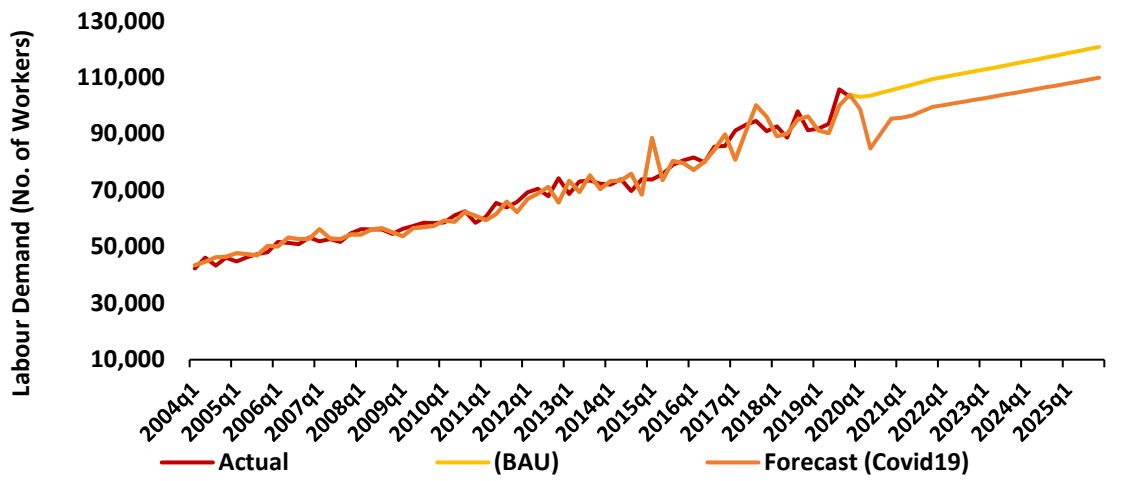
Figure 7.5: Labour Demand Forecast for High Qualification in Five Largest Sectors, Q1 2004 – Q4 2025



The forecasts were estimated using Model 2 (Equation 3, see subsection Modelling Framework).
Source: Economic modelling by consultancy team.

We next present, in Figure 7.6, labour demand projections within the Information and Communications (J) sector under the BAU and COVID-19 scenario. Ongoing technological change has been reflected within the industry, subject to a substantial increase (54%) in the last 8 years (2011-2019). Labour demand for the ICT sector is projected to increase by a further 21% (or demand for an additional 21,088 workers with digital literacy and computer skills) for the years 2020-2025. However, such demand is expected to drop by 11% and demand half of the estimated additional workers in the COVID-19 case (additional workers under the COVID-19 scenario are 10,297 as shown in Table 7.8.)

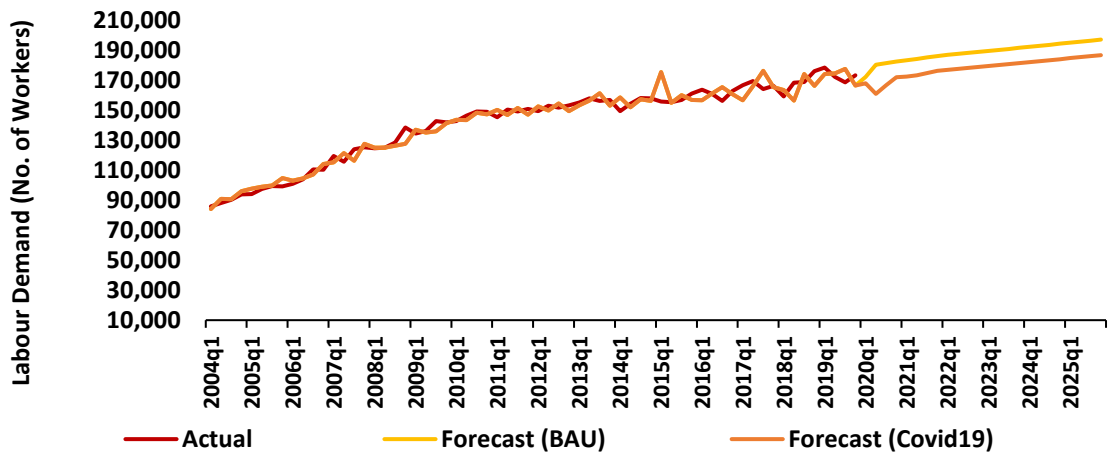
Figure 7.6: Labour Demand Forecast for High Qualification in Information and Communications Sector (J), Q1 2004 – Q4 2025



The forecast for ICT (J) was estimated using Model 2 (Equation 3, see subsection Modelling Framework).
Source: Economic modelling by consultancy team.

The figure below further reports labour demand projections within the Health sector, which represents the highest share of sectoral employment for higher education. Over the years 2019-2025, the Health sector, under the BAU scenario, is expected to expand by 13% (or demand 22,977 additional workers). Figure 7.7 shows an initial spike for year 2020, where demand for health workers is forecasted to expand by 3.4%. Under the COVID-19 scenario, labour demand is halved and expands by only 7% over 2019-2025. Subsequently, the forecast shows a stable yearly growth rate maintained over the years, estimated to be around 1.4% under both scenarios.

Figure 7.7: Labour Demand Forecast for High Qualification in Health Sector (Q), Q1 2004 – Q4 2025



The forecast for Health (Q) was estimated using Model 2 (Equation 3, see subsection Modelling Framework).
Source: Economic modelling by consultancy team.

We now turn our analysis to projections for high qualification labour by field of study and industry. The table below reports the labour demand responsiveness of the education field achieved to changes in GDP. All coefficients are positive, indicating a strong positive relationship to economic growth. Workers with an ICT qualification show the strongest relationship to GDP, where a 1% change in GDP increases labour demand qualified with ICT by nearly 1% (thus a 1:1 relationship). This is followed by Education (0.64) and Health and Welfare (0.57). The weakest relationship is reported by workers with Engineering skills (0.10).

Table 7.9: Labour Demand Responsiveness by Education Field (High Qualification)

Independent Variable: gdp_t	(Model 2)	R-Squared	Observations
General Programmes	0.56***	0.91	63
Education	0.64***	0.87	63
Arts and Humanities	0.33***	0.70	63
Social Sciences, Bus. and Law	0.47***	0.93	63
Natural Sciences, Math. and Statistics	0.45***	0.88	63
ICT	0.98***	0.89	63
Engineering, Manuf., Constr.)	0.10***	0.78	63
Agriculture, Forestry and Fishery	0.30***	0.73	63
Health and Welfare	0.58***	0.91	63
Services	0.14***	0.68	63

Table 7.9 reports only the coefficient β of Equation 3.
The coefficients reported in this table were estimated using log-transformed variables (denoted by lower case letters).
*** p<0.01, ** p<0.05, * p<0.1

Source: Economic modelling by consultancy team.

The tables below report labour demand forecast growth by education fields and economic sectors for workers with high qualification under BAU and COVID-19 scenario. We rely on the assumption that the shares of education fields will remain constant over the next 5 years, and estimate the average share of labour by education field achieved within each industry between 2018 and 2019. We later apply the share to the labour demand forecast point estimates by industry over 2020-2025.

Under this forecast method, we can see a breakdown of skills by sector. Under the BAU scenario, the ICT sector, for example, is expected to demand an additional 9,261 workers with ICT high qualifications, followed by 6,728 workers graduated in Social Sciences. We also predict high qualified workers in Social Sciences to be mostly demanded in Retail (G), Financial services and Real Estate (KL), and Professional, Scientific and Technical Activities (M).

Table 7.10: Labour Demand Forecast Growth by Education Field and Economic Sector for High Qualification under BAU, 2019-2025

	A	BCDE	F	G	H	I	J	KL	M	N	O	P	Q	RSTU
General Programme	17	386	54	621	120	419	677	283	324	196	252	181	288	494
Education	45	349	31	651	57	708	256	154	174	190	196	8,625	756	501
Arts and Humanities	88	723	84	1,868	246	1,377	2,115	780	933	614	773	1,725	895	2,195
Social Sciences, Bus. and Law	356	5,545	472	7,336	1,548	3,584	6,728	8,447	6,849	2,497	3,644	1,657	2,801	2,507
Natural Sciences, Math. and Statistics	142	2,931	71	1,142	144	374	1,196	595	1,220	208	585	908	660	331
ICT	35	1,418	83	1,329	273	435	9,261	1,307	512	431	463	513	209	467
Engineering, Manuf., Constr.)	198	5,494	1,540	1,893	739	760	2,099	480	3,355	603	565	380	255	353
Agriculture, Forestry and Fishery	1,000	594	59	417	120	166	73	52	340	185	253	36	94	226
Health and Welfare	96	1,192	70	1,990	182	857	422	211	431	316	840	887	16,217	1,244
Services	46	717	104	1,344	406	2,885	349	248	327	367	762	211	585	1,418

Source: Economic modelling by consultancy team.

Forecast growth by education field is expected to be halved under the COVID-19 scenario across all industries. For example, we predict the ICT sector to drop its demand from 9,261 under BAU to 4,978 workers with ICT high qualifications, and to 3,617 workers from Social Sciences. On the other hand, labour demand in Construction (F) will turn negative for most of the skills in the labour market: for instance, the demand for graduates in Engineering will drop from 1,540 under BAU to -199 under COVID-19.

Table 7.11: Labour Demand Forecast Growth by Education Field and Economic Sector for High Qualification under COVID-19, 2019-2025

	A	BCDE	F	G	H	I	J	KL	M	N	O	P	Q	RSTU
General Programme	11	231	-7	423	49	220	364	168	198	92	90	87	157	337
Education	28	209	-4	444	23	372	137	92	107	89	69	4,134	413	342
Arts and Humanities	55	433	-11	1,274	99	723	1,137	465	571	287	275	827	489	1,500
Social Sciences, Bus. and Law	222	3,319	-61	5,002	624	1,882	3,617	5,032	4,191	1,166	1,294	794	1,530	1,713
Natural Sciences, Math. and Statistics	89	1,754	-9	779	58	196	643	354	747	97	208	435	361	226
ICT	22	849	-11	906	110	228	4,978	779	313	202	164	246	114	319
Engineering, Manuf., Constr.)	124	3,288	-199	1,290	298	399	1,128	286	2,053	282	201	182	139	241
Agriculture, Forestry and Fishery	624	355	-8	285	48	87	39	31	208	86	90	17	52	154
Health and Welfare	60	714	-9	1,357	74	450	227	125	264	147	298	425	8,859	850
Services	29	429	-13	916	164	1,515	188	147	200	171	271	101	319	969

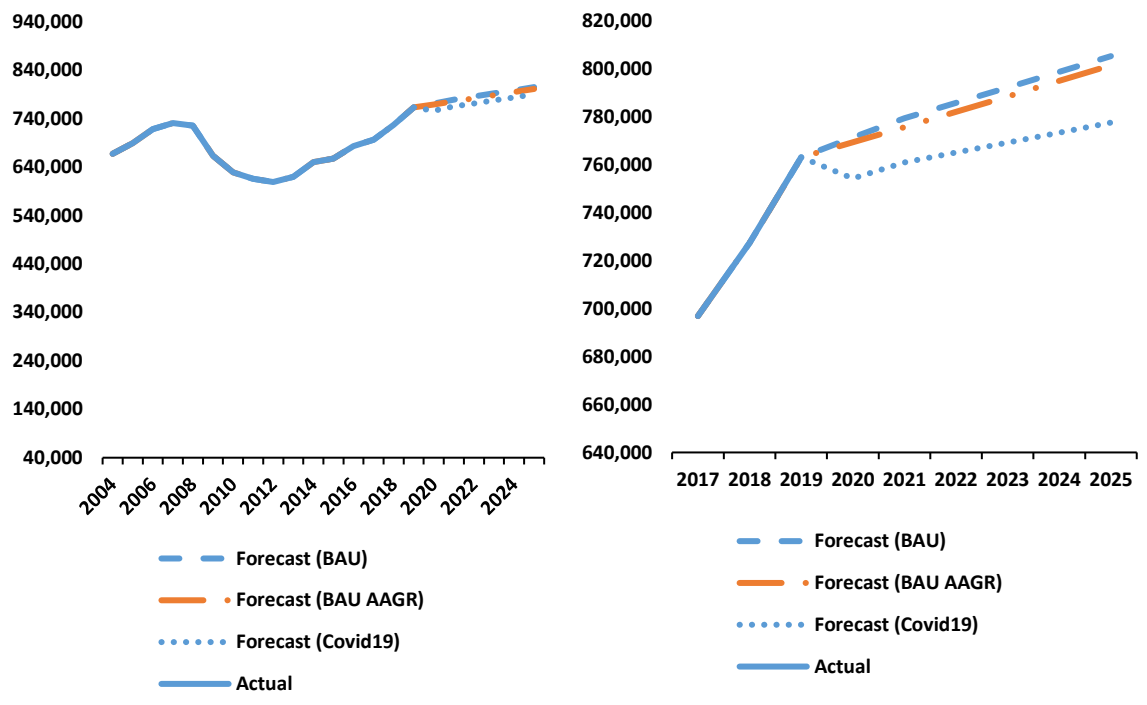
Results have been estimated by taking into account the COVID-19 shock within the labour demand forecast by industry.
Source: Economic modelling by consultancy team.

7.3 Labour Demand Projections for Medium-level Qualifications

Figure 7.8 reports the trend of the aggregate labour demand under BAU, BAU AAGR and COVID-19. The figure on the left focuses more on the historical trend, from which we can see a severe decrease post-recession and a rebound in 2014 in labour demand with medium qualification. The chart on the right presents our projections where, unlike for high qualifications, we estimate a smaller increase

over the forecast period. In 2025 we forecast a total between 777,000 and 800,000 employed workers under the BAU or COVID-19 scenario.

Figure 7.8: Aggregate Labour Demand Forecast for Medium Qualification, over 2004–2025 and 2017 - 2025



Projections are based on the mid-range value of the growth rates reported in Table 7.12.
Source: Economic modelling by consultancy team.

Our modelling suggests that in 2020 labour demand for medium qualifications under the BAU scenario will slightly increase by nearly 1%. In the COVID-19 scenario, the initial impact is less severe for medium as opposed to high qualifications, since the decrease is estimated to be slightly less than -1%. The model suggests a return to a long-run growth of approximately 0.5%-0.6% per annum between 2022 and 2025. The following table shows that the total estimated increase over the time-period equates to growth of 3.36%-4.08% over the whole period under the BAU scenario, and between 1.53%-2.25% under COVID-19.

Table 7.12: Labour Demand Forecast Growth for Medium Qualification, 2020-2025								
Independent Variable: GDP		**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**Total**
Forecasted Labour Demand Growth (BAU)	Variable Growth Rate	0.74%-0.86%	0.7%-0.82%	0.48%-0.6%	0.48%-0.6%	0.48%-0.6%	0.48%-0.6%	3.36%-4.08%
Forecasted Labour Demand Growth (BAU AAGR)	Average Growth Rate	0.48%-0.6%	0.48%-0.6%	0.48%-0.6%	0.48%-0.6%	0.48%-0.6%	0.48%-0.6%	2.88%-3.60%
Forecasted Labour Demand Growth under COVID-19	Variable Growth Rate	-1.22% - -1.1%	0.83%-0.95%	0.48%-0.6%	0.48%-0.6%	0.48%-0.6%	0.48%-0.6%	1.53%-2.25%
Source: Economic modelling by consultancy team.								

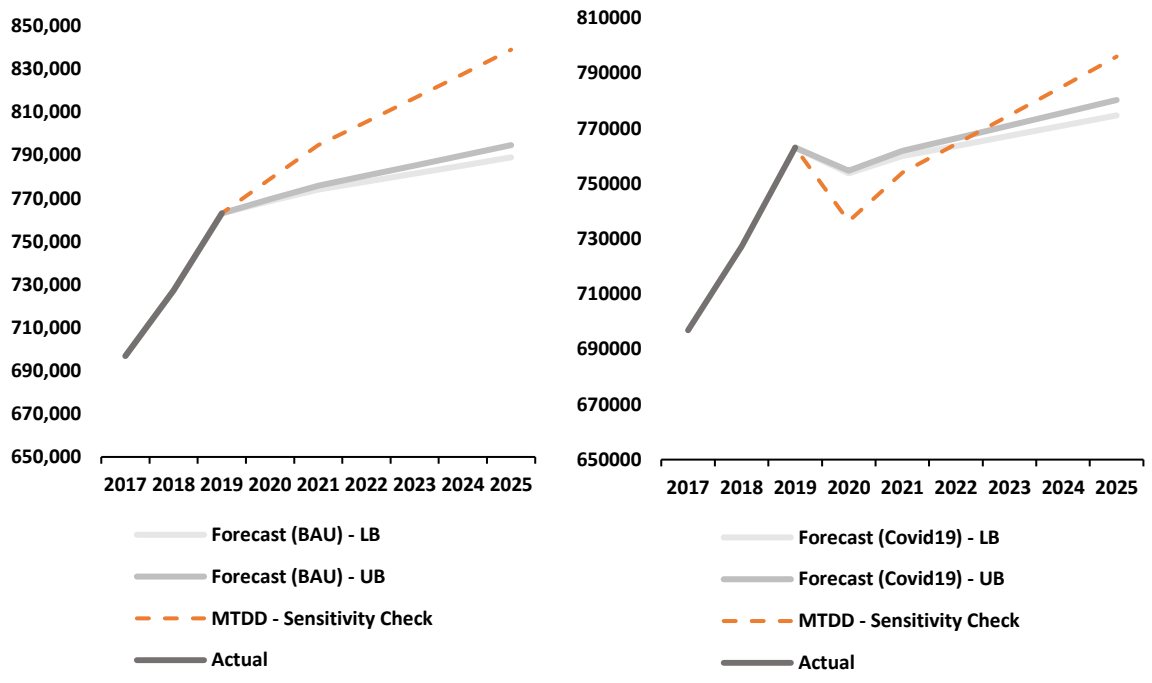
In case of medium qualifications, using the modified total domestic demand to investigate the relationship between demand and economic growth yields higher estimates relative to the estimates that were reported in Table 7.12. In fact, our modelling estimates a stronger relationship between MTDD and labour demand with medium qualification[153]. This leads to a total forecast growth between 4% or 10% (depending on the scenario COVID-19 or BAU) which is two times larger than what estimated previously with GDP (Table 7.12).

Table 7.13: Labour Demand Forecast Growth for Medium Qualification – MTDD Sensitivity Check, 2020-2025								
Independent Variable: MTDD		**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**Total**
Forecasted Labour Demand Growth (BAU)	Variable Growth Rate	2.09%	2.01%	1.37%	1.37%	1.37%	1.37%	9.57%
Forecasted Labour Demand Growth (BAU AAGR)	Average Growth Rate	1.37%	1.37%	1.37%	1.37%	1.37%	1.37%	8.20%
Forecasted Labour Demand Growth under COVID-19	Variable Growth Rate	-3.50%	2.39%	1.37%	1.37%	1.37%	1.37%	4.36%
Growth rates reported in this table are computed using $g_{Y,t} = \beta g_{MTDD,t}$, where $g_{Y,t}$ *is the growth rate of labour demand Y at year t, after having multiplied the coefficient* β *(estimated by using Model 2, Equation 3) by the growth rate of MTDD at year t* ($g_{MTDD,t}$). ***Source: Economic modelling by consultancy team.***								

[153] Model 2 coefficient, β, is estimated to be 0.427 as opposed to 0.150 for gdp (see Table 7.23 and Table 7.24).

Figure 7.9 plots predicted values using MTDD for labour demand with medium qualification as a sensitivity check. Projections are well above the previous forecast range (reported in Table 7.12) and the gap between the two forecasts gets wider over the forecast period in BAU case. There is an initial dip under COVID-19 where projections using MTDD are below the range for 2020-2021. However, a higher long-run growth rate of 1.37% brings them back above the range for 2023-2025.

Figure 7.9: Aggregate Labour Demand Forecast for Medium Qualification under BAU and COVID-19– MTDD Sensitivity Check, 2017 – 2025



Source: Economic modelling by consultancy team.

It is also informative to present estimates of labour responsiveness of medium qualifications by sector. We present results for both the BAU and the COVID-19 scenario. The following table shows the coefficients from our modelling of the responsiveness of demand for medium qualifications jobs in each economic sector. The estimated coefficient (β) from the regression in Model 2 which measures the percentage change in labour demand within an economic sector after a 1% increase in GDP is presented in Table 7.14.

Unlike the analysis with the high qualification sample there is a wide degree of variety in the coefficients for each sector, with some sectors having a positive relationship and some having a negative relationship between economic activity and the achievement of qualification Levels 4 and 5 on the NFQ. The economic sectors of Accommodation and Food service activities (I), Human health and social work activities (Q) and Transportation and Storage (H) report the highest coefficients. In case of Accommodation and Food service activities (I), β is estimated at 0.57, meaning that on average, an increase in demand of 0.57% in that sector when GDP increases by 1%. This was the largest coefficient amongst the medium qualification sample, in-line with our expectations, as

Accommodation and Food services (I) is a pro-cyclical sector highly dependent on consumer spending and income. We therefore suggest that to the extent COVID-19 has long-run impacts on total GDP levels and income, that this sector will be either slow to return once restrictions are lifted or alternatively, if GDP rebounds robustly, then this sector might return more strongly than other sectors.

Financial, insurance and real estate activities (KL), Information and communication (J), Public Administration and defence (O) and Professional, scientific and technical activities (M) all have statistically significant negative coefficients. This may be due to the high degree of professionals in these sectors and thus that economic growth in these sectors is one of shifting labour demand from medium to higher skills requirements. The coefficient of -0.75 indicates that a 1% increase in GDP leads to a 0.75% decline in labour demand in KL amongst medium qualification levels. This, when coupled with the previous analysis suggests that when there is an increase in economic activity labour demand in this sector is for those with higher qualifications. Finally, Agriculture, Forestry and Fishing (A) is not sensitive to economic growth as its estimated coefficient is not different from zero.

Table 7.14: Labour Demand Responsiveness by Economic Sector (Medium Qualifications)

Dependent Variable: total employed	
Independent Variable: gdp_t	**(Model 2)**
A: Agricultural, Forestry and Fishing	0.02
BCDE: Industry	0.07***
F: Construction	0.18***
G: Wholesale and Retail Trade; repair of motor vehicles and motorcycles	0.17***
H: Transportation and Storage	0.30***
I: Accommodation and food service activities	0.57***
J: Information and communication	-0.28***
KL: Financial, insurance and real estate activities	-0.75***
M: Professional, scientific and technical activities	-0.10**
N: Administrative and support activities	0.33***
O: Public administration and Defence: compulsory social security	-0.20***
P: Education	0.25***
Q: Human health and social work activities	0.49***
RSTU: Other NACE	0.27***

Table 7.14 reports only the coefficient β of Equation 3.
The coefficients reported in this table were estimated using log-transformed variables (denoted by lower case letters).
*** p<0.01, ** p<0.05, * p<0.1

Source: Economic modelling by consultancy team.

In Table 7.15, estimates for the growth (or decline) of labour demand for medium qualification between 2019 and 2025 are presented. Accommodation and Food service activities (I) is expected to grow by 16% (or 11,532 additional jobs for medium qualified workers in sector I), as is the human health and social work activities sector (Q) with an expected increase of 13,001 workers. We also expect the ICT sector (J) to fall by 10% (or 1,616 to 1,720 fewer workers under COVID-19). Labour demand in a number of sectors (Education – P and Public administration and defence – O, is expected to decline by at least 10% for those with medium qualifications, while Professional activity- M, Administrative activity - N) is showing smaller negative reductions predicted.

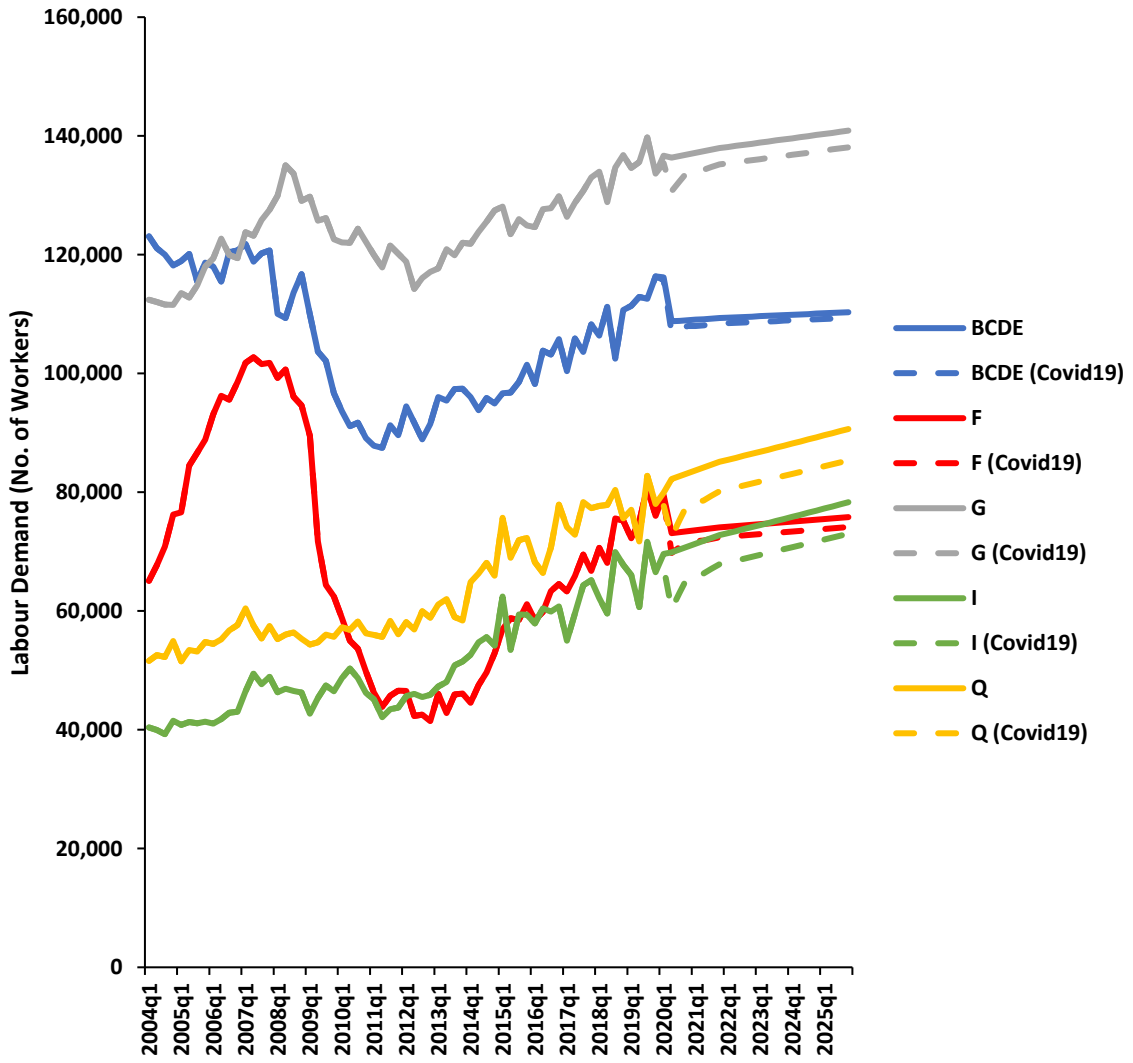
Table 7.15: Labour Demand Forecast Growth for Medium Qualification by Economic Sector, 2019-2025

	Forecasted Increase (BAU)	Growth 2019-2025	Forecasted Increase (COVID-19)	Growth 2019-2025
A: Agricultural, Forestry and Fishing	3,170	9%	3,060	9%
BCDE: Industry	-3,260	-3%	-4,203	-4%
F: Construction	-712	-1%	-2,385	-3%
G: Wholesale and Retail Trade; repair of motor vehicles and motorcycles	4,727	3%	1,923	1%
H: Transportation and Storage	-580	-1%	-2,298	-5%
I: Accommodation and food service activities	11,533	16%	6,279	9%
J: Information and communication	-1,616	-10%	-1,658	-11%
KL: Financial, insurance and real estate activities	-5,917	-32%	-6,011	-33%
M: Professional, scientific and technical activities	-382	-2%	-400	-2%
N: Administrative and support activities	-506	-1%	-2,094	-5%
O: Public administration and defence: compulsory social security	-4,596	-14%	-4,658	-14%
P: Education	-2,582	-11%	-3,263	-14%
Q: Human health and social work activities	13,001	16%	7,766	10%
RSTU: Other NACE	3,216	7%	1,692	4%

Source: Economic modelling by consultancy team.

Wholesale and retail trade (G) is forecast to remain the largest sector, in terms of demand for medium qualifications. The modelled decline in BCDE (Industry) between 2020 and 2025 is relatively small and thus the sector is anticipated to remain the second largest sector.

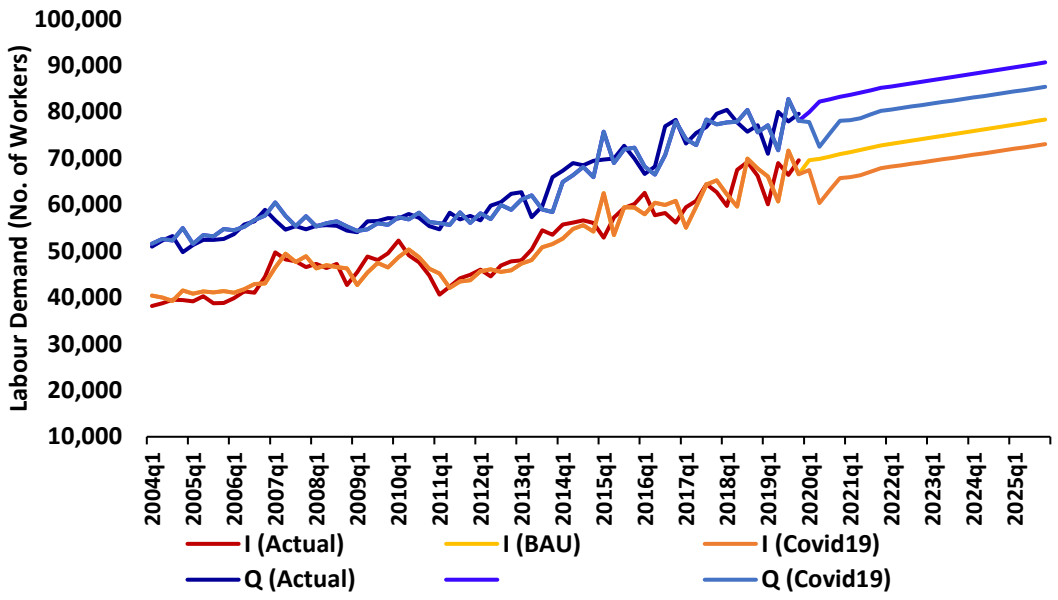
Figure 7.10: Labour Demand Forecast for Medium Qualification in Five Largest Sectors, Q1 2004 – Q4 2025



The forecasts were estimated using Model 2 (Equation 3, see subsection Modelling Framework).
Source: Economic modelling by consultancy team.

As discussed previously accommodation and food services (I) and health and social work (Q) were the two fastest growing sectors in our modelling of labour demand for medium qualifications. While it is likely that health will continue its pace and less likely to be impacted by COVID-19, different scenarios for return to BAU could impact labour demand in accommodation and food services differently. It further should be noted that some sectors such as ICT, the coefficient on medium skills labour demand is negative, and so a return to growth is predicted to reduce labour demand in these sectors. Overall, thus, while the shock may have both short-term and lasting labour demand effects, it might be expected that some jobs in the sectors with negative coefficients are unlikely to return even when a return to a normal GDP growth pattern is achieved.

Figure 7.11: Labour Demand Forecast for Medium Qualification in The Two Fastest Growing Sectors, Q1 2004 – Q4 2025



The forecasts were estimated using Model 2 (Equation 3, see subsection Modelling Framework).
Source: Economic modelling by consultancy team.

The table below reports the labour demand responsiveness of the most recent education field achieved to changes in GDP for workers with medium qualification. Unlike for high qualification, field of studies under medium qualification have a mixed relation to economic growth: Health in medium qualification exhibits the strongest relationship with GDP, where a 1% change in GDP increases labour demand by 1.71%; Natural Sciences, on the other hand, has the most negative coefficient (-0.34).

Table 7.16: Labour Demand Responsiveness by Education Field (Medium Qualification)

Independent Variable: gdp_t	(Model 2)	R-Squared	Observations
General Programme	-0.16***	0.67	63
Education	2.03***	0.89	63
Arts and Humanities	0.15**	0.61	63
Social Sciences, Bus. and Law	0.09**	0.83	63
Natural Sciences, Math. and Statistics	-0.34**	0.76	63
ICT	0.08	0.89	63
Engineering, Manuf., Constr.)	0.20***	0.86	63
Agriculture, Forestry and Fishery	0.29***	0.69	63
Health and Welfare	1.71***	0.95	63
Services	0.82***	0.89	63

Table 7.16 reports only the coefficient β of Equation 3.
The coefficients reported in this table were estimated using log-transformed variables (denoted by lower case letters).
*** p<0.01, ** p<0.05, * p<0.1

Source: Economic modelling by consultancy team.

Table 7.17 and Table 7.18 below report the labour demand forecast growth by education fields and economic sectors for workers with medium qualification. The results outlined below use the same forecast method conducted for high qualification and project labour demand for education fields by sector under BAU and COVID-19 scenario. Employees who hold General Programmes medium qualifications are likely to be subject to a negative labour demand across most of the sectors excluding Accommodation and Food Services (I) and Health and Social Activities (Q), which were also shown to be the fastest growing sectors in Figure 7.11, that account for the largest demand (8,635 and 5,040 additional workers respectively). General Programmes medium qualifications are also expected to be requested in Retail (G), Agriculture (A), and Other (RSTU). Labour demand across the set of skills within medium qualification is largely negative for those industries previously shown to decline during our forecast period such as Financial, Insurance and Real-estate activities (KL) and Information and communication (J).

Table 7.17: Labour Demand Forecast Growth by Education Field and Economic Sector for Medium Qualification under BAU, 2019-2025

	A	BCDE	F	G	H	I	J	KL	M	N	O	P	Q	RSTU
General Programme	1,191	-1,952	-190	3,472	135	8,635	-1,055	-4,047	-236	476	-3,360	-810	5,040	2,097
Education	10	-30	-2	53	2	198	-22	-102	-7	8	-62	-444	556	47
Arts and Humanities	9	-15	-1	40	1	181	-33	-89	-3	4	-21	-24	73	69
Social Sciences, Bus. and Law	64	-144	-8	274	9	492	-146	-834	-71	41	-555	-151	849	125
Natural Sciences, Math. and Statistics	7	-11	0	11	0	37	-2	-17	-2	2	-4	-4	55	3
ICT	10	-38	-4	63	2	91	-170	-186	-11	14	-87	-22	96	22
Engineering, Manuf., Constr.)	136	-595	-137	307	17	195	-94	-95	-64	47	-179	-24	184	101
Agriculture, Forestry and Fishery	1,113	-52	-6	41	3	46	0	-18	-6	20	-69	-5	42	58
Health and Welfare	15	-65	-2	156	2	418	-21	-67	-6	11	-165	-255	5,086	243
Services	59	-164	-32	295	7	1,239	-60	-116	-15	45	-116	-94	715	640

Source: Economic modelling by consultancy team.

Under the COVID-19 scenario, labour demand for medium qualifications is expected to stay positive but largely decrease in Accommodation and Food Services (I) from 8,635 under BAU to just 4,708, and in other sectors such as Retail (G) and Health and Social Activities (Q). Declining sectors such as Financial, Insurance and Real-estate activities (KL) and Information and communication (J) that were already subject to a negative demand under BAU will further fall under COVID-19, but by a smaller amount.

Table 7.18: Labour Demand Forecast Growth by Education Field and Economic Sector for Medium Qualification under COVID-19, 2019-2025

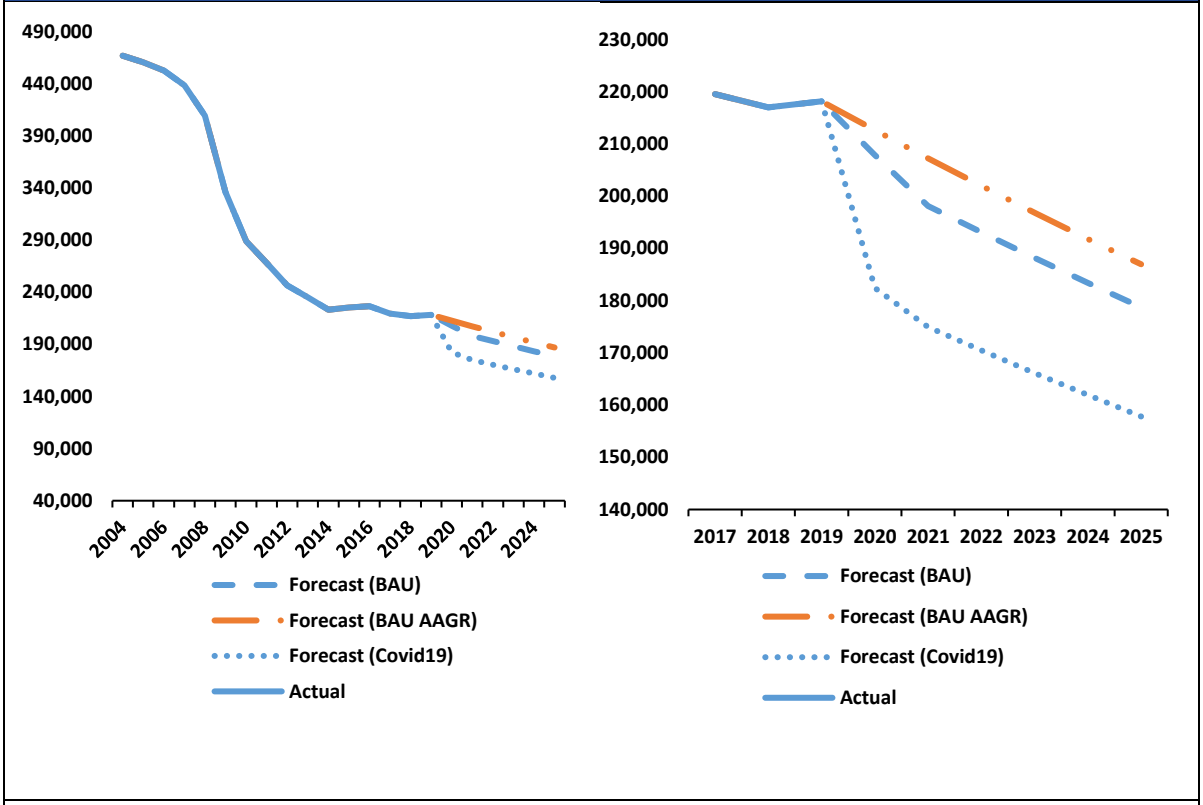
	A	BCDE	F	G	H	I	J	KL	M	N	O	P	Q	RSTU
General Programme	1,141	-2,550	-1,018	1,411	-1,153	4,708	-1,114	-4,162	-245	-655	-3,439	-1,111	2,968	1,160
Education	10	-39	-12	22	-18	108	-24	-105	-7	-11	-63	-609	328	26
Arts and Humanities	9	-20	-6	16	-11	98	-35	-91	-3	-5	-21	-33	43	38
Social Sciences, Bus. and Law	61	-188	-41	111	-77	268	-154	-857	-74	-56	-568	-208	500	69
Natural Sciences, Math. and Statistics	6	-15	-1	4	-2	20	-2	-17	-2	-2	-4	-5	33	2
ICT	10	-50	-23	26	-16	49	-179	-191	-11	-19	-89	-30	57	12
Engineering, Manuf., Constr.)	130	-777	-734	125	-148	107	-99	-98	-67	-65	-183	-32	108	56
Agriculture, Forestry and Fishery	1,066	-67	-30	17	-24	25	0	-19	-6	-27	-71	-6	24	32
Health and Welfare	14	-85	-12	63	-21	228	-22	-69	-6	-15	-169	-349	2,994	134
Services	56	-215	-173	120	-63	676	-63	-119	-16	-62	-119	-129	421	354

Source: Economic modelling by consultancy team.

7.4 Labour Demand Projections for Lower-level Qualifications

Figure 7.12 reports the trend of aggregate labour demand under BAU, BAU AAGR and COVID-19 including both a longer time frame (2004-2025) and the forecast period on the right- hand side of the figure. Unlike high and medium, we can see that the long-run aggregate trend in low qualifications is negative, and GDP growth is associated with a reduction in the number of low qualification jobs. Between 2009 and 2019 there was an approximate fall of 150,000 workers with low qualifications. From slightly above 200,000 at the end of 2019 Indecon models a decline to just over 178,000 workers by the end of 2025 in the BAU scenario.

Figure 7.12: Aggregate Labour Demand Forecast for Low Qualification, over 2004 – 2025 and 2017 – 2025



Projections are based on the mid-range value of the growth rates reported in Table 7.19.
Source: Economic modelling by consultancy team.

We use the same approach to predict the impact of COVID-19, however, the negative relationship with GDP growth leads to a separate method for low qualifications under COVID-19 which is outlined below. A negative coefficient on GDP for aggregate low qualification workers, indicates that a reduction in GDP due to COVID-19 would predict an *increase* in low skilled labour demand. A more robust approach to forecasting low qualifications demand under COVID-19 might take a variety of directions. One direction would be to model explicitly the long run trend and recession-based components. Another approach could be a corrected model with an asymmetric coefficient on GDP for recessions, which would allow the coefficient to be positive in a recession (and thus predict a fall in low skilled demand as gpd falls), but be negative during times of growth.

This effect can be observed ad-hoc in the data during the last large recession from 2008-2012 in the Figure 7.12 above, where low qualification labour demand fell about 33% between end 2008 and 2010. However, as there is only one large recession during the data-sample time period of the LFS, we were unable to model this explicitly. We further tried a number of other modelling approaches, but decided on an ad-hoc adjustment to low qualification labour demand. Thus, we imposed a proportional reduction in low qualification labour demand of 16%, which is developed as the 1-year similar proportional impact relative to the 2008 recession. In other words, we estimated the average annual rate of low qualification labour demand reduction for 2009 and 2010, and found that to be 16%. Once the economy returns to normal then the long-run estimated GDP relationship is resumed.

The range of growth rates in Table 7.19 have been constructed using the same methodology previously applied to high and medium qualifications (see Equation 5 and 6). Our modelling suggests a decline between -15.2% and -21.8% for low qualifications in the labour market and a decline between -28.4% and 35.1% under the COVID-19 scenario. The following table shows that the model predicts an initial drop in 2020 before finding a steady rate of decline of within the range of -2.17% and -3.28% a year.

Table 7.19: Labour Demand Forecast Growth for Low Qualification, 2020-2025

Independent Variable: GDP		2020	2021	2022	2023	2024	2025	Total
Forecasted Labour Demand Growth (BAU)	Variable Growth Rate	-3.33% - -4.44%	-3.17% - -4.28%	-2.17% - -3.28%	-2.17% - -3.28%	-2.17% - -3.28%	-2.17% - -3.28%	-15.2% - -21.8%
Forecasted Labour Demand Growth (BAU AAGR)	Average Growth Rate	-2.17% - -3.28%	-2.17% - -3.28%	-2.17% - -3.28%	-2.17% - -3.28%	-2.17% - -3.28%	-2.17% - -3.28%	-13% - -19.7%
Forecasted Labour Demand Growth under COVID-19	Variable Growth Rate	-16% - -17.11%	-3.76% - -4.87%	-2.17% - -3.28%	-2.17% - -3.28%	-2.17% - -3.28%	-2.17% - -3.28%	-28.4% - -35.1%

Source: Economic modelling by consultancy team.

The sensitivity analysis developed using modified total domestic demand rather than GDP is presented in the table overleaf. Annual growth rates in labour demand for low qualification using MTDD are negative as expected, but above the range of our previous forecast (see Table 7.19). In fact, our model estimates a weaker negative relationship between MTDD and labour demand (see Table 7.23 and Table 7.24).

Table 7.20: Labour Demand Forecast Growth for Low Qualification – MTDD Sensitivity Check, 2020-2025

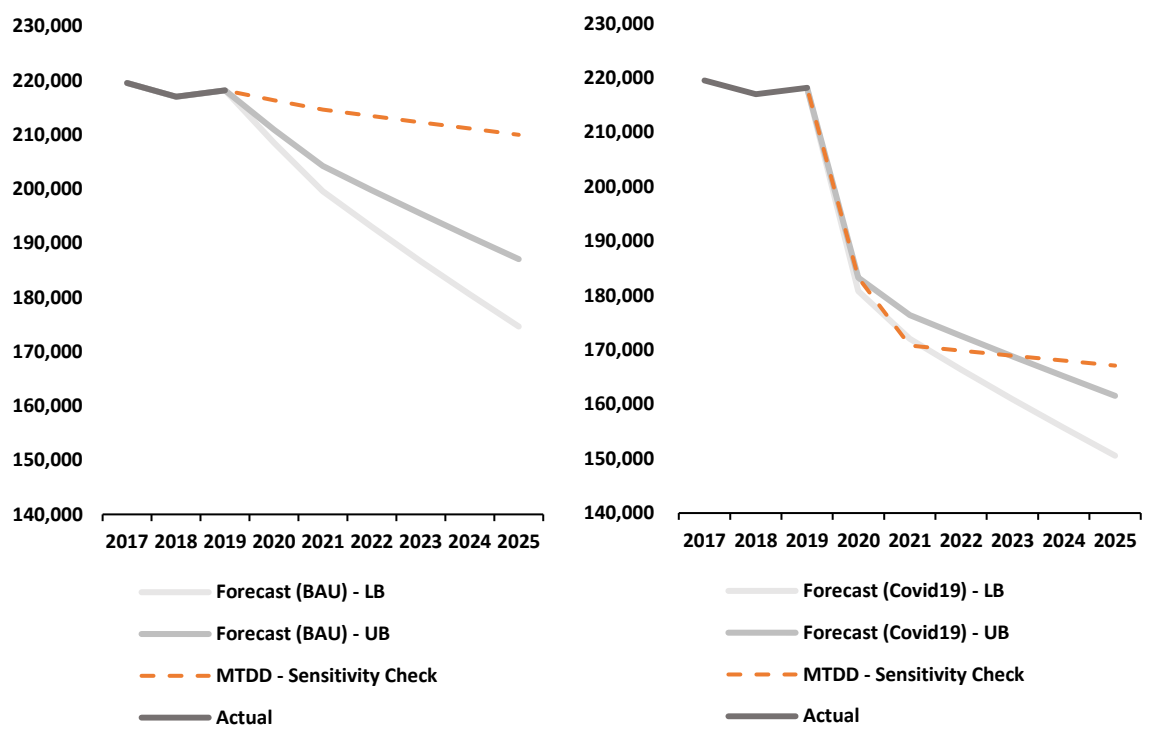
Independent Variable: MTDD		2020	2021	2022	2023	2024	2025	Total
Forecasted Labour Demand Growth (BAU)	Variable Growth Rate	-0.83%	-0.80%	-0.54%	-0.54%	-0.54%	-0.54%	-3.81%
Forecasted Labour Demand Growth (BAU AAGR)	Average Growth Rate	-0.54%	-0.54%	-0.54%	-0.54%	-0.54%	-0.54%	-3.27%
Forecasted Labour Demand Growth under COVID-19	Variable Growth Rate	-16.00%	-6.80%	-0.54%	-0.54%	-0.54%	-0.54%	-24.98%

Growth rates reported in this table are computed using $g_{Y,t} = \beta g_{MTDD,t}$, where $g_{,Y,t}$ *is the growth rate of labour demand Y at year t, after having multiplied the coefficient* β *(estimated by using Model 2, Equation 3) by the growth rate of MTDD at year t* ($g_{MTDD,t}$).

Source: Economic modelling by consultancy team.

In line what done previously for the other qualifications, Figure 7.13 plots projections using MTDD for labour demand with low qualification as a sensitivity check. Like for medium qualification, projections are well above the range of the previous forecast (also reported in Table 7.19) and the gap between the two forecasts gets wider over 2020-2025 in BAU case. In the COVID-19 scenario projections are within the range until 2023. Projections then decline at a higher (less negative) estimated long-run growth rate (-0.54% as reported in Table 7.20).

Figure 7.13: Aggregate Labour Demand Forecast for Low Qualification under BAU and COVID-19– MTDD Sensitivity Check, 2017 – 2025



Source: Economic modelling by consultancy team.

Other analysis of a sectoral basis, shows that expected labour demand for workers with low qualifications has been falling with economic growth, with the coefficient for every sector both negative and statistically significant. Certain sectors, such as information and communications (J) and financial, insurance and real estate activities are estimated to experience greater than 1% decline in demand as GDP increases by 1%. This is expected due to the high percentage of these sectors who are professionals, and the ability of these sectors to shift labour and outsource, for what few jobs remain for the low skilled. Administrative and support activities (N) and accommodation and food service activities (I) are expected to have the smallest decline as GDP increases. Administrative and support services for example are expected to experience a 0.17% decline when GDP grows by 1%.

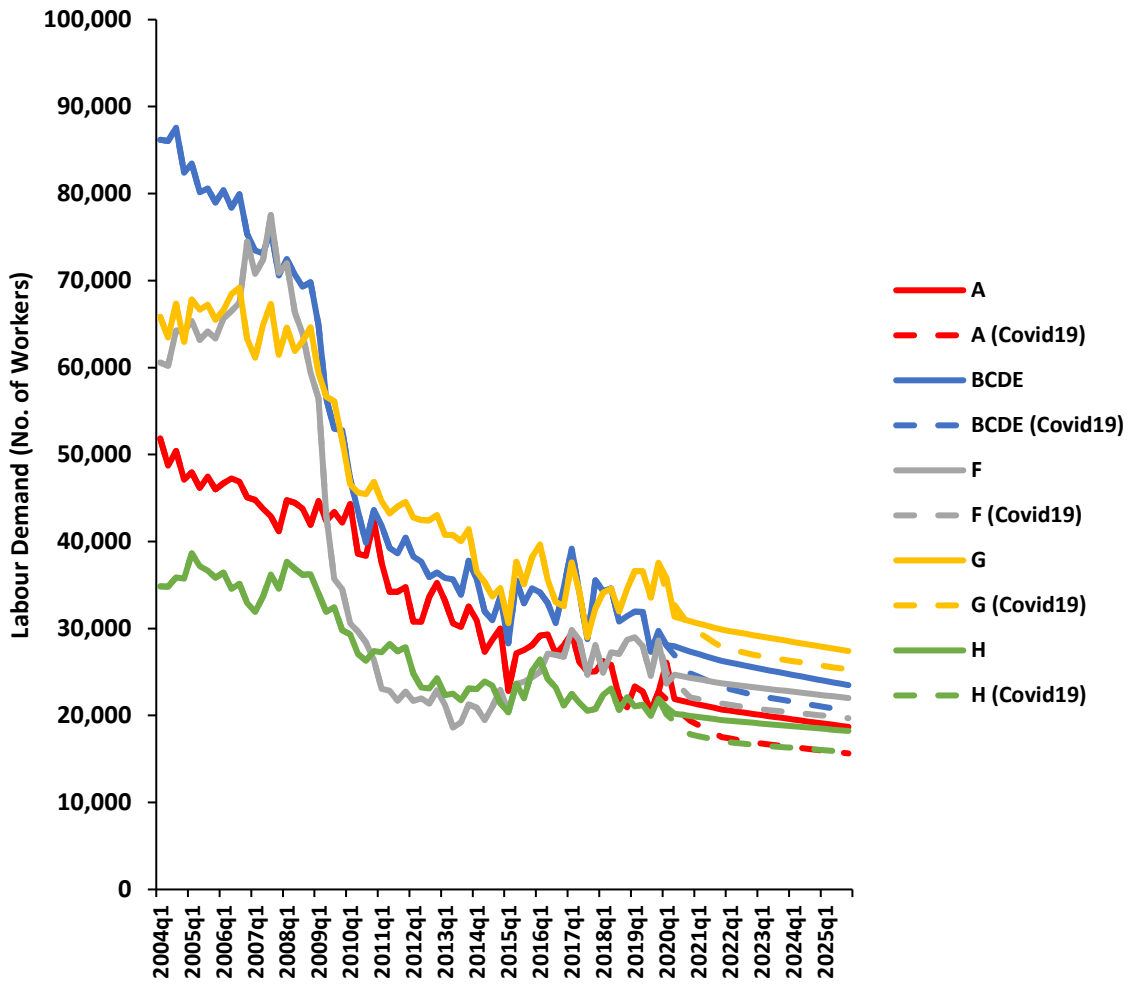
Table 7.21: Labour Demand Responsiveness by Economic Sector (Low Qualifications)	
Dependent Variable: total employed	
Independent Variable: gdp_t	**(Model 2)**
A: Agricultural, Forestry and Fishing	-0.79***
BCDE: Industry	-0.87***
F: Construction	-0.58***
G: Wholesale and Retail Trade; repair of motor vehicles and motorcycles	-0.67***
H: Transportation and Storage	-0.52***
I: Accommodation and food service activities	-0.38***
J: Information and communication	-1.01***
KL: Financial, insurance and real estate activities	-1.09***
M: Professional, scientific and technical activities	-0.68**
N: Administrative and support activities	-0.17***
O: Public administration and Defence: compulsory social security	-0.87***
P: Education	-0.92***
Q: Human health and social work activities	-1.00***
RSTU: Other NACE	-0.48***
Table 7.21 reports only the coefficient β of Equation 3. The coefficients reported in this table were estimated using log-transformed variables (denoted by lower case letters). *** p<0.01, ** p<0.05, * p<0.1	
Source: Economic modelling by consultancy team.	

In Table 7.22, estimates for the growth (or decline) of labour demand for low qualification between 2020 and 2025 are presented. Accommodation and Food service activities (I) is expected to fall by 25% to 40% (or lose about 3.6 to 5.6 thousand workers in sector I), as is the human health and social work activities sector (Q) with an expected fall of similarly three to five thousand workers. We also expect the ICT sector (J) to considerably fall by over 50% under either scenario (or one thousand fewer workers). Labour demand for low qualifications is expected to fall in all sectors.

Table 7.22: Labour Demand Forecast Growth for Low Qualification by Economic Sector, 2019-2025				
	Forecasted Increase (BAU)	**Growth 2019-2025**	**Forecasted Increase (COVID-19)**	**Growth 2019-2025**
A: Agricultural, Forestry and Fishing	-3,882	-19%	-7,116	-38%
BCDE: Industry	-5,429	-21%	-8,619	-35%
F: Construction	-3,750	-16%	-6,216	-27%
G: Wholesale and Retail Trade; repair of motor vehicles and motorcycles	-7,822	-25%	-10,173	-34%
H: Transportation and Storage	-2,597	-13%	-5,269	-29%
I: Accommodation and food service activities	-3,666	-25%	-5,590	-40%
J: Information and communication	-1,147	-55%	-1,337	-68%
KL: Financial, insurance and real estate activities	-717	-46%	-890	-61%
M: Professional, scientific and technical activities	-998	-33%	-1,094	-37%
N: Administrative and support activities	-4,108	-24%	-6,036	-37%
O: Public administration and defence: compulsory social security	-817	-19%	-1,466	-37%
P: Education	-1,473	-36%	-1,626	-41%
Q: Human health and social work activities	-3,254	-23%	-5,086	-38%
RSTU: Other NACE	-2,979	-24%	-3,629	-30%
Source: Economic modelling by consultancy team.				

Wholesale and retail trade (G) is forecasted to remain the largest sector, despite a forecasted decline in labour demand for low qualifications. The all sectors are forecast to continue the downward trend for low qualification workers that had been experienced in the previous 10-year period.

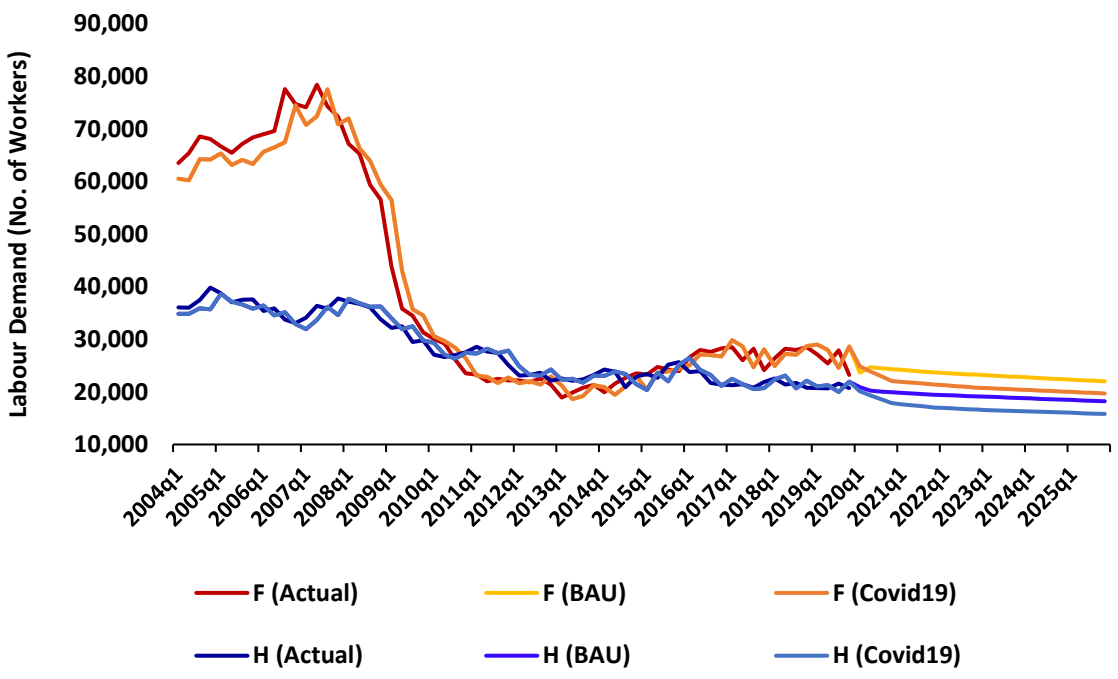
Figure 7.14: Labour Demand Forecast for Low Qualification in Five Largest Sectors, Q1 2004 – Q4 2025



The forecasts were estimated using Model 2 (Equation 3, see subsection Modelling Framework).
Source: Economic modelling by consultancy team.

Whilst the construction (F) and transportation and storage (H) sectors are expected to experience declining demand for labour with low qualifications they are the two sectors that are modelled to have the slowest decline.

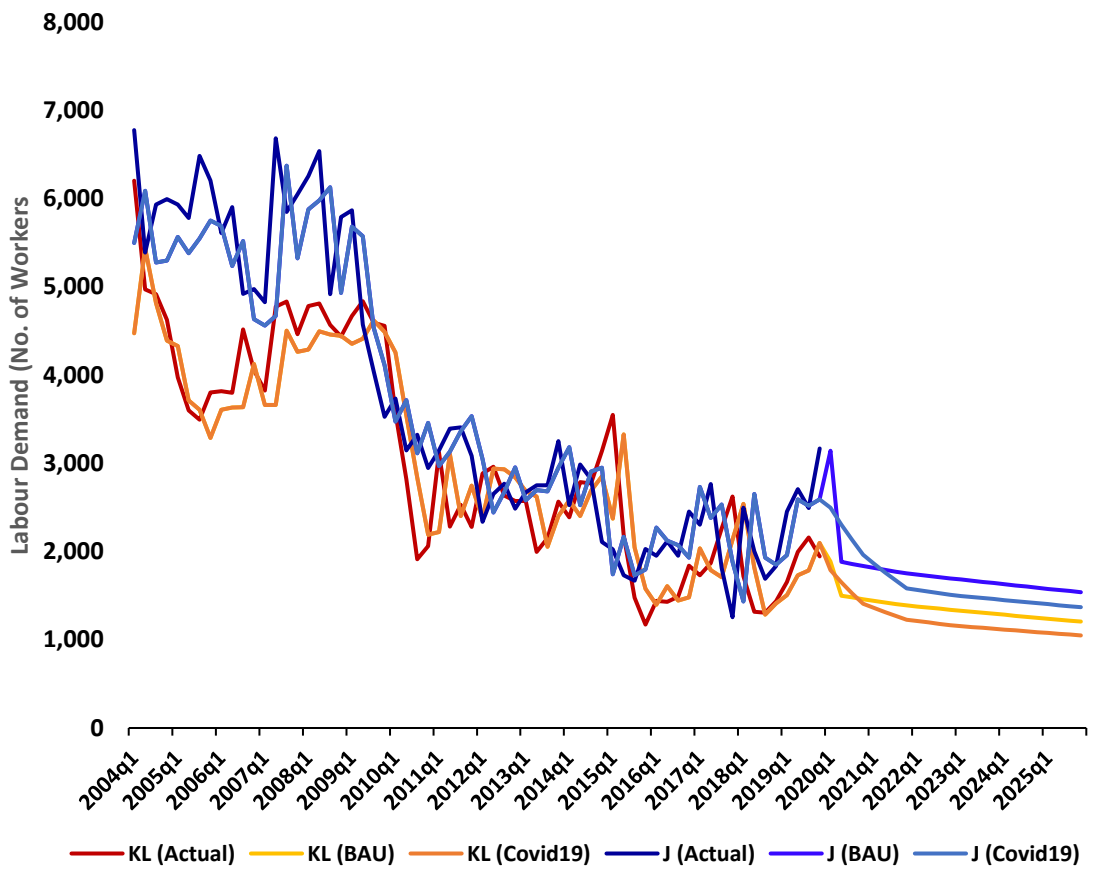
Figure 7.15: Labour Demand Forecast for Low Qualification in Two Sectors with Slowest Decline, Q1 2004 – Q4 2025



The forecasts were estimated using Model 2 (Equation 3, see subsection Modelling Framework).
Source: Economic modelling by consultancy team.

Information and communications (J), and financial, insurance and real estate activities (KL) are the two sectors expected to experience the fastest decline. Whilst these sectors are already amongst the smallest sectors in terms of demand for labour with low qualifications, they are anticipated to have labour demand of less than 2,000 by 2025. It is noteworthy that these sectors are forecasted to grow and increase highly qualified employment demand.

Figure 7.16: Labour Demand Forecast for Low Qualification in Two Fastest Declining Sectors, Q1 2004 – Q4 2025



The forecasts were estimated using Model 2 (Equation 3, see subsection Modelling Framework).
Source: Economic modelling by consultancy team.

7.5 Comparison of Projections by Qualification Level

It is useful to compare the labour demand projections across high, medium and low qualifications. We begin with a comparison of the aggregate employment or labour demand by the aggregate qualification levels: high, medium and low. The following table shows the coefficients from our Model 2. The coefficients for GDP can be interpreted as the percentage change in labour demand as a result of a 1% change in GDP from the aggregate models. For example, labour demand for high qualifications is modelled to increase by 0.517% as GDP increases by 1%. However, a 1% increase in GDP is forecast to lead to a 0.677% decline in demand for labour with low qualifications. This is consistent with our analysis of expected demand for labour with low qualifications by sector.

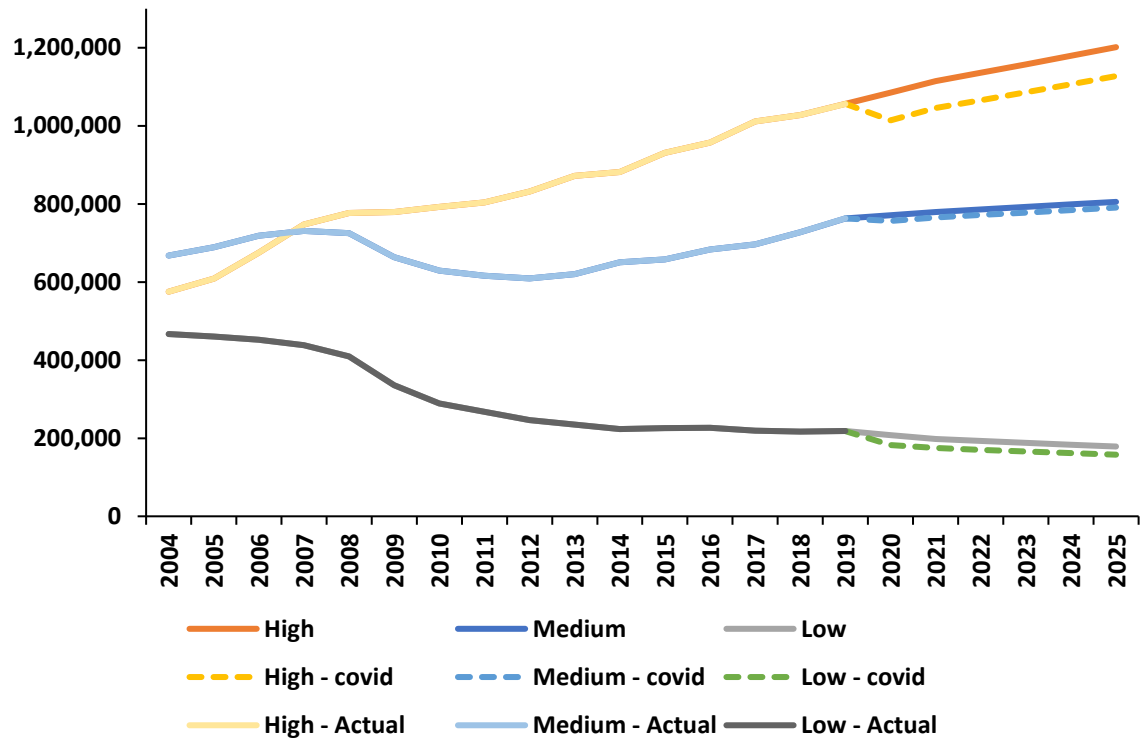
Table 7.23: Summary of Outputs from Modelling (Model 2)			
Coefficient-variable	**Low**	**Medium**	**High**
β-gdp	-0.677*** (0.024)	0.150*** (0.009)	0.517*** (0.014)
δ-MA(1)	0.975*** (0.026)	0.954*** (0.0398)	0.914*** (0.035)
α-Constant	19.944*** (0.266)	11.797*** (0.095)	8.007*** (0.156)
n-Observations	64	64	64
R-squared	0.974	0.932	0.972
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			
Source: Economic modelling by consultancy team.			

The table below presents aggregate labour demand responsiveness to economic growth proxied by modified total domestic demand (MTDD) rather than GDP as a sensitivity check. We note that our model estimates a very similar coefficient for labour demand with high qualification. Nevertheless, figures below report a much weaker negative relationship between the Irish economy and labour demand for low qualification, where demand for such workers are expected to just decrease by -0.170% as MTDD increases by 1%. Labour demand for medium qualification is also expected to increase by 0.427%, thus a much a higher increase compared to the 0.150% increase with a 1% increase in GDP (see table 6.21).

Table 7.24: Summary of Outputs from Our Modelling (Model 2) – MTDD Sensitivity Check			
Coefficient-variable	**Low**	**Medium**	**High**
β- MTDD	-0.170*** (0.034)	0.427*** (0.022)	0.550*** (0.028)
δ-MA(1)	0.986*** (0.015)	0.694*** (0.090)	0.948*** (0.024)
α-Constant	14.37*** (0.359)	8.918*** (0.234)	7.822*** (0.299)
n-Observations	64	64	64
R-squared	0.986	0.883	0.971
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			
Source: Economic modelling by consultancy team.			

The figure below presents aggregate labour demand projections by qualification. This suggests that the projected increase in labour demand for high qualifications, whilst medium qualifications are expected to be relatively stable. Labour demand for low qualifications is forecast to decline gradually.

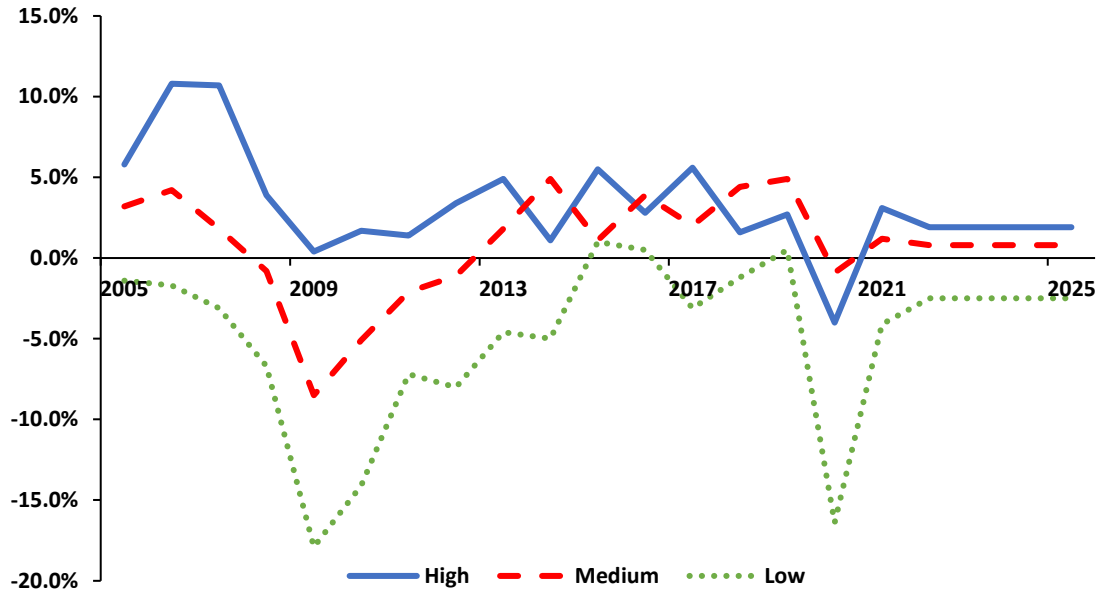
Figure 7.17: Aggregate Labour Demand Forecast for High, Medium and Low Qualification, Q1 2004 – 2025



Source: Economic modelling by consultancy team.

Aggregate labour demand projections are also presented in the form of yearly growth rates under the COVID-19 scenario. For high and medium qualifications, the initial impact of COVID-19 is expected to decrease demand by 3.8% and 3.3% respectively. In case of low qualifications, demand has been adjusted to decline by 16%, a proportional reduction made to reflect the similar 1-year impact of the 2008 recession.

Figure 7.18: Aggregate Labour Demand Forecast % Change under COVID-19 for High, Medium and Low Qualification,Q1 2004 – Q4 2025



Source: Economic modelling by consultancy team.

Whilst the previous analysis shows the changes in aggregate labour demand for each sector between 2004 and 2025, the following table focuses on the change over the next six years for each of the sectors modelled under BAU scenario and COVID-19. In case of BAU, Human health and social work activities (Q) is anticipated to remain the largest sector, as measured by labour demand (number of workers). Growth of over 12% is estimated in the sector with nearly 300,000 workers expected to be in demand in 2025. Accommodation and food service activities (I) are forecast to be the fastest growing sector over the 2019-2025 period under both BAU and COVID-19. Two sectors, construction (F) and transportation and storage (H) are expected to experience slight declines in labour demand under BAU, and further drop by 6-7 percentage points under COVID-19.

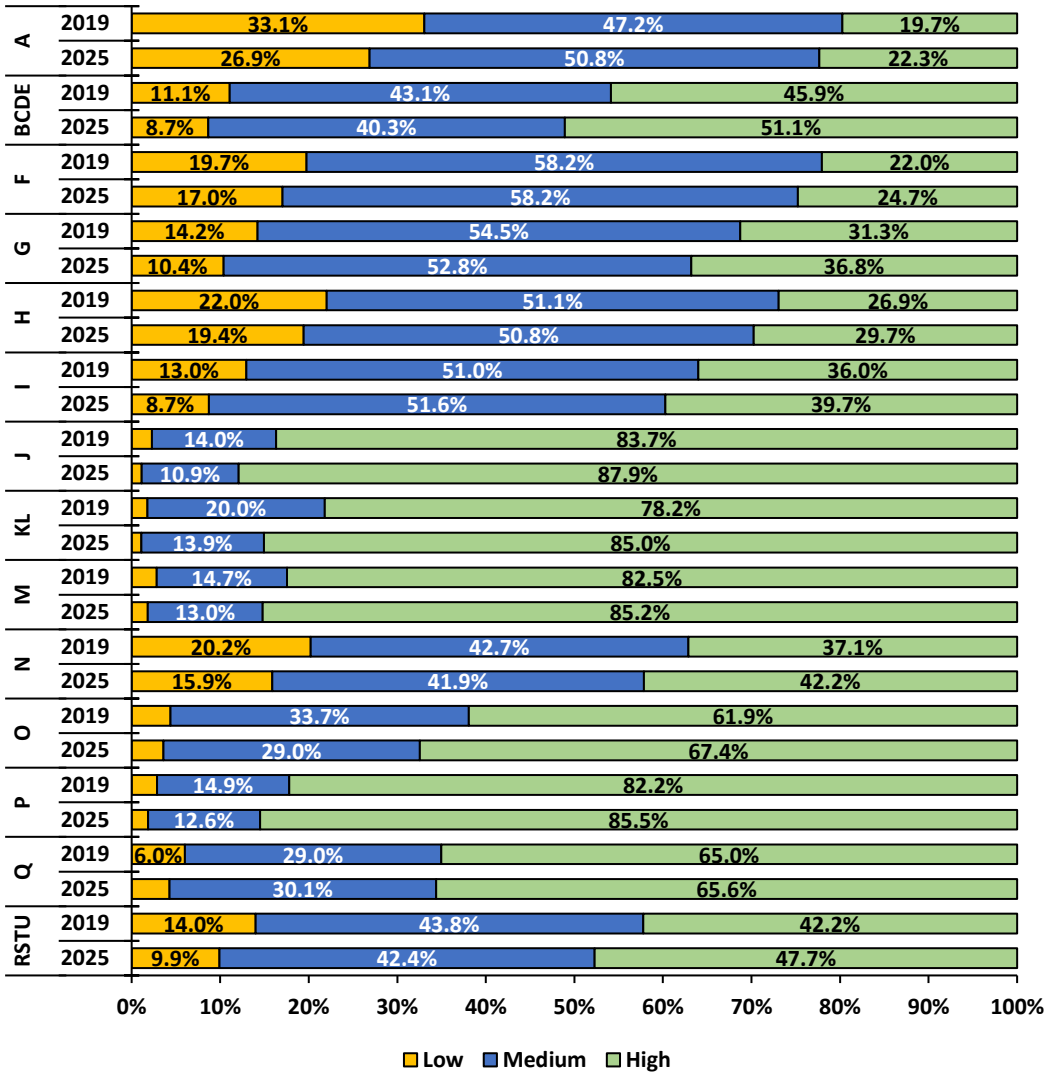
Table 7.25: Modelled Change in Aggregate Labour Demand Forecast (2019 – 2025)					
	2019 Actual	2025 Forecast (BAU)	Percentage Change	2025 Forecast (Covid 19)	Percentage Change
A: Agricultural, Forestry and Fishing	68,798	70,186	2.0%	66,076	-4.0%
BCDE: Industry	263,588	273,841	3.9%	261,889	-0.6%
F: Construction	131,199	129,979	-0.9%	122,926	-6.5%
G: Wholesale and Retail Trade; repair of motor vehicles and motorcycles	249,309	266,254	6.8%	255,115	2.3%
H: Transportation and Storage	95,072	94,373	-0.7%	87,829	-7.9%
I: Accommodation and food service activities	129,805	150,881	16.2%	138,151	6.2%
J: Information and communication	117,823	136,147	15.6%	125,125	6.0%
KL: Financial, insurance and real estate activities	107,644	112,518	4.5%	107,140	-0.5%
M: Professional, scientific and technical activities	125,367	139,199	11.0%	133,449	6.2%
N: Administrative and support activities	96,938	97,385	0.5%	90,844	-6.5%
O: Public administration and defence: compulsory social security	107,733	109,339	1.5%	103,212	-4.3%
P: Education	168,533	179,036	6.2%	170,309	1.0%
Q: Human health and social work activities	266,344	299,069	12.3%	281,644	5.6%
RSTU: Other NACE	98,666	109,428	10.9%	104,149	5.4%
Source: Economic modelling by consultancy team.					

The coefficients in the following table represent a percentage change in the demand for labour amongst the qualification level in the sector for a 1% increase in GDP. As mentioned previously each of the sectors is expected to experience an increase in labour demand for high qualifications of between 0.4% and 0.8% as GDP grows by 1%. However, declining labour demand for low qualifications is expected in each sector, with J and KL expecting greater than 1% declines as GDP grows by 1%.

Table 7.26: Labour Demand Responsiveness by Economic Sector			
Independent Variable: gdp_t	**Low**	**Medium**	**High**
A: Agricultural, Forestry and Fishing	-0.79***	0.02	0.41***
BCDE: Industry	-0.87***	0.07***	0.47***
F: Construction	-0.58***	0.18***	0.78***
G: Wholesale and Retail Trade; repair of motor vehicles and motorcycles	-0.67***	0.17***	0.52***
H: Transportation and Storage	-0.52***	0.30***	0.70***
I: Accommodation and food service activities	-0.38***	0.57***	0.80***
J: Information and communication	-1.01***	-0.28***	0.77***
KL: Financial, insurance and real estate activities	-1.09***	-0.75***	0.45***
M: Professional, scientific and technical activities	-0.68**	-0.10**	0.40***
N: Administrative and support activities	-0.17***	0.33***	0.63***
O: Public administration and Defence: compulsory social security	-0.87***	-0.20***	0.63***
P: Education	-0.92***	0.25***	0.43***
Q: Human health and social work activities	-1.00***	0.49***	0.45***
RSTU: Other NACE	-0.48***	0.27***	0.50***
The coefficients reported in this table were estimated using log-transformed variables (denoted by lower case letters).			
*** p<0.01, ** p<0.05, * p<0.1			
Source: Economic modelling by consultancy team.			

The following figures shows how high qualifications are expected to grow as a percentage of the labour demand within a sector, whilst demonstrating the decline in labour demand for low qualifications in terms of proportions by sector. Sectors such as financial, insurance and real estate services which are already mostly filled by those with high qualifications are expected to become even more so. Some sectors, agriculture, forestry and fishing (A) for example, are forecast to have an increase in the share of labour with medium qualifications with over half of the sector expected to have medium qualifications in 2025, moving from 47.2% to 50.8%.

Figure 7.19: Labour Demand Forecast for High, Medium and Low Qualification under BAU 2019 - 2025



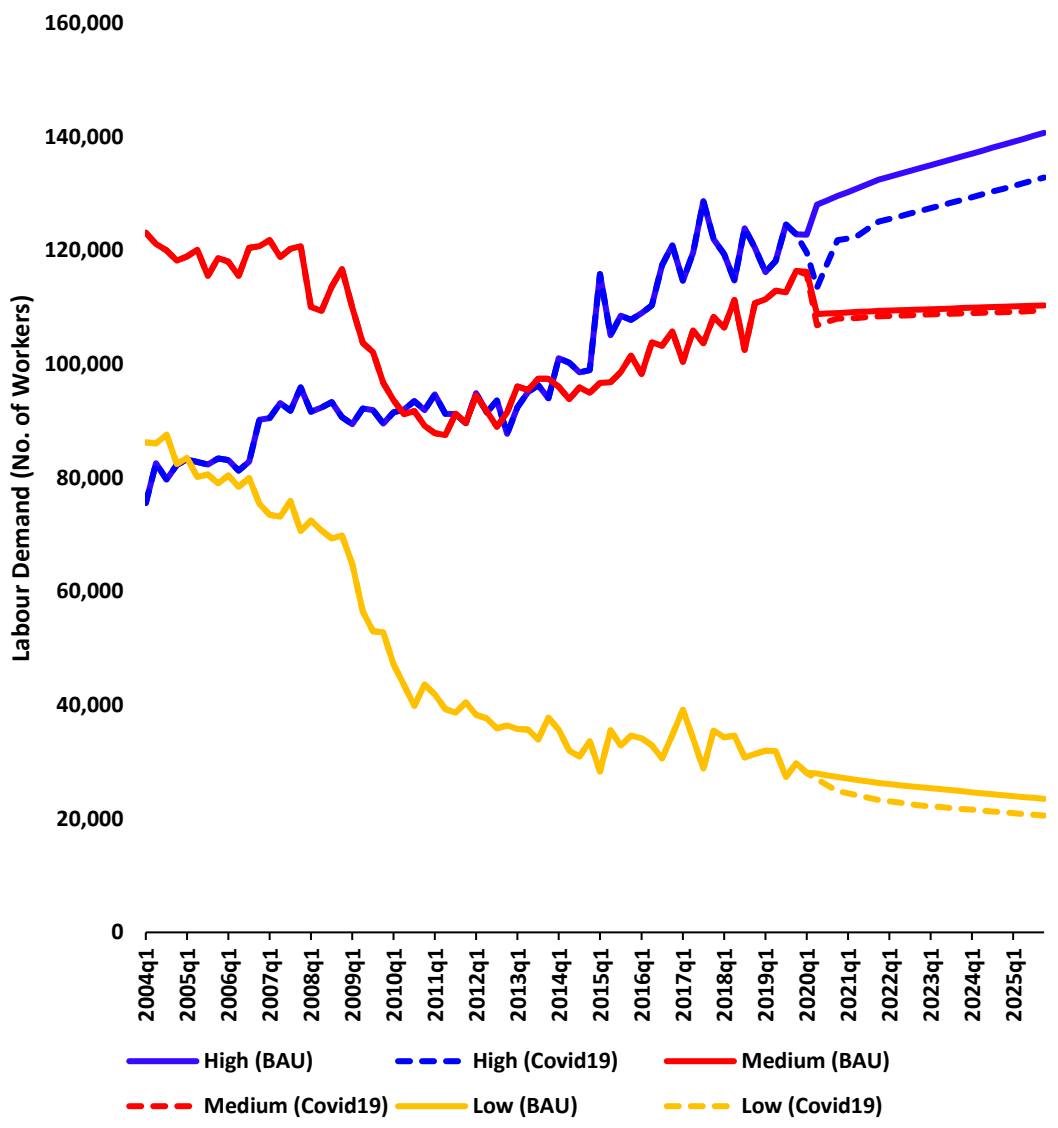
Source: Economic modelling by consultancy team.

The following table compares the numbers behind the previous figure under COVID-19 against the BAU scenario by breaking down the number of workers modelled by the different levels of qualification. In 2025, almost 200,000 workers with high qualifications are expected to be in demand in the human health and social work activities sector (Q) under BAU. Industry (BCDE) is expected to remain one of the largest sectors across each of the qualification levels.

Table 7.27: Modelled Labour Demand in 2025 (Number of Workers)						
	BAU			COVID-19		
	Low	Medium	High	Low	Medium	High
A: Agricultural, Forestry and Fishing	18,871	35,629	15,686	15,636	35,520	14,921
BCDE: Industry	23,736	110,229	139,876	20,547	109,286	132,057
F: Construction	22,160	75,657	32,162	19,693	73,985	29,249
G: Wholesale and Retail Trade; repair of motor vehicles and motorcycles	27,628	140,620	98,006	25,277	137,816	92,022
H: Transportation and Storage	18,336	47,961	28,076	15,814	46,243	25,772
I: Accommodation and food service activities	13,152	77,785	59,944	11,229	72,530	54,392
J: Information and communication	1,557	14,891	119,698	1,369	14,848	108,908
KL: Financial, insurance and real estate activities	1,222	15,610	95,686	1,049	15,515	90,577
M: Professional, scientific and technical activities	2,540	18,081	118,579	2,443	18,063	112,943
N: Administrative and support activities	15,481	40,843	41,061	13,552	39,255	38,038
O: Public administration and defence: compulsory social security	3,908	31,693	73,737	3,261	31,631	68,320
P: Education	3,350	22,598	153,089	3,198	21,916	145,195
Q: Human health and social work activities	12,747	90,114	196,208	10,915	84,879	185,850
RSTU: Other NACE	10,838	46,393	52,197	10,188	44,869	49,092
Source: Economic modelling by consultancy team.						

We next present graphical illustrations of the labour demand by industry comparing high, medium and low qualifications trends and forecasts under BAU and COVID-19. Labour demand for high qualifications in industry is expected to grow steadily from 2020 to 2025, widening the gap between it and medium qualifications. Demand for low qualifications is expected to continue its decline from the previous ten-year period. Notably, high qualification numbers in industry now exceed medium, which interestingly was due more to the fall in medium qualification workers during the last recession than for the increase in high qualification workers during the same period.

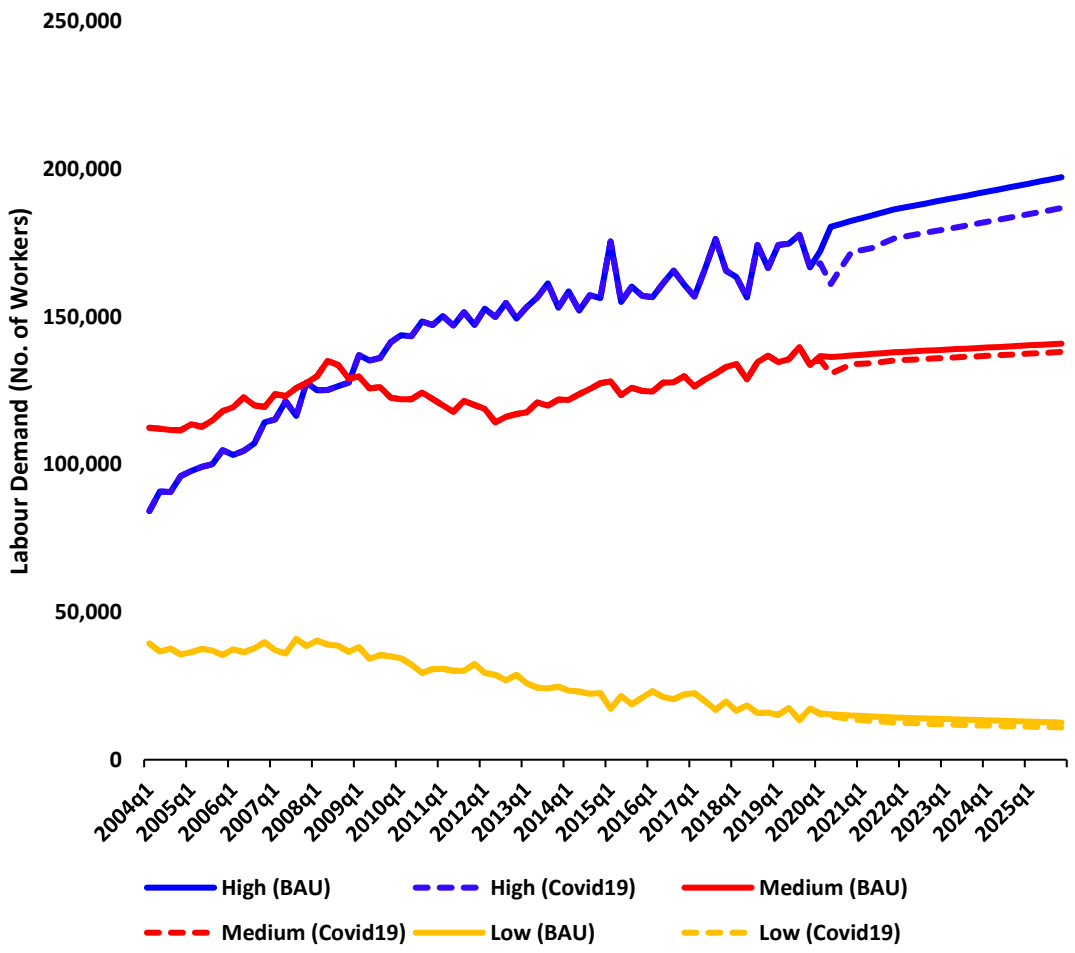
Figure 7.20: Labour Demand Forecast for High, Medium and Low Qualification for Industry (BCDE), Q1 2004 – Q4 2025



The forecasts were estimated using Model 2 (Equation 3, see subsection Modelling Framework).
Source: Economic modelling by consultancy team.

Health and Social Work (Q) is one of the largest sectors, with growth anticipated in labour demand for both high and medium qualifications. Labour demand for those with high qualifications is modelled to reach 198,000 by the end of 2025, with over 90,000 workers with medium qualifications expected to be needed by the end of 2025 under BAU. Labour demand for low qualifications is however expected to decline in both BAU and COVID-19.

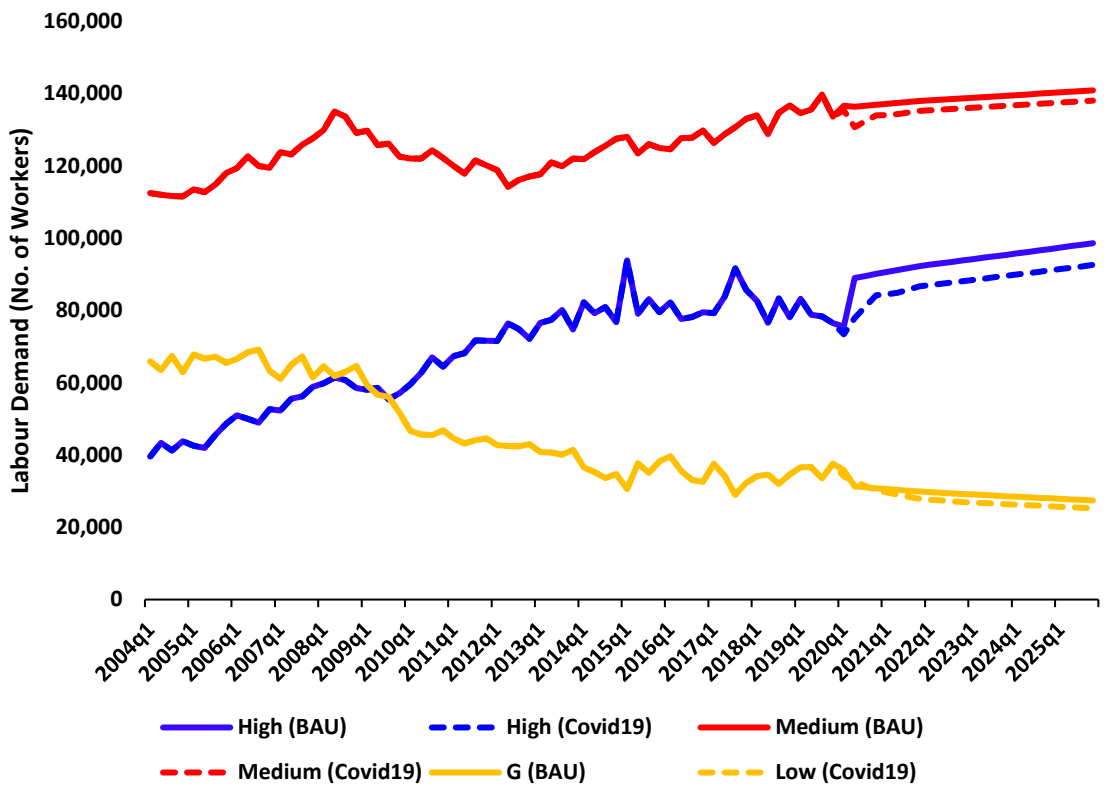
Figure 7.21: Labour Demand Forecast for High, Medium and Low Qualification for Human Health and Social Work Activities (Q), Q1 2004 – Q4 2025



The forecasts were estimated using Model 2 (Equation 3, see subsection Modelling Framework).
Source: Economic modelling by consultancy team.

The next figure illustrates wholesale and retail trade (G). Whilst labour demand for high qualifications in wholesale and retail trade (G) is expected to grow, it is anticipated that it will remain below the demand for those with medium qualifications. As with other sectors, demand for low qualifications is expected to fall.

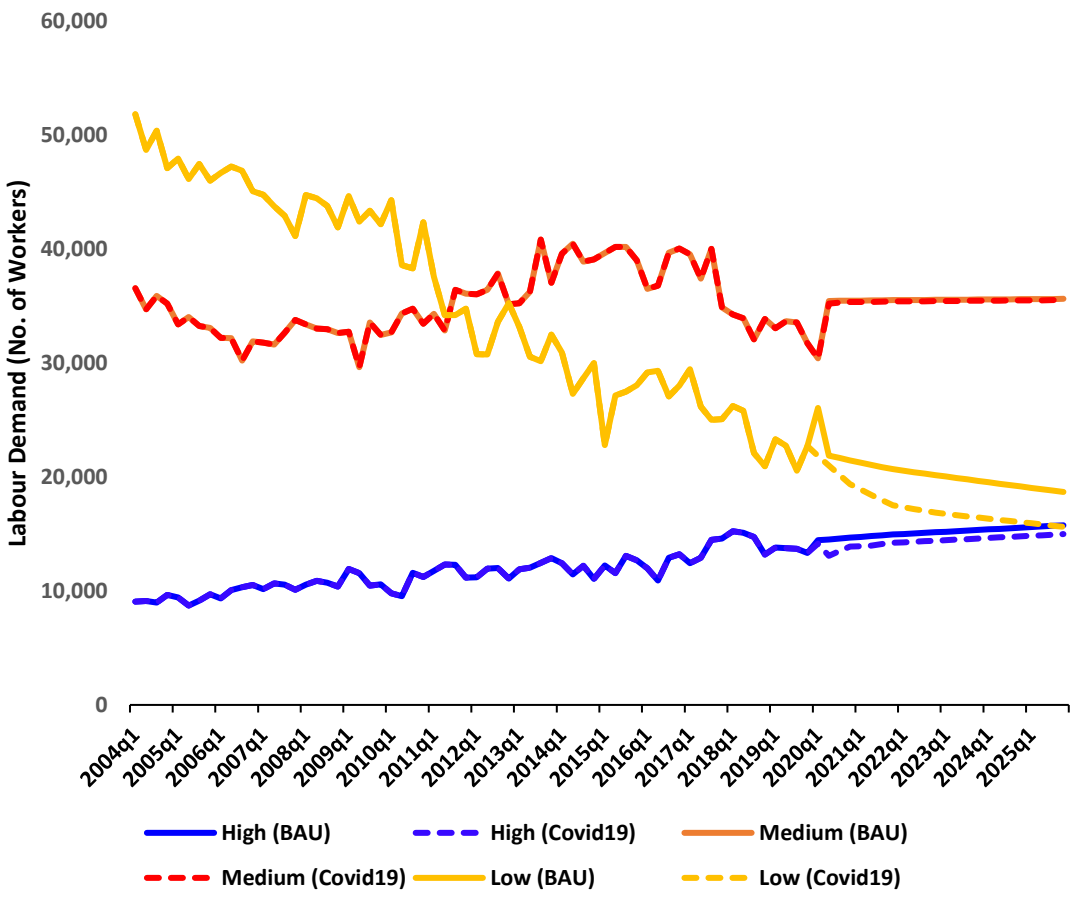
Figure 7.22: Labour Demand Forecast for High, Medium and Low Qualification for Wholesale and Retail Trade (G), Q1 2004 – Q4 2025



The forecasts were estimated using Model 2 (Equation 3, see subsection Modelling Framework).
Source: Economic modelling by consultancy team.

The following figure examines expected trends in labour demand in the agriculture, forestry and fishing sectors (A). This sector is one of the few sectors where low qualification demand was highest; but even in this sector medium qualification is now the largest component. Whilst demand for low qualifications is anticipated to fall it is expected to remain above the demand for high qualifications over the 2020-2025 period. Labour demand for those with medium qualifications accounts for the majority of anticipated labour demand in the sector, although its growth rate (as seen by the slope of the forecast line) is expected to be lower than high qualification.

Figure 7.23: Labour Demand Forecast for High, Medium and Low Qualification for Agriculture, Forestry and Fishing (A), Q1 2004 – Q4 2025



The forecasts were estimated using Model 2 (Equation 3, see subsection Modelling Framework).
Source: Economic modelling by consultancy team.

An analysis of the relationship between field of study and economic growth is presented in Table 7.28. This shows that:

- Models by field show Hatfield sensitivity to changes in GDP.
- ALL High Qual fields show strong positive relationship to economic growth.
- High qual ICT shows strongest and almost 1:1 relationship to GDP, followed by Education and Health.
- Med Quals fields mixed relation to GDP growth: Natural Sciences<0, ICT=0, Health>1, Social Science, Agriculture, Engineering, Arts week positive.

Table 7.28: Relationships Between Field of Study and Economic Growth											
Coefficients lngdp	**Highest Achieved Field (Hatfield)**										
Dependent Variable	**gen_prog**	**edu**	**arts**	**soc_sci**	**nat_sci**	**ict**	**eng**	**agr**	**health**	**services**	**unk**
High qualification Labour	0.56***	0.636***	0.329***	0.467***	0.446***	0.982***	0.102***	0.301***	0.575***	0.143***	0.558***
Observations	64	63	63	63	63	63	63	63	63	63	63
R-squared	0.419	0.870	0.699	0.932	0.883	0.894	0.776	0.727	0.909	0.679	0.747
Medium Qualification Labour	-0.16***	2.034***	0.146**	0.0935**	-0.341**	0.0789	0.199***	0.287***	1.707***	0.816***	0.695***
Observations	64	63	63	63	63	63	63	63	63	63	63
R-squared	0.814	0.894	0.606	0.829	0.760	0.894	0.858	0.685	0.954	0.892	0.634

Source: Analysis of LFS data
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7.6 Summary of Key Findings

- Major difficulties in estimating future demand by qualifications and the econometric modelling undertaken is focused on enhancing Ireland's skills intelligence of importance. However, some key findings from models are evident.
- All sectors show positive relationship between high qualifications and economic growth and negative relationship between low qualifications.
- Shift in the sectoral mix of qualifications towards higher skills predicted to continue in post-COVID-19 scenario.
- The impact of COVID-19 on forecasts highlights how developments in the economy can quickly change skill requirements. This suggests the importance of flexibility within the FET and HE systems.
- The move towards higher skills does not imply increased numbers have to be accommodated within the HE system, and the likely loss in low skill jobs suggests an increasing role for FET in assisting individuals with the skills needed to adapt to these changes.
- Overall, the analysis suggests that FET and HE systems will need great flexibility to adjust to the expected changes in labour market requirements in order to avoid significant skill mismatches.

8 Emerging Sectors and Technologies

8.1 Impact of Technological Change on Skill Needs

Emerging industries come into existence with the creation of a new industrial value chain, or the radical reconfiguration of an existing one, driven by a disruptive idea or ideas. This leads to new products/services with higher added value, driving a high growth rate in the industries concerned and further market potential.[154] Technological change, and the increased reliance on that technology, can also result in changes in the skill needs within industries. Further, changing societal needs, such as the need to address climate change, are resulting in the emergence of new sectors and activities.

The disruptive nature of technological change makes the task of predicting future skill needs evermore challenging.[155] Long-term labour market forecasts are limited by the difficulty of estimating future skill demand, as the latter is sensitive to unpredictable technological or other changes, which reduces the reliability of such exercises.[156] However, developing a longer-term view of labour market changes in the face of technological changes, and updating this regularly, can help ensure that any structural changes in the economy are captured in the estimation process, while allowing for the alteration of assumptions in the face of new economic and social developments.[157] Skills assessment and anticipation exercises do not attempt to predict the future with certainty or precision. They are tools to help prepare or plan for future scenarios constructed from reliable evidence-based information.[158]

8.2 Skills Requirements of Internationally Traded Sector

Ireland is one of the most open trading nations in the world, with a very high rate of engagement with international trade. The composition of Ireland's export base has also changed rapidly over the last number of decades, as Ireland transitioned from relatively low value-added operations in the 1990s to higher-end R&D, logistics, and management functions today.

Ireland has a concentration in a number of industrial sub-sectors, which in turn influences the nature of skills needs. These include: pharmaceuticals and chemicals, medical devices, ICT/internet services, financial services, and business services. The total sales, exports and employment levels across sectors are shown in Table 8.1.

[154] European Commission, https://ec.europa.eu/growth/industry/policy/cluster/emerging-industries_en, accessed on 25.05.20.

[155] ILO and OECD (2018), "Approaches to anticipating skills for the future of work", Report prepared by the ILO and OECD for the G20 Employment Working Group.

[156] Wilson and Zukersteinova (2011), as cited in ILO and OECD (2018).

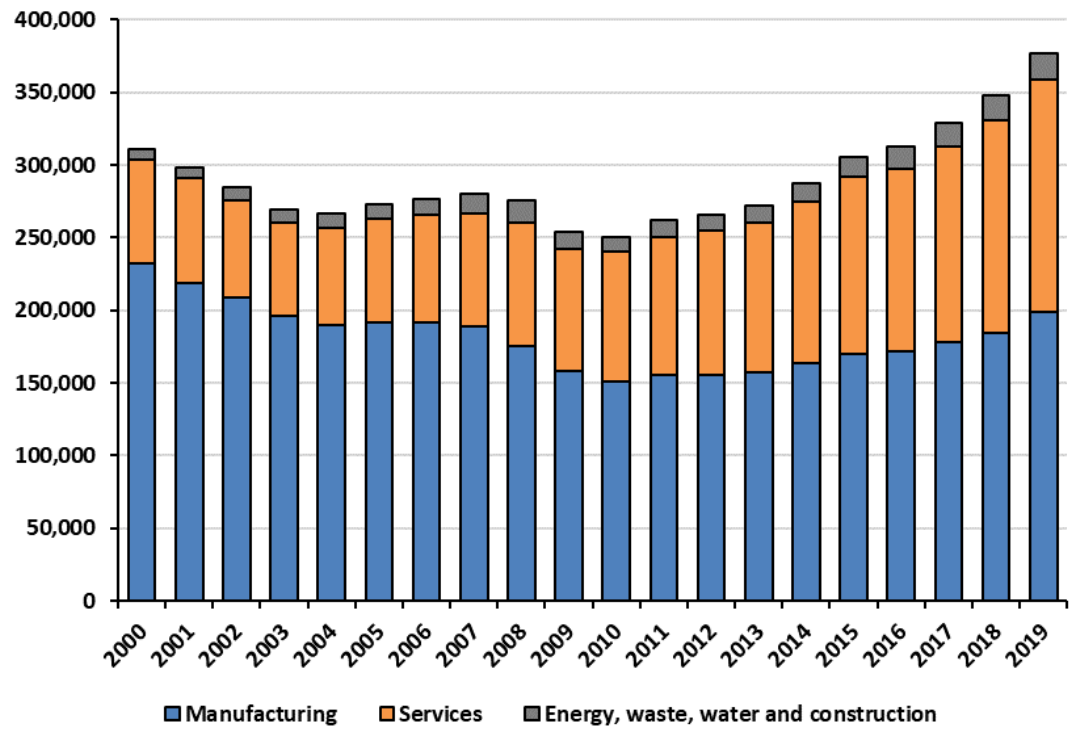
[157] Thomas, Jasmin. Review of best practices in labour market forecasting with an application to the Canadian Aboriginal population. No. 2015-16. Centre for the Study of Living Standards, 2015

[158] Wilson (2012), "Wilson, R. (2012), "Skills Forecasting: Applying the Cedefop Skills Forecasting Framework to Transition and Developing Countries", ETF Workshop on Foresight and Policies and Strategies for VET.

Table 8.1: Sectoral Composition of Exporting Firms in Ireland, 2019			
	Sales €m	***Exports €m***	***Employment Number***
Agriculture, Fishing, Forestry, Mining & Quarrying	*531*	*254*	*2,443*
Food, Drink & Tobacco	*23,403*	*14,258*	*47,219*
Textiles, Clothing, Footwear & Leather	*623*	*449*	*2,112*
Wood & Wood Products	*1,168*	*507*	*3,527*
Paper & Printing	*767*	*213*	*4,196*
Chemicals	*55,459*	*54,869*	*27,449*
Rubber & Plastics	*2,265*	*1,684*	*7,561*
Non-Metallic Minerals	*1,972*	*767*	*11,707*
Basic & Fabricated Metal Products	*2,707*	*1,595*	*12,543*
Computer, Electronic & Optical Products	*14,813*	*14,373*	*17,285*
Electrical equipment	*1,669*	*1,356*	*6,120*
Machinery & Equipment	*4,713*	*3,822*	*13,560*
Transport Equipment	*1,242*	*1,147*	*5,160*
Medical Device Manufacturing	*11,026*	*10,860*	*31,276*
Other Misc. Manufacturing	*1,173*	*724*	*6,299*
Energy, Water, Waste & Construction	*7,580*	*2,527*	*18,643*
Publishing, Broadcasting & Telecommunications	*1,268*	*758*	*8,021*
Computer Programming, Consultancy & Facilities Management	*100,522*	*95,522*	*77,447*
Other IT & Computer Services	*33,179*	*32,426*	*18,664*
Financial Services	*5,349*	*3,635*	*17,142*
Business Services	*6,964*	*4,483*	*27,642*
Education	*699*	*627*	*1,664*
Other Services	*5,028*	*4,221*	*9,480*
Total	***284,121***	***251,077***	***377,160***
Source: Annual Business Survey of Economic Impact			

The employment composition of exporting firms has also changed significantly over the last two decades, as shown in Figure 8.1 below. There has been a notable increase in services employment, with over 160,000 jobs in 2019 compared to 84,000 ten years previously, mirroring the increased share of services value-added as a percentage of GNP. This changing composition towards greater services is likely to have a significant impact on skill demand.

Figure 8.1: Employment in Agency-Supported Firms by Broad Sector, 2000-2019



Source: Annual Business Survey of Economic Impact

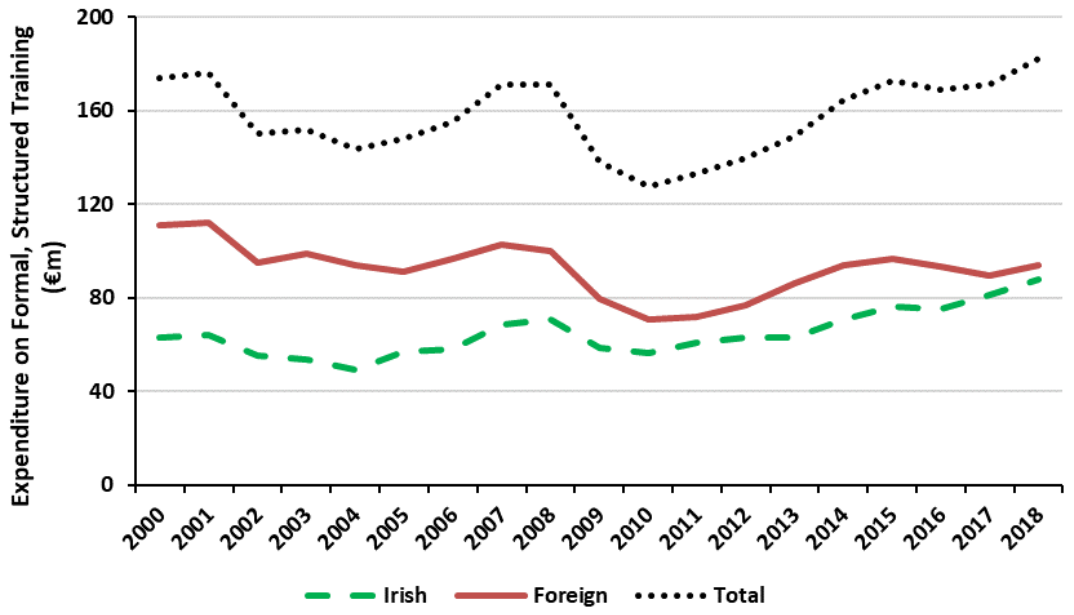
The following table shows the growth, or decline, between 2015 and 2019 in employment in sectors which employed 10,000 or more people in 2019. Retail trade was the largest sector and experienced growth of 8.3% between 2015 and 2019. Education grew by 23% to become the second largest sector, whilst a 3% decline in employment saw human health activities shrink slightly as a sector; however, it remained the third largest sector in terms of employment in 2019. Two sectors experienced growth of over 100%: civil engineering and other manufacturing; whilst a number of sectors decreased by over 50% including: machinery and equipment, and other professional, scientific and technical activities.

Table 8.2: Evidence on Growing and Declining Sectors which Employ 10,000 or More		
	2019 Employment (Thousand)	**% growth 2015-2019**
All NACE economic sectors	2,322.50	12.9%
Crop and animal production, hunting and related service activities	97.90	-5.8%
Food products	48.93	-2.3%
Beverages	6.75	11.1%
Basic pharmaceutical products and preparations	42.85	12.0%
Fabricated metal products, except machinery and equipment	15.85	6.6%
Computer, electronic and optical products	20.23	-27.8%
Machinery and equipment n.e.c	8.38	-74.8%
Other manufacturing	49.25	574.7%
Electricity, gas, steam and air conditioning supply	13.65	40.0%
Construction of buildings	54.08	5.1%
Civil engineering	15.15	163.5%
Specialised construction activities	77.75	50.7%
Motor trades	39.05	-4.2%
Wholesale trade	50.25	-4.4%
Retail trade	214.13	8.3%
Land transport	50.73	8.9%
Warehousing and support activities for transportation	28.00	97.9%
Postal and courier activities	17.43	9.9%
Accommodation	53.08	-4.5%
Food and beverage service activities	124.98	34.8%
Telecommunications	17.18	-10.8%
Computer programming, consultancy and related activities	78.53	29.0%
Information service activities	8.15	13.6%
Financial service activities, except insurance and pension funding	65.93	1.0%
Insurance, reinsurance and pension funding, except compulsory social security	24.48	15.4%
Activities auxiliary to financial services and insurance activities	13.15	64.4%
Legal and accounting activities	52.60	56.8%
Activities of head offices; management consultancy activities	10.08	55.0%
Architectural and engineering activities; technical testing and analysis	36.30	5.9%
Advertising and market research	11.93	66.8%
Other professional, scientific and technical activities	16.70	-53.1%
Renting and leasing activities	12.73	73.7%
Security and investigation activities	17.73	20.0%
Services to buildings and landscape activities	46.10	60.9%
Office administrative, office support and other business support activities	18.48	38.4%
Public administration and defence; compulsory social security	113.48	22.7%
Education	183.63	23.0%
Human health activities	160.55	-3.0%
Residential care activities	42.40	45.3%
Social work activities without accommodation	87.10	17.4%
Creative, arts and entertainment activities	10.58	-37.2%
Sports activities and amusement and recreation activities	30.03	31.0%
Activities of membership organisations	17.83	10.5%
Other personal service activities	37.60	14.0%
Source: CSO		

Expenditure on Formal Training

Export-orientated firms spend over €180m per annum on formal, structured training. The aggregate level of expenditure for 2000-2018, broken down by form of ownership, is show in Figure 8.2 below. It shows that aggregate expenditure by Irish-owned firms on formal training of their employees has increased over the last ten years to almost match the expenditure of foreign-owned firms, despite the latter catering for more employees. This evidence is important in understanding the contribution of employers in certain sectors in enhancing skills in the Irish economy.

Figure 8.2: Expenditure on Formal, Structured Training (€ Million)



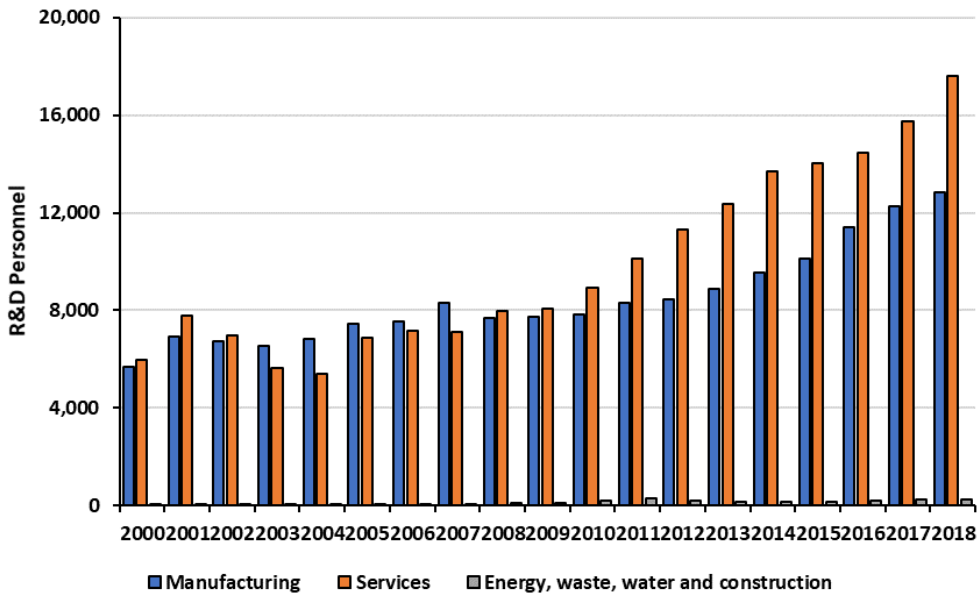
Source: Annual Business Survey of Economic Impact

The level of training expenditure differs across industries, and by ownership. The evidence shows the annual breakdown of formal training expenditure by broad industrial grouping and by ownership (indigenous or foreign owned). It shows that training expenditure in 2018 totalled €88.2 million in Irish owned firms, and €94.4 million in foreign-owned firms. Levels of expenditure were highest in computer services and traditional manufacturing, and lowest in financial and other services.

Table 8.3: Annual Training Expenditure of Agency-Supported Firms, 2018, € million			
	Indigenous (€m)	Foreign Owned (€m)	Total (€m)
Traditional Manufacturing	31.2	4.9	**36.1**
Computer, Electronic & Optical Products	2.3	6.2	**8.5**
Chemicals	1.8	17.5	**19.4**
Electrical equipment; Machinery & Misc Manu	9.5	4.8	**14.4**
Medical Device Manufacturing	1.1	11.6	**12.8**
Energy, Water, Waste & Construction	9.1	0.3	**9.4**
Computer Services	12.7	38.4	**51.0**
Financial Services	2.5	4.8	**7.3**
Business Services	11.5	3.4	**14.9**
Other services	6.4	2.3	**8.8**
Total	**88.2**	**94.4**	**182.5**
Source: Annual Business Survey of Economic Impact			

Ireland has increasingly become a R&D centre for many indigenous and foreign-owned companies and the availability of high-quality R&D skills has become increasingly important. Figure 8.3 shows the number of R&D personnel employed in exporting firms, broken down between manufacturing and services firms. Employment in R&D activities by services firms has become increasingly important, with researchers in this area outnumbering the manufacturing sector for the last decade.

Figure 8.3: R&D Employment of exporting firms by broad industrial area, 2000-2018



Source: Annual Business Survey of Economic Impact

8.3 Automation, Digitisation and Artificial Intelligence

Technological development has major implications for labour markets. Innovations such as automation and digitalisation drive productivity growth, increase revenues, generate new jobs, and thus can contribute to higher living standards.[159] Increased automation and digitalisation is already having an impact on demand in the labour market. Cedefop skills forecasts for Ireland up to 2025[160] predict an increase in demand for high-level ICT skills such as skills in cloud computing and big data analytics, as well as an increase in the demand for various other levels of ICT skills across all sectors as a result of technology becoming increasingly embedded in business functions and processes. The European Skills and Jobs Survey (ESJS) highlights that 43% of adult employees have recently experienced changes in the technologies they use at work and 47% saw changes in their working methods or practices as a result of changes to technology.[161] Berger and Frey,[162] suggest that advanced digital skills, mainly programming and coding, will soon become mandatory in many jobs.

According to the EGFSN, the worldwide ICT market is forecast to continue growing as a result of emerging technologies known as "Innovation Accelerators."[163] Innovation Accelerators include cognitive systems and artificial intelligence (AI), robotics, the Internet of Things (IoT), 3D printing, augmented and virtual reality, and next-generation security. These technologies are predicted to transform businesses and improve customer experiences, while also innovating products and services; however, the adoption of these technologies will result in a change in the skills needs of organisations, resulting in an increase in demand for graduates with 'hybrid' skills in both business and technology.

Artificial intelligence ('AI') also has the potential to impact on the skills required in the modern economy. Artificial intelligence can be defined as systems that display intelligent behaviour by analysing their environment and acting with some degree of autonomy to achieve specific goals.[164] A few examples of artificial intelligence are shown in the table below.

Table 8.4: Examples of AI Adoption in Ireland
❑ **Healthcare:** Artificial intelligence is applied to bio-medical and translational research such as automated data collection and experiments, which impact on drug discovery. It is also used in clinical practices such as diagnosis, automated surgery and patient monitoring.[165] ❑ **Financial services:** AI enables automated customer support and insurance underwriting and claims servicing, credit scoring, and regulatory compliance. The electronic retail payments have been facilitated by AI, transforming Ireland's payment system. ❑ **Transportation:** AI is used in the transport sector to enhance driver safety, as well as to reduce fuel consumption and traffic congestion with resultant benefits for climate change. ❑ **ICT**: Advancement in machine learning facilitates digital commerce as well as supply chain management. ICT services have also been developed through AI programmes to support other sectors such as smart tourism.
Source: Economic modelling by consultancy team.

[159] OECD (2018), "Job Creation and Local Economic Development 2018: Preparing for the future of work."
[160] http://www.cedefop.europa.eu/en/publications-and-resources/country-reports/ireland-skills-forecasts-2025
[161] Cedefop: Insights into skill shortages and skill mismatch- Learning from Cedefop's European skills and jobs survey
[162] Berger, T.; Frey, C. (2016). Structural transformation in the OECD: digitalisation, deindustrialisation and the future of work. OECD social, employment and migration working papers, No 193. Paris: OECD Publishing. http://dx.doi.org/10.1787/5jlr068802f7-en
[163] EGFSN: Forecasting the Future Demand for High-Level ICT Skills in Ireland, 2017-2022
[164] EU Co-ordinated Plan on Artificial Intelligence
[165] For example, the EGFSN report, "Future Skills Needs of the Biopharma Industry in Ireland", reported a growth in demand for professionals with bioinformatics and advanced data analytics healthcare skillsets as the need for information-based medicine grows too. As larger volumes of data are being captured from both patients and the production plant process, there is a need for people with advanced data analytic skills.

The EGFSN Steering Group considered several emerging skills needs across the ICT sector noting that "at the heart of the digital transformation trend is the blurring of the lines between ICT and business."[166] Firstly, they noted the increasing pace at which AI/CS technologies are growing which has created challenges in relation to acquiring workers with appropriate skillsets in this relatively new domain, with many organisations struggling to meet their demand for AI talent. Furthermore, they noted the increase in demand for data scientists who are equipped with the ability to make sense of the ever-increasing amount of data being generated by technologies such as the Internet of Things (IoT). Again, a lack of skills in this area was noted as a key challenge for enterprises expanding in analytics.

The Future Jobs Ireland 2019 report argues that with the ongoing movement towards automation and AI, it is necessary to maintain a workforce that will be able to adapt and respond adequately to the changes that technology will bring. Therefore, individuals should be encouraged to participate in ongoing training and reskilling courses. Future Jobs Ireland sets out various ambitions to ensure Ireland's workforce remains high-level and is continuously upskilling. Interviews undertaken by the Irish Expert Group on Future Skills suggested that most organisations expected to see some change in the skillset required in the future with many planning to hire people with knowledge in emerging technologies such as AI.[167]

Given the importance of internationally traded sectors to the Irish economy, it is important to understand the potential impact in terms of skills to examine the employment of those sectors which are believed to have high levels of AI adoption. Building on the findings by McKinsey and others, Indecon has grouped internationally traded sectors which have high levels of AI adoption. Our analysis of the employment levels in those sectors in 2019 is presented in the table below. In total, these sectors employ almost 250,000 workers, representing two in three of the total employment in firms assisted by IDA (Ireland), Enterprise Ireland and Údarás na Gaeltachta.

Table 8.5: Employment in the Irish Economy in Top AI Adoption Sectors in Ireland (2019)

Sectoral Groups	Sectors in Detail	Employment (Number)	Employment (% of Total Supported by IDA, EI and Údarás)
High-technology Manufacturing	Chemicals	27,449	7%
	Computer, Electronic, and Optical products	17,285	5%
	Electrical equipment	6,120	2%
	Machinery and equipment	13,560	4%
	Transport equipment	5,160	1%
	Medical Device Manufacturing	31,276	8%
	Sub-total	***100,850***	**27%**
High-technology Services and Telecommunication	Publishing, Broadcasting & Telecommunication	8,021	2%
	Computer Programming	33,140	9%
	Computer Consultancy	31,475	8%
	Computer Facilities Management	12,832	3%
	Other IT and Computer Services	18,664	5%
	Sub-total	***104,132***	**28%**
Financial and Business Services	Financial Services	17,142	5%
	Business Services	27,642	7%
	Sub-total	***44,784***	**12%**
Grand-Total in These Sectors		***249,766***	***66%***
Source: Analysis of ABSEI database.			

[166] http://www.skillsireland.ie/all-publications/2019/high-level-ict-skills-demand-analysis.pdf
[167] Expert Group on Future Skills Needs, "Forecasting the Future Demand for High-Level ICT Skills in Ireland, 2017-2022"

Sectors in Ireland where there are high levels of AI adoption are characterised as having high levels of output per employee. An examination of output per employee, captured by total sales per person employed, is shown in Table 8.6.

Table 8.6: Total Output per Employee in Top AI Adoption Sectors in Ireland (2019)

Sectoral Groups	Sectors in Detail	Output per Employee ('000 €)
High-technology Manufacturing	Chemicals	2,020
	Computer, Electronic, and Optical products	857
	Electrical equipment	273
	Machinery and equipment	348
	Transport equipment	241
	Medical Device Manufacturing	353
High-technology Services and Telecommunication	Publishing, Broadcasting and Telecommunication	158
	Computer Programming	1,615
	Computer Consultancy	1,292
	Computer Facilities Management	494
	Other IT and Computer Services	1,778
Financial and Business Services	Financial Services	312
	Business Services	252
Output per Employee all sectors (AI and non-AI intensive)		***753***
Output per Employee Across the High AI adoption Sectors		***946***
Source: Analysis of ABSEI database.		

Total exports from agency assisted firms in internationally traded sectors of the Irish economy which have high levels of AI adoption are shown in Table 8.7. The evidence shows that over €223 billion is exported from sectors in Ireland which have high potential for AI adoption.

Table 8.7: Total Exports in Top AI Adoption Sectors in Ireland (2019)

Sectoral Groups	Sectors in Detail	Exports (€ Million)
High-technology Manufacturing	Chemicals	54,869
	Computer, Electronic, and Optical products	14,373
	Electrical equipment	1,356
	Machinery and equipment	3,822
	Transport equipment	1,147
	Medical Device Manufacturing	10,860
	Sub-total	***86,427***
High-technology Services and Telecommunication	Publishing, Broadcasting and Telecommunication	758
	Computer Programming	50,935
	Computer Consultancy	38,840
	Computer Facilities Management	5,747
	Other IT and Computer Services	32,426
	Sub-total	***128,706***
Financial and Business Services	Financial Services	3,635
	Business Services	4,483
	Sub-total	***8,118***
Exports Across High AI adoption Sectors		***223,252***
Source: Analysis of ABSEI database.		

Table 8.8 presents estimates of the total value added of the sectors which are ranked as having high levels of AI adoption. The evidence shows that value added in the Irish economy of these sectors amounted to over €80 billion.

Table 8.8: Total Value Added in Top AI Adoption Sectors in Ireland (2018)

Sectoral Groups	Sectors in Detail	Total Value Added (€ Million)
High-technology Manufacturing	Chemicals	27,117
	Computer, Electronic, and Optical products	8,722
	Electrical equipment	580
	Machinery and equipment	1,302
	Transport equipment	526
	Medical Device Manufacturing	4,241
	Sub-total	***42,488***
High-technology Services and Telecommunication	Publishing, Broadcasting and Telecommunication	574
	Computer Programming	15,482
	Computer Consultancy	5,835
	Computer Facilities Management	3,450
	Other IT and Computer Services	5,767
	Sub-total	***31,108***
Financial and Business Services	Financial Services	3,733
	Business Services	3,262
	Sub-total	***6,995***
Value Added across High AI adoption Sectors		***80,591***

Source: Analysis of ABSEI database.

The evidence on the propensity for those sectors with the highest levels of AI usage to also represent some of the most high value added and most export-oriented sectors in the Irish economy clearly demonstrates the need for the skills available in the Irish labour force to adapt to developments in AI in order to provide the relevant skills in these sectors into the future.

Outside of ICT, changes in technology can have different implications for other occupations and industries, and across different regions. Over the last 15 years, a number of studies have been conducted which try to estimate the risk of automation on current occupations, and consequently the impact of automation on employment. In this section, we review the potential impact of technological change on future skills needs in the Irish economy.

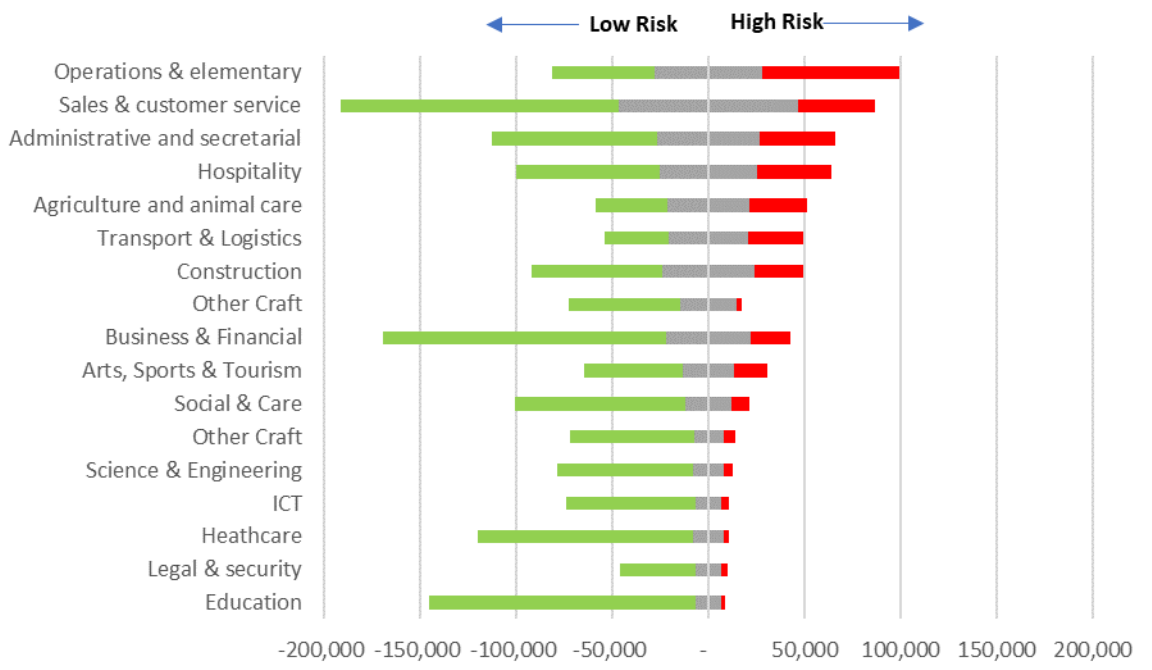
In considering the impact on future skills of automation and artificial intelligence it is important to consider two aspects. Firstly, the impact of automation on those with lower skills as this has implications for the FET sector in helping impacted individuals to re-train for other occupations or for employment in other sectors. Secondly, it is important to consider the opportunities for an expansion in opportunities for those with higher skills arising from the growth of internationally traded high-tech sectors in Ireland. Indecon notes that there has been a lot of detailed work done on the impact of automation on opportunities for those with lower skills. As less work has been undertaken on the labour market opportunities arising from AI and the implications for increased skill requirements in the economy, Indecon presents the results of new econometric modelling estimating the potential benefits.

8.4 Employment Impact on Lower-Skilled Employment

The Irish Government Economic and Evaluation Service carried out an assessment on the impact of automation in Ireland in 2018, extended by SOLAS in 2020 to quantify occupations in Ireland in terms of their level of automation risk. This analysis is based on the 16 occupational groups in the occupational employment profiles section of the National Skills Bulletin. These estimates were based on a methodology developed by Frey and Osbourne (2013) and Nedelkoska and Quintini (2018). These in turn were based on a probabilistic model that depended on a two-by-two matrix with routine versus non-routine tasks on one axis and manual versus non-manual on the other (Autor et al, 2003). The first study was the first substantive attempt to measure the potential impact of automation on labour markets. The second paper, published by the OECD in 2018, reflects the most recent attempt at measuring the impact of automation and incorporates a number of refinements of the Frey and Osbourne methodology. Nedelkoska and Quintini, using their refined model, found lower estimates than in the original study.

The estimates for Ireland show that around two in five workers are at high or medium risk of automation. Over 370,000 people in Ireland are estimated to be employed in occupations at high risk of automation, representing 15% of the working population. A further 600,000 were in jobs considered at medium risk of automation, representing a further 26% of the working population. This is illustrated in the figure below. Of the top six occupational groups with the largest number of persons employed whose jobs were at high risk of automation, operations and elementary had the highest share (40%) with sales and customer service having the lowest share (15%). The individual occupations driving the high-risk weight in each group were assemblers and routine operatives, drivers, farmers, kitchen and catering assistants, other administrators, and sales assistants.

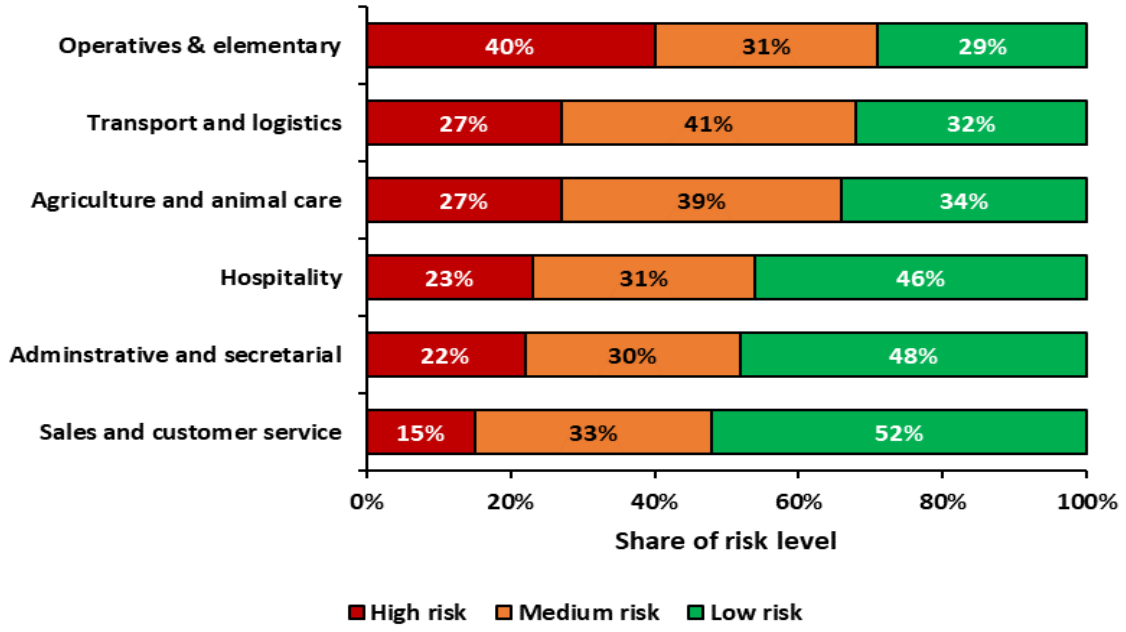
Figure 8.4: Occupational groups by level of automation risk, total persons employed



Source: SOLAS/SLMRU analysis of CSO LFS, Q4 2019

The recent SOLAS/SLMRU analysis noted that of the top six occupational groups with the largest number of persons employed whose jobs were at high risk of automation, operatives & elementary had the highest share (40%) with sales and customer service having the lowest share (15%), as shown in the below figure. The individual occupations driving the high-risk weight in each group were: assemblers and routine operatives, drivers, farmers, kitchen and catering assistants, other administrators, and sales assistants.

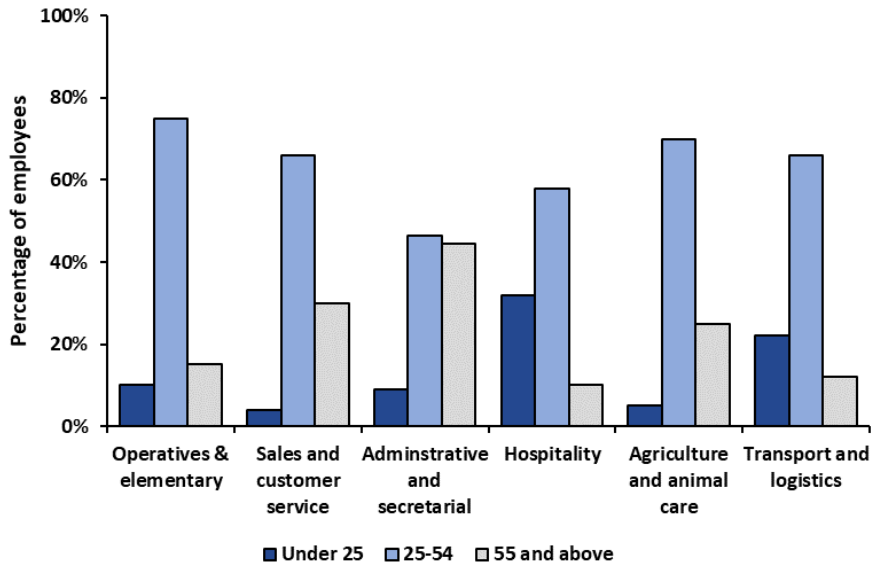
Figure 8.5: Top 6 occupational groups by share of risk level



Source: SOLAS/SLMRU analysis of CSO LFS, Q4 2019

SOLAS/SLMRU research shows that, in terms of age profile, each of the occupational groups showed very low shares of persons employed aged less than 25, apart from hospitality (31%) and sales and customer service (23%), both of which were above the State average of 11%. There was a significant portion of persons employed aged 55 and above in agriculture and animal care (46%) (predominantly made up of famers), transport and logistics (28%), and administrative and secretarial (25%), as shown in the following figure. The national average for persons employed aged 55 and above stood at 19%.

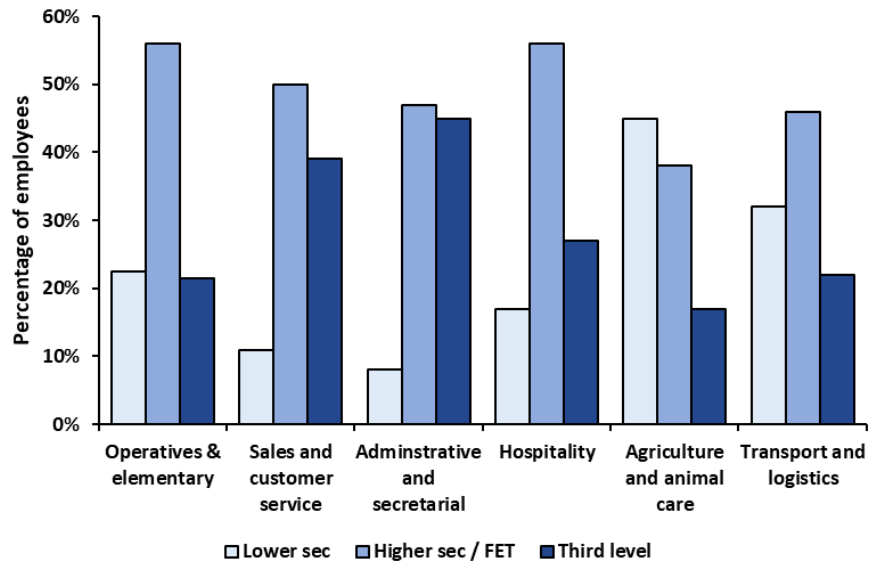
Figure 8.6: Top 6 occupational groups by age group



Source: SOLAS/SLMRU analysis of CSO LFS, Q4 2019

Lower-skilled workers are more at risk of automation. The SOLAS/SLMRU research also illustrated that administrative and secretarial occupations had the highest share of persons employed with a third-level qualification at 43%, followed by those employed in sales and customer service occupations (37%). Each of the top six occupations with the highest number of employees at high risk of automation had a lower skill profile than the national average, as measured by the share of persons in each occupation with third-level qualifications. This share is lowest for agriculture and animal care, operatives and elementary, and transport and logistics.

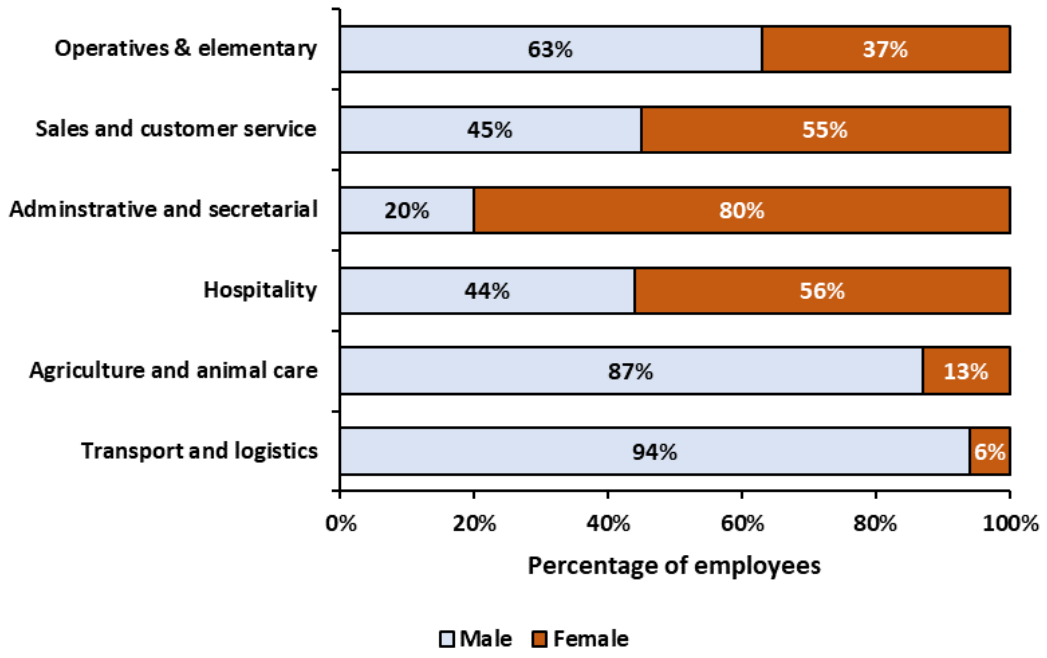
Figure 8.7: Top 6 occupational groups by education level



Source: SOLAS/SLMRU analysis of CSO LFS, Q4 2019

In terms of gender, the SOLAS/SLMRU study illustrated that transport and logistics (94%) and agriculture and animal care (87%) were predominantly male, while 80% of those employed in administrative and secretarial occupations were female, as shown in the below figure. The other three occupational groups had a gender distribution closer to the national averages of 54% for males and 46% for females. Sales and customer service, administrative and secretarial, and hospitality combined, accounted for over 385,000 females employed, highlighting the need for upskilling and/or retraining for this particular cohort in these areas.

Figure 8.8: Top 6 occupational groups by gender

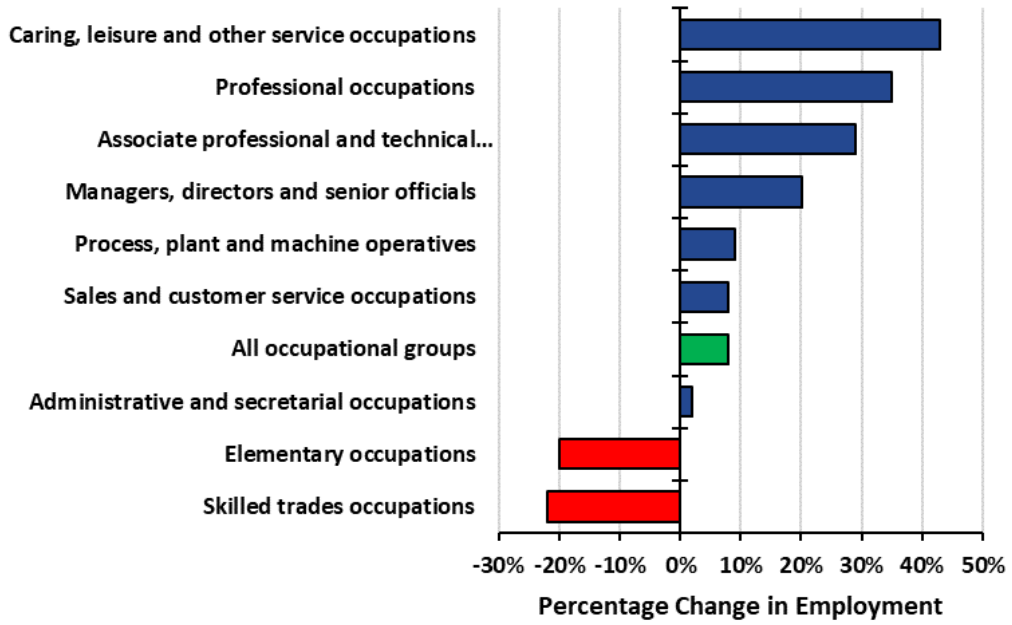


Source: SOLAS/SLMRU analysis of CSO LFS, Q4 2019

It is also useful to examine the employment experience across different occupational groups in recent years to see to what extent a process of automation replacing certain skills has already commenced. The Figure below illustrates the change in employment by broad occupational group from Q1 2007 to Q1 2020. It should be noted that inevitably some of the changes witnessed in this period are as the result of cyclical economic changes, rather than longer-term secular changes in patterns of employment, particularly given the scale and depth of the recession which followed the financial crisis commencing in 2007 and 2008.

However, some clear trends are still worth noting. There has been a sharp fall in the demand for elementary occupations and skilled trades occupations over the thirteen-year period from 2007 to 2020. Turning first to elementary occupations, the largest falls within this category were witnessed in elementary construction occupations (-81%); and elementary process plant occupations (-49%). However, this was counter-balanced by rises in non-elementary construction operatives and process plant operatives, suggesting potentially an element upskilling within these sectors over this period.

Figure 8.9: Change in Employment Q1 2007 to Q1 2020 (Broad Occupation Group)



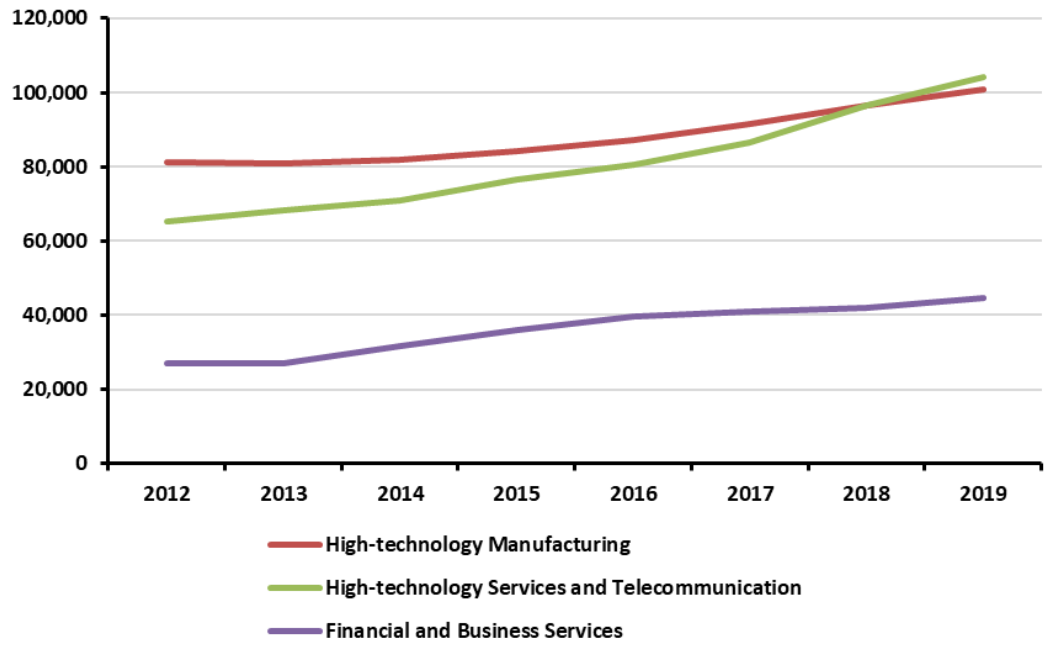
Source: SOLAS/SLMRU analysis of CSO LFS, Q4 2019

8.5 Employment Impact of AI/Digitisation

In assessing the employment and skills impacts of AI, it is important to note that AI is a different concept than automation. Application of AI is often driven by the handling of data requirements which are needed to facilitate innovation in new service areas. Automation, in contrast, involves the automation of repetitive tasks without human intervention. A recent study commissioned by the National Standards Authority of Ireland (NSAI) shows that almost four out of 10 Irish companies currently use AI.[168] Moreover, the survey results suggest that more than half of businesses say that they plan to use AI in the next five years, while 82% believed that the development of standards in AI is important to their businesses. There has been a very fast growth in AI capital stock in recent years in Ireland. Figure 8.10 presents the trend of employment for three broad sectors encompassing manufacturing and services that are identified as having high levels of AI adoption. The data shows that overall employment levels have grown strongly in internationally traded sectors with high levels of AI adoption.

[168] Four in ten Irish companies currently use Artificial Intelligence (AI) published on 8th April, 2019. Retrieved from: https://www.adaptcentre.ie/news/four-in-ten-irish-companies-currently-use-artificial-intelligence-ai

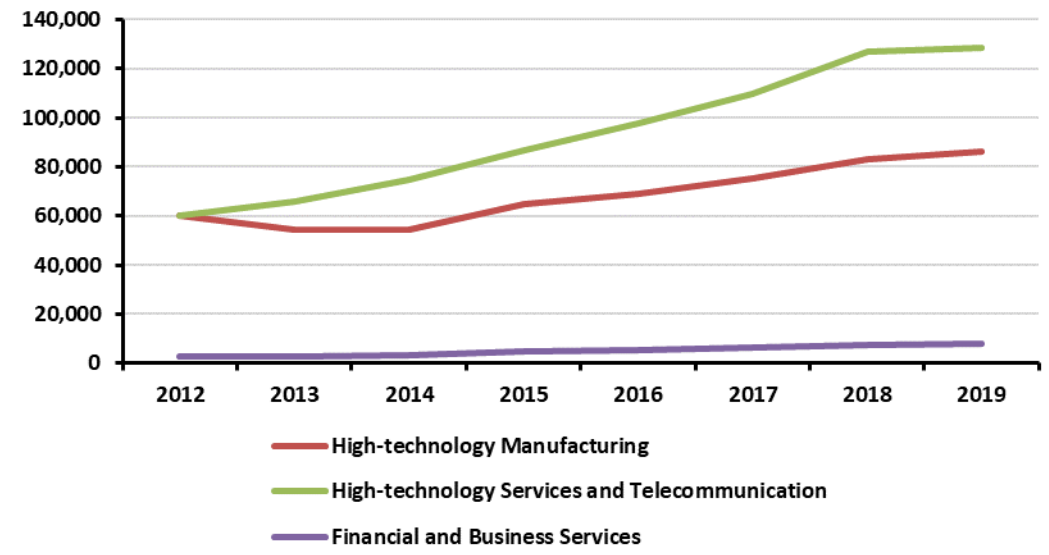
Figure 8.10: Trend of Employment in Sectors with Higher AI adoption in Ireland



Source: Analysis of ABSEI database.

Data on the trend of exports also suggests a continuing expansion of exports by sectors with high levels of AI adoption, namely high-tech manufacturing and high-tech services and telecommunications.

Figure 8.11: Trend of Exports in Sectors with Higher AI adoption in Ireland



Source: Analysis of ABSEI database.

By potentially increasing productivity, AI and digitisation more widely impacts on the employment levels required to produce a given level of output.[169] In examining the likely skills and employment impact, it is useful to empirically model the relationship between labour and capital stock- both AI[170] and non-AI. In order to inform the analysis, we completed new econometric modelling on this using panel data from CSO for total labour (hours worked), real fixed capital stock for AI[171] and non-AI, and total output. The panel dataset is based on sectoral data available for: agriculture, forestry, and fishing; human health and social work activities; education; financial and insurance activities; information and communication; construction; professional, scientific and technical services; and transportation and storage. The regression, as shown in Equation 1, is estimated using panel fixed effects to account for unobserved time invariant fixed effects at the sectoral level (α_i).

$$\ln(L)_{i,t} = \alpha_i + \beta \ln(Y)_{i,t-1} + \mu \ln(K^{AI})_{i,t-1} + \theta \ln(K^N)_{i,t-1} + \gamma(Sector_i * \ln Y_{t-1}) + \sigma(Sector_i * \ln K^{AI}) + \delta(Crisis)_t + \varepsilon_{i,t} \quad \textbf{(Equation 1)}$$

Moreover, the independent variables on the right-hand side, such as total economic output (Y), AI capital stock (K^{AI}) and non-AI capital stock (K^N), are not taken as contemporaneous variables. We take the first lag of these variables to control for the possibility of reverse causation or simultaneity in estimating the regression equation. The key variable of interest in this regression is the marginal effect of additional AI capital stock on labour input at each economic sector included in the regression. This is captured by '$\boldsymbol{\mu} + \boldsymbol{\sigma}$'. In addition to the variables on output and capital stock, the regression also controls for the period of economic crisis in Ireland by using the dummy 'Crisis' that takes value as equal to 1 for period from 2008 to 2012, and zero otherwise.

[169] See for example: (1) Brynjolfsson, E. and McAfee, A. (2014). *The Second Machine Age: Work, Progress and Prosperity in a Time of Brilliant Technologies,* New York: W.W. Norton and Company; (2) Autor, D. H. (2015). Why Are There Still So Many Jobs? The History and Future of Workplace Automation. *Journal of Economic Perspectives*, 29(3): 3-30; (3) Frey, C. B., and Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological forecasting and social change*, 114, 254-280; (4) Crowley, C. and Doran, J. (2019). *Automation and Irish Towns: Who's Most at Risk?* Spatial and Regional Economics Centre, Department of Economics, University College Cork. SRERCW2019-1.

[170] In this section, AI will be used as shorthand for AI/digitisation.

[171] Taken as intangible fixed assets such as computer software, research and development, and other computing software as a proxy for AI Capital, while the rest is taken as non-AI Capital stock.

Table 8.9: Regression Estimates for Relationship between Labour and Capital Stock			
Variables	**Log of Labour Input (Hours)**	**Log of Labour Input (Hours)**	**Marginal Effects of AI Stock**
Log of Output (1st Lag)	0.300***	0.0787*	
	(0.0287)	(0.0384)	
Log of AI Capital (1st Lag)		0.281***	
		(0.0592)	
Log of non-AI Capital (1st Lag)		-0.159	
		(0.168)	
Crisis	-0.104**	-0.0750**	
	(0.0331)	(0.0241)	
Agri. Forestry, Fishing*Log of Output(t-1)	-0.548***	0.0318	
	(0.0391)	(0.0551)	
Construction*Log of Output(t-1)	0.275***	0.489***	
	(0.0280)	(0.0248)	
Education*Log of Output(t-1)	0.178***	-0.0698**	
	(0.00100)	(0.0287)	
Financial and Insurance Activities*Log of Output(t-1)	-0.00156	0.270***	
	(0.0185)	(0.0148)	
Human, Health and Social Work*Log of Output(t-1)	0.382***	0.00904	
	(0.00628)	(0.0453)	
Information and Communication Tech.*Log of Output(t-1)	-0.0166	0.245***	
	(0.0271)	(0.0706)	
Professional, Scientific and Tech.*Log of Output(t-1)	0.0221	0.147***	
	(0.0197)	(0.0262)	
Transportation and Storage*Log of Output(t-1)	-0.185***	0.171	
	(0.0146)	(0.0938)	
Agri. Forestry, Fishing*Log of AI Capital (t-1)		-0.383***	-0. 101***
		(0.0532)	(0.0084)
Construction*Log of AI Capital (t-1)		-0.400***	-0.1185**
		(0.00951)	(0.0544)
Education*Log of AI Capital (t-1)		0.208***	0.4896***
		(0.0453)	(0.1044)
Financial and Insurance Activities*Log of AI Capital (t-1)		-0.242***	-0.0391
		(0.0292)	(0.0884)
Human, Health and Social Work*Log of AI Capital (t-1)		0.118***	0.3997***
		(0.0288)	(0.0878)
Information and Communication Tech.*Log of AI Capital (t-1)		-0.216***	0.0657
		(0.0195)	(0.0484)
Professional, Scientific and Tech.*Log of AI Capital (t-1)		-0.180***	0.1017
		(0.0126)	(0.0713)
Transportation and Storage*Log of AI Capital (t-1)		-0.269***	0.0123
		(0.0234)	(0.0383)
Constant	5.018***	8.251**	
	(0.264)	(2.635)	
Observations	180	180	
R-squared	0.782	0.899	
Number of Sector	9	9	
Sectoral FE	Yes	Yes	

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Analysis of CSO sectoral panel-data.

It should be noted that the regression specification in Equation 1 may be prone to endogeneity issues due to omitted variable or other factors, hence the results obtained from this regression should be interpreted with care. Table 8.9 presents panel fixed effects results for Equation 1, where two specifications are estimated: first, covariates excluding capital stocks; and second, full specification with all variables included. The positive and significant coefficient on log of output confirms that there is a positive relationship between economic output and labour input.

The results for our key variables of interest, the marginal effect of AI capital stock on labour input for each sector 'i', as captured by '$\boldsymbol{\mu} + \boldsymbol{\sigma}$', are presented in the third column of Table 8.9. The results indicate that additional AI capital stock has a negative relationship with labour input in sectors such as agriculture, forestry and fishing. However, there are sectors such as education and human health and social work where there appears to be significant complementarity of labour input with AI capital stock. We also find no significant relationship for AI capital stock on employment in sectors such as financial and insurance activities, ICT, and Transportation. The econometric results suggest that the net effect of AI expansion on total employment will vary across different economic sectors and may be influenced by other factors such as the extent to which AI enhances competitiveness in internationally traded activities or Ireland's attractiveness as a location for foreign investment in certain sectors. Our analysis of employment growth in high AI adoption sectors noted previously has demonstrated the significance of employment in these sectors.

Furthering our analysis, in order to estimate the contribution of AI to overall productivity growth in Ireland, Indecon has developed a model to estimate the elasticity of AI capital stock on labour productivity. This is based on the foundations of a simple Constant Returns to Scale (CRS) production function which is estimated using a pooled regression for the sample extracted for the period from 1997 to 2017 from the EU-KLEMS database. Productivity growth is key to maintaining Ireland's international competitiveness and having the Irish labour force in a position to leverage the productivity improving aspects of increase AI adoption is an important objective when assessing future skills requirements.

Our regression analysis allows us to derive the marginal effect of AI uptake per labour (recorded in total hours worked) on overall productivity. This is done by estimating a simple Cobb-Douglas production function, as shown in Equation 2.

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \qquad \textbf{(Equation 2)}$$

Here, Y is gross output, K is the stock of capital, while L is the stock of labour, and A is the total factor productivity. With the assumption of Constant Returns to Scale (implied by parameter restriction 1-α+α=1), and rearrangement of variables brings us to Equation 3, where the left-hand side variable represents average labour productivity $(Y/L)_t$, and the right-hand side $(K/L)_t$ represents capital/labour ratio.

$$\ln\left({}^{Y}/_{L}\right)_t = \ln A_t + \alpha \ln\left({}^{K}/_{L}\right)_t \qquad \textbf{(Equation 3)}$$

The above model can be estimated using a regression where capital 'K' is divided into AI (K^{AI}) and non-AI (K^{N}) capital, thus allowing us to estimate the relationship between AI and non-AI capital per worker on productivity. Here, '**β**' is our coefficient of interest, which represents the elasticity of productivity with respect to AI, while '**δ**' controls for the time-trend over the years.

$$(\ln Y/L)_t = \alpha_t + \beta \ln(K^{AI}/L)_t + \theta \ln(K^{N}/L)_t + \delta_t + \varepsilon_t \qquad \textbf{(Equation 4)}$$

It should be noted that there was no direct measure of AI capital in the database, and therefore we use the statistics for real fixed capital stock of computing equipment, computer software and databases, and communications equipment as a proxy was AI capital stock. For non-AI capital stock, we use data on transport equipment, other machinery and equipment, total non-residential investment, residential structures, cultivated assets, research and development, and other IPP assets.

A total of 26 EU countries are included in the sample and '**β**' in Equation 4 provides the estimate for the full EU sample. In order to derive the relationship for Ireland, the aforesaid regression is modified by including an additional co-variate capturing the interaction of country dummies with AI per labour, as shown in Equation 5 below.

$$(\ln Y/L)_t = \alpha_t + \beta \ln(K^{AI}/L)_t + \theta \ln(K^{N}/L)_t + \boldsymbol{\gamma}(\boldsymbol{Country_i} * \mathbf{ln}(\boldsymbol{K^{AI}/L})_t) + \delta_t + \varepsilon_t$$

(Equation 5)

Including the interaction of AI stock per labour with the countries in the sample allows us to estimate the marginal effect of additional AI capital per labour on labour productivity for Ireland, which is '**β+ϒ**', the slope coefficients that are additive.

Table 8.10: Econometric Results for the Elasticity of Productivity w.r.t AI for Ireland

Variables	(Equation 4) Log Labour Productivity	(Equation 5) Log Labour Productivity	Ireland Marginal Effect
Log AI per Labour Hour	0.347***	0.420***	
	(0.0462)	(0.0381)	
Log Non-AI per Labour Hour	0.615***	0.373***	
	(0.0464)	(0.0859)	
Year (Trend)	0.0134***	0.0183***	
	(0.00222)	(0.00186)	
Ireland*Log AI per Labour Hours		-0.153***	***0.267****
		(0.00754)	***(0. 03508)***
Constant	-26.25***	-36.36***	
	(4.539)	(3.880)	
Observations	432	432	
R-squared	0.943	0.990	
EU Other 25 Interaction Controls	No	Yes	

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Marginal Effect of AI stock per labour input for Ireland: **0.267-0.141=0.126**
Source: Analysis of EU-KLEMS database.

The regression results for Equation 4 and Equation 5 are presented in Table 8.10. Here, Equation 5 represents the interaction coefficient for Ireland. The model result for the marginal effect for Ireland is around 0.27% which implies that if AI stock per hour was to increase by 1%, then a corresponding increase in labour productivity in Ireland will be 0.27%.

Going back to the Cobb-Douglas production function, shown earlier in Equation 2, we disaggregate the capital stock $(K/L)_t$ into AI (K^{AI}/L) and non-AI capital stock (K^N/L) respectively, shown in Equation 6 below.

$$\ln({}^{Y}/_{L})_t = \ln A_t + \beta \ln({}^{K^{AI}}/_{L})_t + \gamma \ln({}^{K^{N}}/_{L})_t \qquad \textbf{(Equation 6)}$$

Then, the growth of labour productivity can be obtained by obtaining total logarithmic differential with respect to time '***t***' of Equation 6, as shown in Equation 7.

$$d\frac{\ln({}^{Y}/_{L})_t}{dt} = \beta\frac{dlnK_t^{AI}}{dt} + \gamma\frac{dlnK_t^{N}}{dt} - \beta.\frac{dlnL_t}{dt} - \gamma\frac{dlnL_t}{dt} \qquad \textbf{(Equation 7)}$$

A further re-arrangement of Equation 7 will allow us to deduce the contribution of the rate of growth in AI Capital stock on the rate of growth in labour productivity. As shown in Equation 8, this equals to $\beta\frac{dlnK_t^{AI}}{dt}$.

$$d\frac{\ln({}^{Y}/_{L})_t}{dt} - \gamma\frac{dlnK_t^{N}}{dt} + (\beta+\gamma).\frac{dlnL_t}{dt} = \beta\frac{dlnK_t^{AI}}{dt} \qquad \textbf{(Equation 8)}$$

Having derived '**β**' from regressions (taken as '**β+ϒ'** due to interaction with country dummies), it is imperative to estimate the rate of change of AI capital stock with time, i.e., $\frac{dlnK_t^{AI}}{dt}$ in order to calculate the contribution of rate of growth in AI capital stock on the rate of growth in labour productivity. Thus, a univariate regression of the AI capital stock with the time trend is conducted to predict the pattern of capital stock over time for Ireland. The results of this regression are shown in Table 8.11. The marginal impact suggests a growth rate of AI capital stock in Ireland of around 6.6%.

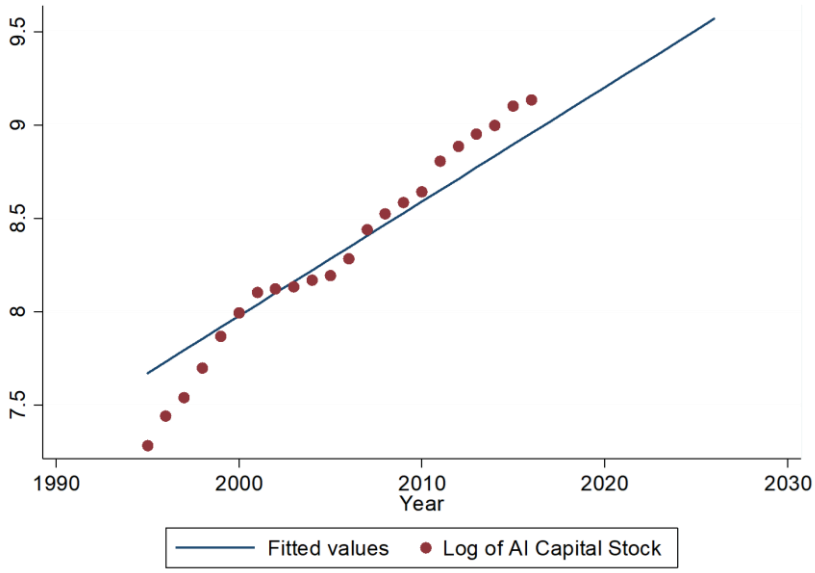
Table 8.11: Econometric Results for the assessment of AI Capital Growth in Ireland

Variables	Log AI Capital	Log AI Capital	Ireland Marginal Effects
Year	0.0470***	0.0622***	
	(0.0153)	(0.00240)	
Year*Ireland		-0.00102***	***0. 0612******
		(2.79e-05)	***(0. 0024)***
Constant	-84.47***	-114.4***	
	(30.70)	(4.802)	
Observations	432	432	
R-squared	0.022	0.985	
EU Other 25 Interaction with Year		Yes	

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Marginal Effect for AI stock time trend for Ireland: 0.0673-0.0010=0.0663
Source: Analysis of EU KLEMS database.

The estimated rate of growth of AI is used to obtain the trend of AI Capital stock for Ireland, keeping other things constant, as shown in Figure 8.12.

Figure 8.12: AI Capital Stock Time Trend in Ireland



Source: Analysis of EU KLEMS database.

Having estimated the rate of growth of AI capital stock at 6.1% (see Table 8.11) and the elasticity of AI capital stock on labour productivity as 0.27%, the resulting contribution of the rate of growth in AI Capital stock on the rate of growth in labour productivity is calculated as 1.59%. These results are summarised in Table 8.12. A similar approach is adopted to derive the rate of growth of overall labour productivity. Thus, a univariate regression of log of labour productivity on a time trend is conducted. The results suggest a growth rate of 5.6% of labour productivity over time.

Table 8.12: Growth Rate of Labour Productivity attributable to AI Capital Growth Rate

Elasticity of AI Capital Stock to Labour Productivity	0.26%
Rate of Growth of AI Capital	6.10%
Rate of Growth of Labour Productivity attributable to increase in AI Capital Stock	***1.59%***

Source: Analysis of EU KLEMS database.

Having estimated the rate of growth of labour productivity attributable to AI capital and overall rate of growth of total labour productivity, the share of growth of labour productivity attributable to an increase in AI capital stock is estimated around 28% of the total rate of growth of labour productivity in Ireland, as summarised in Table 8.13.

Table 8.13: Share of Growth of Labour Productivity attributable to AI Capital Stock in Ireland	
Rate of Growth of Labour Productivity attributable to Growth of AI Capital Stock	1.59%
Rate of Growth of Total Labour Productivity	5.60%
Share of Growth of Labour Productivity attributable to growth in AI Capital Stock	***28.32%***
Source: Analysis of EU KLEMS database.	

The evidence shows that productivity is likely to grow as a result of the application of AI. This will reduce employment for any given level of output. However, the overall employment impact will depend on the extent to which AI facilitates the expansion of economic activity in the relevant sectors. A key contributing factor to the extent to which advancements in AI impact on employment will be the availability of the skills in the Irish labour force to take advantage of new opportunities in those sectors experiencing the greatest increase in productivity from the application of AI.

The analysis presented suggests that increased employment opportunities are likely to emerge education and human health and social work activities as AI adoption increases. However, we note that this analysis is based on trends to date, as the technology continues to develop there is the potential for AI and digitisation in different sectors to having an even greater impact on productivity. Such an outcome may lead to additional demand for high-skilled employees in Ireland's high-tech, export orientated sectors.

8.6 Transitioning to a Low Carbon Economy

Agenda 2030 and the Paris Agreement on climate change require a transformational shift of the world's economies and societies towards climate resilient and sustainable development. At European level, the European Green Deal provides a roadmap with actions to boost the efficient use of resources, with the intention that the EU is climate neutral in 2050. To do this, a proposed European Climate Law is being proposed which would turn this aspiration into a legal obligation, and require a reform of all sectors of the European economy. This includes:

- Investing in environmentally friendly technologies;
- Encouraging industry to innovate;
- Rolling out cleaner, cheaper and healthier forms of private and public transport;
- Decarbonising the energy sector; and
- Ensuring buildings are more energy efficient.

As signalled in the Climate Action Plan 2019, the Irish Government supports the adoption of a net zero target of carbon emissions by 2050 at EU and Ireland levels. The Climate Action Plan sets out a decarbonisation pathway to 2030 which would be consistent with the adoption of a net zero target in Ireland by 2050. The plan also commits to evaluating in detail the changes which would be necessary in Ireland to achieve this target.

The movement to a carbon-neutral economy will have a significant impact on the jobs needed in the future. Some forms of environmental change may have a negative effect on certain sectors and regions but there will also be opportunities to develop new skills as Ireland transitions to a low greenhouse gas economy. Worldwide, it is projected that this will lead to a net creation of jobs across Europe equivalent to around 0.2% of the working population.[172] The Government's Future Jobs Ireland document includes the challenge of transitioning to a low carbon economy as one of its five core pillars. The transition to a more sustainable economy and society can result in changes in the number of workers in different occupations, and changes in the skills required for a particular occupation without changing the number of jobs.[173] According to the European Commission, the climate and energy transition may require skills not fully available in the current labour market, nor provided by the education system. Providing workers with the skills required would require investing more in education and training.[174] A specific example of achieving the transition is the Irish 'Just Transition Fund' for the Midlands, covering investment in retraining and reskilling and helping local communities and businesses adjust to closure of the peat-burning plants in Shannonbridge and Lanesboro.

A review of 27 skills needs assessments conducted by various developed and developing countries indicated that studies on changes in skillsets required within particular occupations are more common than changes between occupations. More generally, the OECD has said that it is difficult to gauge whether green technology will prove to be as general and transformative of work across the economy as ICT has been,[175] or whether it will primarily impact on the skills requirements for a relatively narrow range of industries/occupations.

Evidence from European and developing countries indicates that the sectors that are most often included in adaptation strategies are infrastructure (including energy infrastructure), water (including flood-prevention measures), agriculture (including forestry, fisheries and husbandry), biodiversity conservation, and health (Harsdorff, Lieuw-KieSong and Tsukamoto, 2011; ILO, 2011, 2015a; Triple E Consulting, 2014). A list of some of occupations/skills most likely to be affected by the need to adapt the global economy to a more environmentally sustainable manner are shown in Table 8.14 below. Skills identification exercises regularly indicate that skills in the STEM (science, technology, engineering and mathematics) fields are the ones most relevant to climate change adaptation.

[172] Triple E Consulting (2014).

[173] Gregg, Strietska-Ilina and Büdke, (2015) "Anticipating skill needs for green jobs: A practical guide"

[174] European Commission (2020), "Country Report Ireland 2020."

[175] OECD (2012), "The jobs potential of a shift towards a low-carbon economy."

Table 8.14: Sectors and occupations with high relevance for climate change adaptation	
Agriculture	Agricultural extension; control of plant disturbing organisms; organic agriculture; inspector of organic crop production; inspector of organic livestock production; agricultural engineer
Biodiversity & ecosystem services	Forest ecosystem controller
Built environment	Building of coastal protections; mechanical heating, ventilation and air conditioning systems; brownfield site redevelopment specialist; civil engineer; quantity surveyor; building inspector
Environmental protection & pollution treatment (carbon sinks, etc.)	Desulphurization and denitrification; forest protection and nature conservation; environmental manager; geologist; geophysicist; conservation scientist; environmental scientist; earth and soil scientist; air pollution analyst; environmental engineer; environmental impact and restoration analyst; prediction and modelling of climate change; climate change impact assessment and adaptation; CO2 capture, storage and, processing; treatment of non-CO2 GHG emissions; monitoring of harmful substances and purification of the environment
Forestry, husbandry and fishery	Food safety supervisor; forestry technical support personnel; forestry management unit; forest carbon inventory; rehabilitation & reclamation of forest & land; harvesting & storage of seeds of forest plants; watershed management; forestry counsellor; feed quality control; agricultural extension; control of plant disturbing organisms; organic agriculture; inspector of organic crop production; inspector of organic livestock production; brackish water aquaculture; marine safety officer
Public health	Environmental sanitation system planner; food safety supervisor; environmental and occupational health inspector
Transport	Transport manager; transport analyst; road transport manager; aeronautical engineer
Water management	Drinking water management; drinking water supply system operator; maintenance of production units for drinking water treatment; maintenance of water transmission and distribution units; water relief expert; water quality analyst; water treatment plant operator
Waste management (solid waste, electronic waste)	Waste collection and segregation; waste management planner; waste materials plant operator; recycling or rubbish collector; refuse sorter
Source: ILO (2018)	

To the extent that adaptation programmes require employment in medium- and low-skilled sectors, training programmes in vocational institutions or for workers in the informal economy may be required. The focus on further education and training is also evident in the UK.[176] However, skills for green transition are not yet part of the vocational training curriculum in a large number of countries. This is often due to the disconnect between vocational training systems, environmental policies and national development strategies, as well as between vocational training institutions and industry.[177]

[176] HM Government (2011), "Skills for a green economy: A report on the evidence."

[177] ILO (2018), "World Employment and Social Outlook 2018 – Greening with jobs"

The challenge of ensuring the right vocational skills to address climate change is recognised in the forthcoming SOLAS Strategy for Further Education and Training. The FET sector in Ireland has particular capabilities around energy, building and the environment. The strategy places emphasis on programme and curricula development, as opposed to facilitating a greatly increased number of workers in these areas:

> *"There should be a national roll-out of NZEB (near zero energy buildings) construction skills centres, programme development across all green skills areas should be ramped up, and curricula across all relevant apprenticeships and other FET programmes should be updated to embed a sustainable development focus."*[178]

The Future Jobs Ireland 2019 strategy identifies already emerged skills gaps and shortages across the construction, building renovation, environmental services and renewables sectors. The Expert Group on Future Skills Needs will be commencing a study in 2020 on skills for the low carbon economy. Identified areas which will be examined include retrofitting, installation of heat water pumps, electric vehicle charging stations, and the development of offshore energy. The study will aim to identify the scale of demand for occupations over the coming decade to meet Ireland's responsibilities in climate change mitigation.

There are also a number of sector-specific initiatives regarding skills. For example, the forthcoming Demand for Skills within Ireland's Construction Sector to 2030 is scheduled to be published in Q3 of 2020. Important considerations in this research will be emerging trends within construction and built environment activities, which include the need to develop environmental sustainability across the sector, including with respect to building information modelling and the circular economy.

8.7 Implications of Brexit for Existing and Emerging Sector

Brexit is likely to impact on trade and the economy both in the short term and long term. Customs procedures, potential delays at border crossings, changes to transport routes and markets are likely to create short-term challenges while regulatory divergence potentially presents a long-term challenge, even to those sectors more insulated from the impact of Brexit. Virtually every economic sector is considered to be vulnerable to a varying extent. The majority of sectors are likely to lose jobs, especially low margin sectors such as agri-food, which areas outside of Dublin are more reliant upon.

EGFSN: Addressing the Skills Needs Arising from the Potential Trade Implications of Brexit

In June 2018, the Expert Group on Future Skills Needs (EGFSN) established a steering group tasked with *Addressing the Skills Needs Arising from the Potential Trade Implications of Brexit.* This study aimed to identify the areas of the Irish economy that would most likely be affected by Brexit and then to identify whether the skills requirements of these sectors could change. This study recognized that as a result of the immense growth in employment experienced in Ireland in recent years, Irish goods and services exports increased too. The freight, transport, distributions and logistics sector is responsible for facilitating this vitally important movement of goods. Transported goods range from building products and heavy machinery right through to agricultural and forestry outputs and food and drink products.[179] Following Brexit, it is predicted that significant changes will occur to supply chains across many businesses in Ireland. Furthermore, complex issues are likely to arise as a result of these changes and therefore, skilled and experienced personnel in the freight and logistics industry will be required to deal with these issues and to help identify cost efficient solutions for affected businesses.

[178] SOLAS (2020), "Future FET: Transforming Learning - The National Further Education and Training (FET) Strategy"
[179] AIB: Transport & Logistics Outlook: The Lifeblood of the Economy (May 2017)

As part of this report, workshops with organisations representing all aspects of international trade and the Freight, Transport, Distributions and Logistics sector (FTDL) were facilitated in order to identify the numerous areas of the Irish economy in which skills needs are likely to change. As the UK is Ireland's largest market for food and drink, accounting for 35% of all the food and drink exported in 2017; it is clear that Brexit will have many effects on the Irish agri-food sector. Workshop respondents noted that following Brexit, there will be an increased focus on trading with other non-English speaking countries and opportunities to diversify customer bases and explore new markets will arise. As a result of this, foreign language and cultural awareness skills as well as international selling skills will be required. In addition, supply chain management skills and skills in regulatory divergence (tailoring products to reflect specific market regulations) will be necessary too.

In relation to the health life sciences sector, this report notes that Ireland is a major exporter worldwide and that skills such as international selling, cultural awareness, market research and business planning are valued. As China is likely to increase its importation of life science products from Ireland, it is noted that people with a knowledge of intellectual property will be desirable too. The report further notes that the technology sector could benefit from Brexit as tech start-ups will be enticed to base themselves in Ireland and this will lead to further demand for highly skilled individuals able to manage global supply chains, as well as increase the need for experienced management and marketing professionals and ICT professionals.

Moreover, this report recognizes that as a result of Brexit and as is the case for the agri-food and health life sciences sectors, the likely reduction in exports to the UK will result in the high value manufacturing sector also diversifying into new markets. Workshop respondents noted that in recent years, it had become difficult to recruit people with global and international management skills, international sales skills, international marketing skills, customer service/support skills, design and development skills and logistical and distribution skills; and therefore graduates with these skills will continue be in high demand following Brexit.

In relation to the construction sector, this document acknowledges that growth of the construction sector is strongly correlated with growth of the economy. Following the burst of the property bubble, a huge number of people employed in this sector became unemployed and as a result, people began to perceive construction work as volatile, which subsequently had a negative effect on the uptake of apprentices in construction. Therefore, skills gaps have appeared in a number of areas such as 'wet trades', curtain walling and installation. Additionally, this document notes that Brexit could be a potential catalyst for an increase in construction activities and this will exacerbate the existing shortage of skills. All workshop respondents were aware and concerned about the likely need for customs clearance skills.

In relation to the FTDL sector, this report identifies skills needs across a range of jobs. In warehouses, the increasing use of sophisticated warehouse management systems and stock control systems will result in a need for skilled staff in this area. In relation to support services and as a result of businesses aspirations to grow internationally following Brexit, there will be an increased requirement for language skills and cultural awareness skills. In relation to supply chains in Ireland, there will be an increased need for workers who can apply innovative techniques. As supply chains are data driven, skills in statistical analysis are growing in importance. Effective supply chains require individuals trained in numerous areas including software development, data analysis, risk management, contract law, and more.

Furthermore, this report notes that as the UK is currently a member of the Customs Union and European Single Market, knowledge and expertise of customs procedures has not been required because the transportation of goods between the UK and Ireland has occurred without checks or complications. However, this could change following the UK's exit and this would result in an increased need for people who have knowledge and expertise in customs procedures. However, investment in customs clearance skills and exploration of new markets is not being undertaken to a great extent.

The analysis identifies numerous areas of the Irish economy that will be subject to a change in skills needs following the UK's departure from the European Union. Although some international trade sectors such as the agri-food sector are extremely reliant on the UK market for exports and therefore are at risk of losing jobs, there is also strong potential for job diversification as identified in this report. Language and cultural awareness skills were cited as being in high demand across a number of sectors across the Irish economy following Brexit; as were statistical and data analysis skills for supply chain managers and skills relating to international trade and customs procedures.

8.8 Summary of Key Findings

The evidence on emerging sectors and technologies on skills needs in Ireland indicates that:

- Increased automation and digitisation are already having an impact on demand in the labour market. Cedefop skills forecasts for Ireland up to 2025 predict an increase in demand for high-level ICT skills such as skills in cloud computing and big data analytics, as well as an increase in the demand for various other levels of ICT skills.
- Technology change and digitisation can also have an impact on non-ICT occupations. The estimates for Ireland show that around two in five workers are at high or medium risk of automation. Over 370,000 people in Ireland are estimated to be employed in occupations at high risk of automation, representing 15% of the working population. A further 600,000 were in jobs considered at medium risk of automation, or 26% of the working population.
- Lower skilled workers are more at risk of automation. Each of the top six occupations with the highest number of employees at high risk of automation had a lower skill profile than the national average, as measured by the share of persons in each occupation with third-level qualifications. These occupations are more prevalent outside the Greater Dublin Area.
- Artificial Intelligence can be defined as systems that display intelligent behaviour by analysing their environment and acting with some degree of autonomy to achieve specific goals. The internationally traded sectors in Ireland which have highest levels of AI adoption employ almost 250,000 workers, representing two in three of the total employment in such firms.
- The evidence shows that productivity is likely to grow as a result of the application of AI. This will reduce employment for any given level of output. However, the overall employment impact will depend on the extent to which AI facilitates the expansion of economic activity in the relevant sectors.
- The movement to a carbon-neutral economy will have a significant impact on the jobs needed in the future. Some forms of environmental change may have a negative effect on certain sectors and regions but there will also be opportunities to develop new skills as Ireland transitions to a low greenhouse gas economy.

- The OECD has said that it is difficult to gauge whether green technology will prove to be as general and transformative of work across the economy as ICT has been, or whether it will primarily impact on the skills requirements for a relatively narrow range of industries/occupations.
- To the extent that climate adaptation programmes require employment in medium- and low-skilled sectors, training programmes in vocational institutions or for workers in the informal economy may be required. The forthcoming SOLAS Strategy for FET places emphasis on programme and curricula development to meet skills needs in this area.
- In understanding further demand for skills in the Irish labour market, it is useful to consider trend in employment in different sectors.
- Reflecting the catch-up in construction investment very fast growth was evidenced in civil engineering and specialised construction sectors.
- A number of internationally traded sectors also demonstrated very fast growth. These sectors have also recorded high growth in R&D employment and in investment in training.
- In terms of emerging technologies, AI is particularly important and this is likely to impact negatively on lower skilled sectors but this also opens opportunities for higher skilled employees in certain exporting sectors of the economy. These export oriented AI-adapting sectors have shown fast growth in employment.
- The scale of potential impact of AI on low skilled employees may require special attention by the FET system with tailored programmes to address the transition to other sectors.

9 Alignment of Skills Provision and Existing Labour Demand

9.1 Skill Mismatches

In examining the alignment of skills provision and existing labour demand, it is necessary to consider different concepts of skills mismatches, and various measurements of skills mismatches in Ireland.[180] The following table outlines the various types of skills mismatch, including vertical skills mismatch, horizontal skills mismatch and skills shortages or gaps. A vertical skills mismatch may be due to over- or underqualification of the workforce when compared to market requirements. Horizontal mismatch relates to graduates who are employed in sectors that are not directly aligned with their field of study, which may lead to a wage penalty incurred by the graduate. The third type is where there are difficulties in recruiting suitable graduates at market rates due to skills shortages or gaps.

Table 9.1: Different Concepts of Potential Skill Mismatches

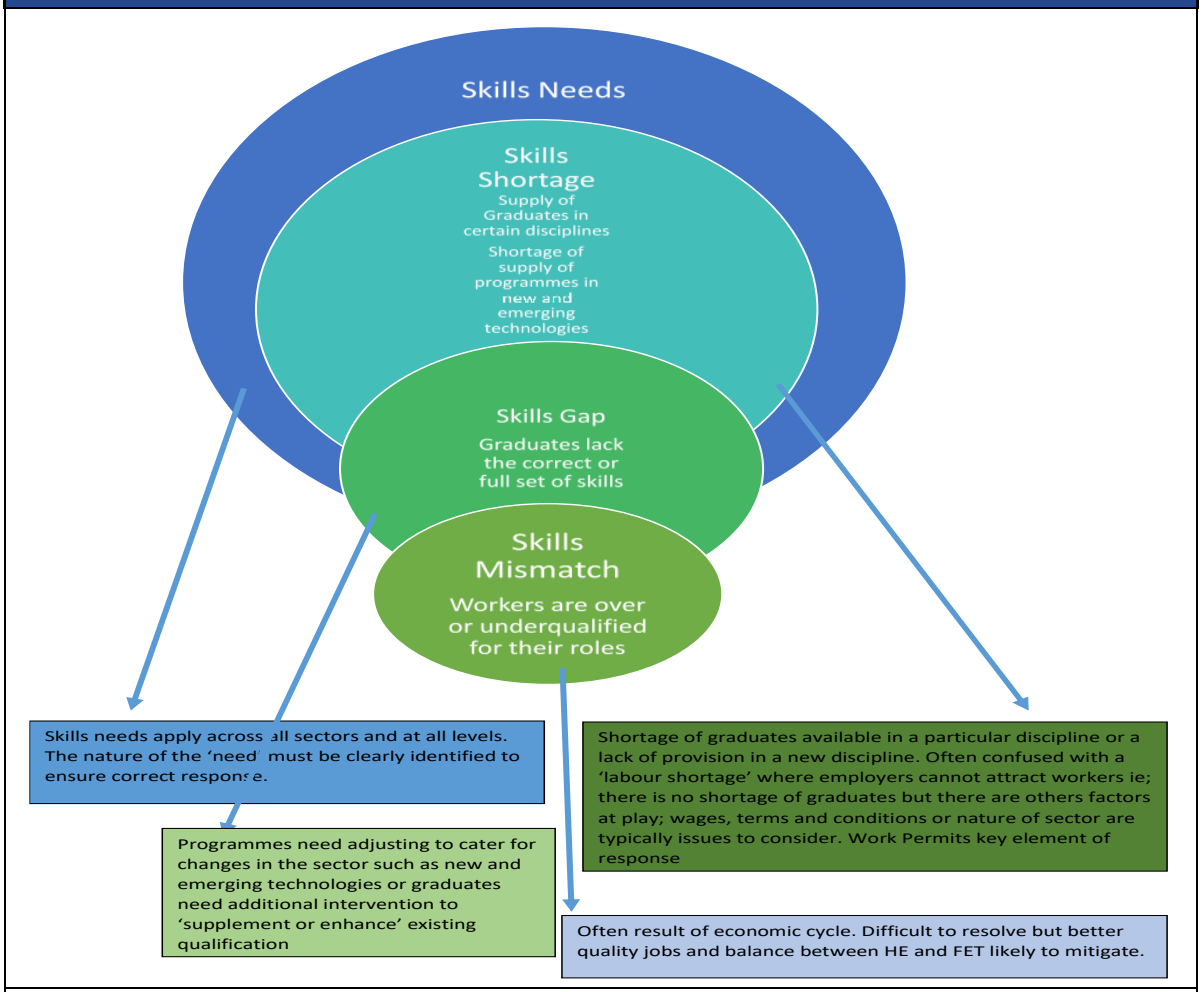
Vertical Skills Mismatch	**Implications**
Over education / over-skilling compared to market requirements	• Potentially suggests that levels of education and training for some individuals is in excess of current requirements. • Need to consider wider societal impacts • Critical to take account of future rather than existing demand. • Underutilisation of human capital imposes substantial costs for employees and society
Undereducation/ under skilling compared to market requirements	• Has received less attention in empirical studies • Impacts on wage levels and probability of employment
Horizontal Skills Mismatch	
Graduates employed in occupations not directly related to principal field study	• Wage penalty compared to where field of study is matched but may be other determinants of wage differences
Skills Shortages / Skills Gaps	
Difficulties in recruiting suitable graduates at market rates	• Skill gaps impact on economic output / productivity • Impacts of attractiveness of Ireland for Investment
Source: Economic modelling by consultancy team.	

[180] See details in References

Table 9.2: Methodology Used to Measure Skill Mismatches	
Vertical Skills Mismatch	**Examples of Measurement Technologies**
Over education / over-skilling compared to market requirements Undereducation/ under skilling compared to market requirements	• Subjective Methods • Empirical methods comparing skills to mode or average skills • Job evaluation methods
Horizontal Skills Mismatch	
Graduates employed in occupations not directly related to principal field study	• Comparison of empirical data on employment and areas of study • Subjective methods
Skills Shortages / Skills Gaps	
Difficulties in recruiting suitable graduates at market rates	• Employee surveys • Employers surveys
Source: Economic modelling by consultancy team.	

The following figure shows the relationships between skills needs, shortages, gaps and mismatches, and outlines how these may be subsets of each other.

Figure 9.1: Relationship Between Skills Needs, Shortages, Gaps and Mismatches



Source: Department of Education and Skills[181]

9.2 Macroeconomic Skills Mismatch

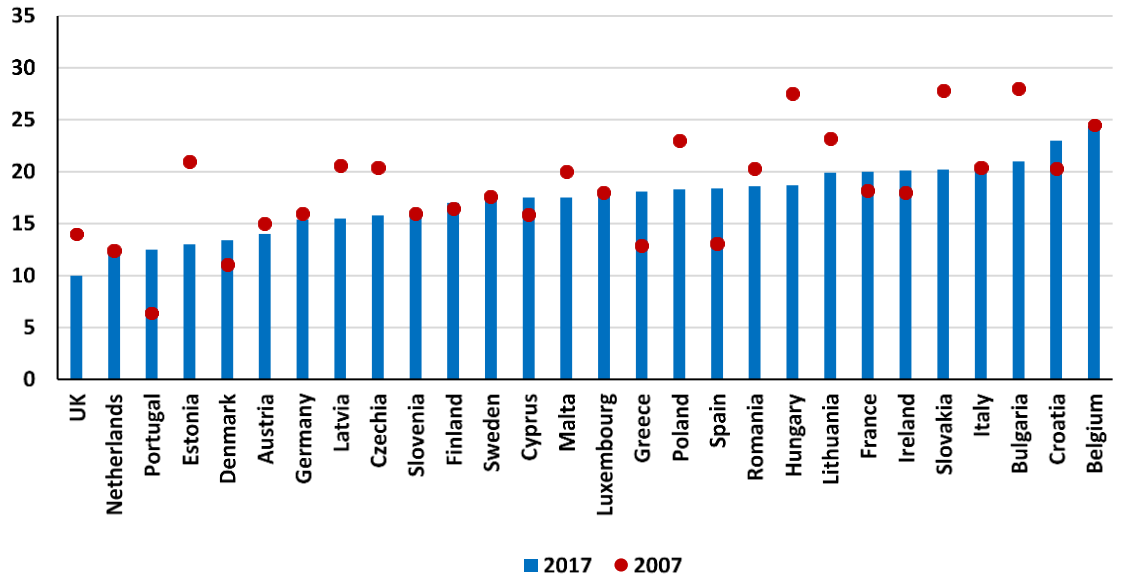
In considering skills mismatches, it is useful to compare Ireland to other EU Member States in relation to macroeconomic skills mismatch in terms of employment. The macroeconomic skills mismatch indicator (SMI) is based on the following formula:

$$SMI = \sum_{i=L,M,H} \left| \frac{E_i}{E_t} - \frac{P_i}{P_t} \right| = \frac{1}{e_t} \sum_{i=L,M,H} \left| \frac{P_i}{P_t}(e_i - e_t) \right|$$

Where L, M and H denote the different qualification groups, E represents the number of people in employment, P representations the working age population and e represents employment rates of groups by education level. Thus, the higher the difference in ratios between employment by education level to overall employment and working age population by education level to overall working age population the higher the skills mismatch indicator is. Another way of describing this is that the closer employment rates by education are to the overall employment rate, then all else equal the lower the indicator. The data in the next figure suggests relatively high levels of macroeconomic skill mismatches in Ireland.

[181] Thanks are due to Kathleen Gavin for providing this helpful chart.

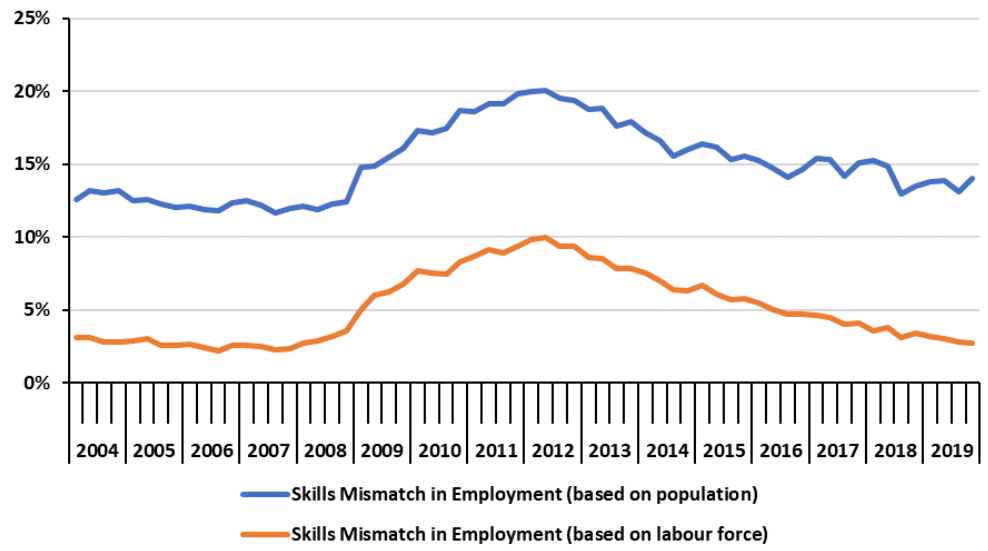
Figure 9.2: Comparison of Macroeconomic Skills Mismatch in terms of Employment (%) Across EU Member States



Source: European Commission, Skills Mismatch and Productivity in the EU Discussion Paper July 2019

The following figure calculates the SMI for Ireland over time, based on the formula used in the previous EU discussion paper. We have estimated skills mismatch applying both the entire working age population and separately the population of the labour force. Under both measures there was an increase in mismatch following the recession. Both measures have experienced a downward trend since 2012, suggesting a decrease in the level of mismatch.

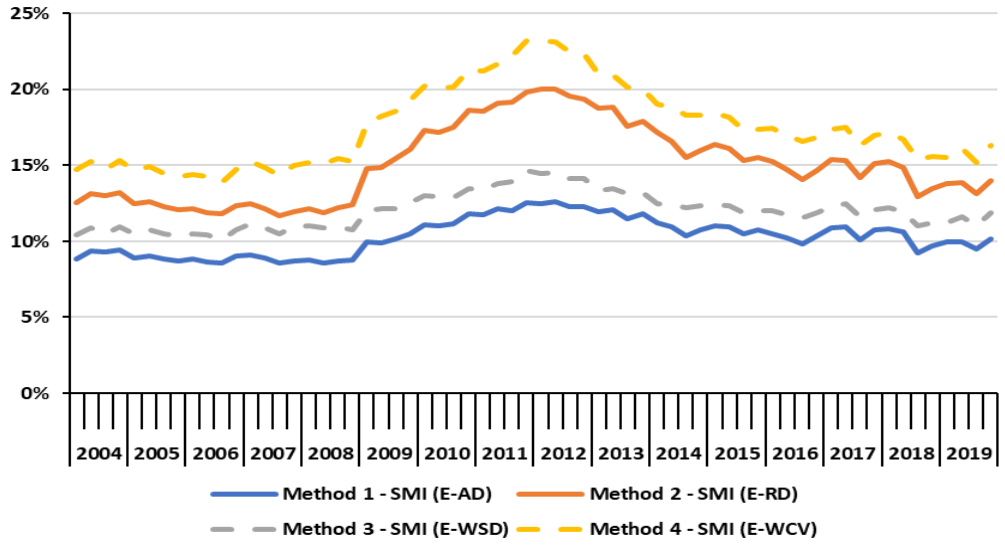
Figure 9.3: Macroeconomic Skills Mismatch in Employment in Ireland (2004-2019)



Source: Analysis of LFS data

Figure 9.4 utilises four separate methodologies of calculating skills mismatch outlined in Kiss and Vandeplas (2015).[182] Each methodology shows the peak in skills mismatch occurring between 2011 and 2012 and declining since.

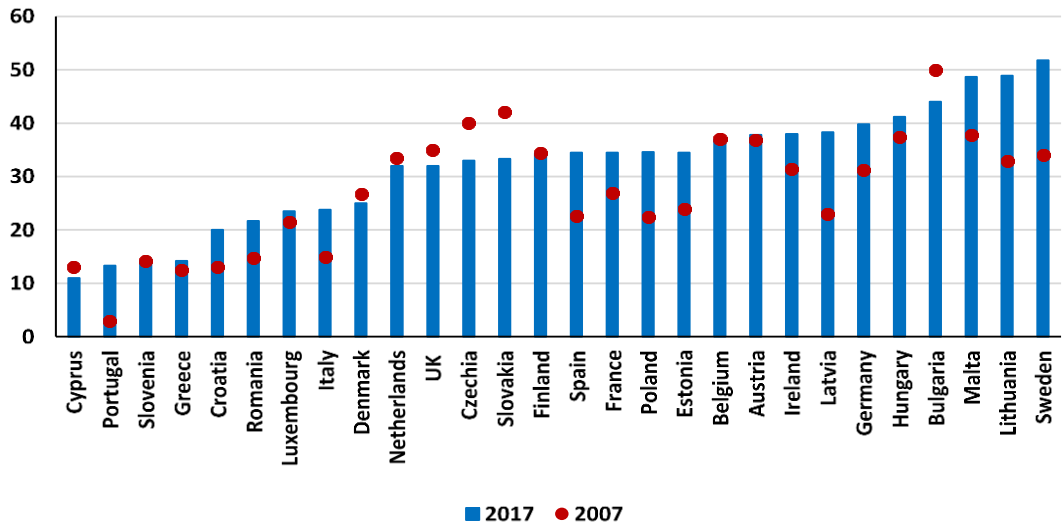
Figure 9.4: Macroeconomic Skills Mismatch in Employment in Ireland (2004-2019), Alternative Methodologies



Source: Analysis of LFS data

A comparison of the skills mismatch in terms of unemployment can be found in the following table. This measure replaces the employment rate in the previously discussed formula with the unemployment rate.

Figure 9.5: Comparison of Macroeconomic Skills Mismatch in terms of Unemployment (%) Across EU Member States

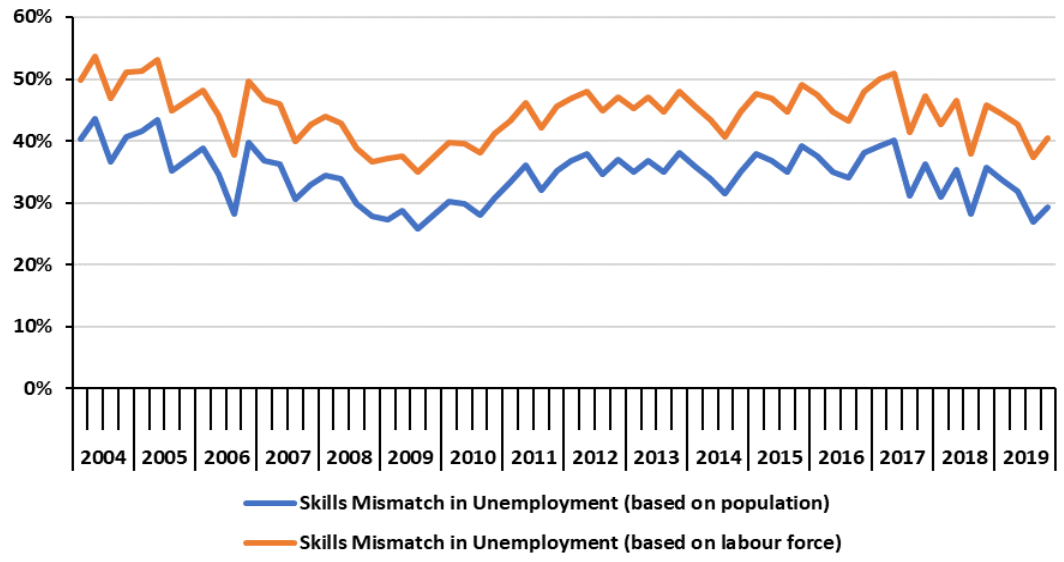


Source: European Commission, Skills Mismatch and Productivity n the EU Discussion Paper July 2019

[182] Kiss, A., Vandeplas, A. (2015) Measuring skills mismatch. DG EMPL Analytical webnote 7/2015, European Commission. Downloadable from http://ec.europa.eu/social/BlobServlet?docId=14974&langId=en.

Indecon has estimated this skills mismatch indicator in terms of unemployment over time in Ireland. The following figure shows the fluctuations over time in skills mismatch, with skills mismatch based on the population falling to 30% in late 2019.

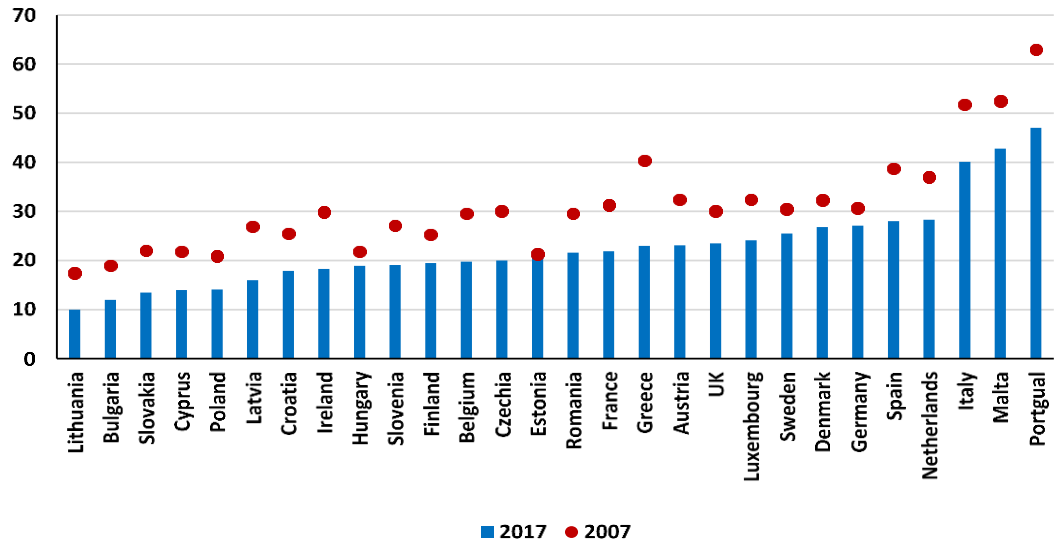
Figure 9.6: Macroeconomic Skills Mismatch in Unemployment in Ireland (2004-2019)



Source: Analysis of LFS data

The EU Discussion Paper presents a measure of underqualification based on the number of low- and medium-qualified workers that hold a job for which they are unqualified, as a share of total employment. Thus, the measurement is based on the probability of a worker being underqualified and the share of low and medium qualified workers in employment. Ireland's level of underqualification, as calculated by the authors fell between 2007 and 2017, with Ireland's estimate amongst the lowest in the EU.

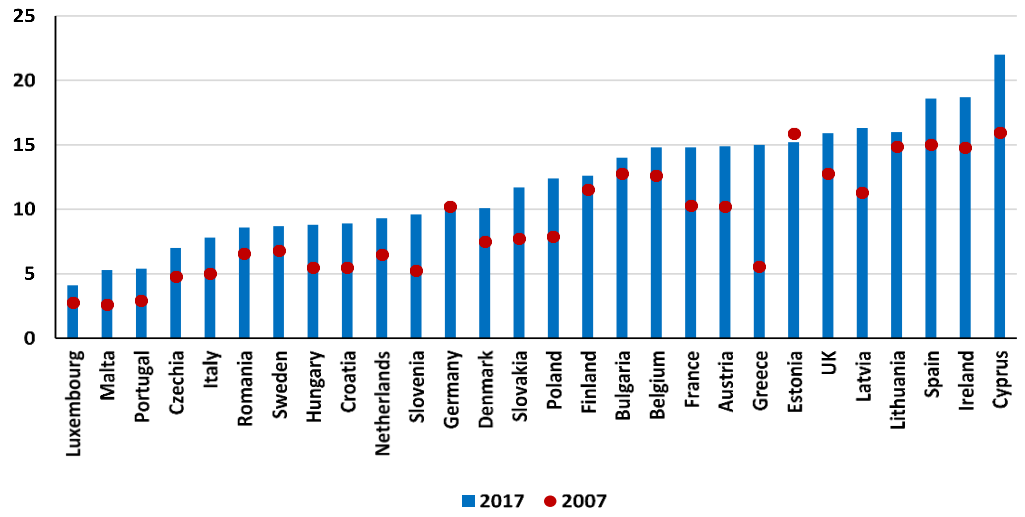
Figure 9.7: Underqualification as a Percentage of Total Employment



Source: European Commission, Skills Mismatch and Productivity n the EU Discussion Paper July 2019

Ireland has a high level of overqualification based on this approach. This measure is based on the probability of high- or medium-qualified workers being overqualified and the share of high- and medium-qualified workers in total employment.

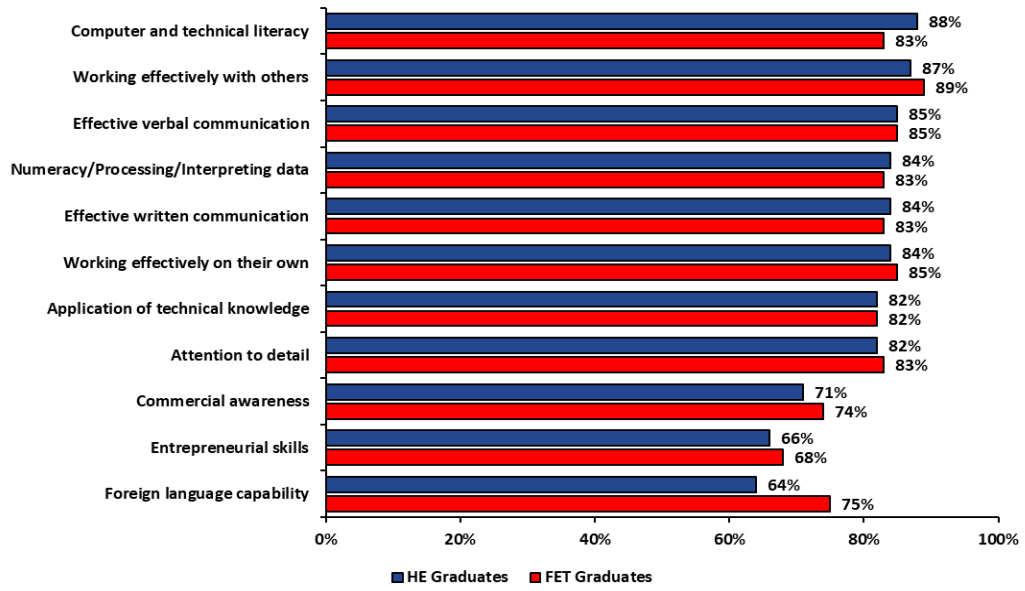
Figure 9.8: Overqualification as a Percentage of Total Employment



Source: European Commission, Skills Mismatch and Productivity n the EU Discussion Paper July 2019

The following figure based on the Irish National Employer and Eurobarometer surveys, asked employers for their views on the skills of HE and FET graduates, their recent recruits and the potential skill gaps in the future. The majority of employers were satisfied with both HE and FET graduates across a range of skills, including computer and technical literacy, working effectively with others, effective verbal communication as well as other skills outlined in the following figure.

Figure 9.9: Irish Employers' Satisfaction Levels with Skills of HE and FET Graduates



Source: Irish National Employer Survey (SOLAS, HEA, QQI and Fitzpatrick's Associates)

Irish employers are more satisfied with the HE graduates recruited when compared to the rest of the EU. However, similar percentages of employers felt that they were either very or rather satisfied with their graduates across the different skills.

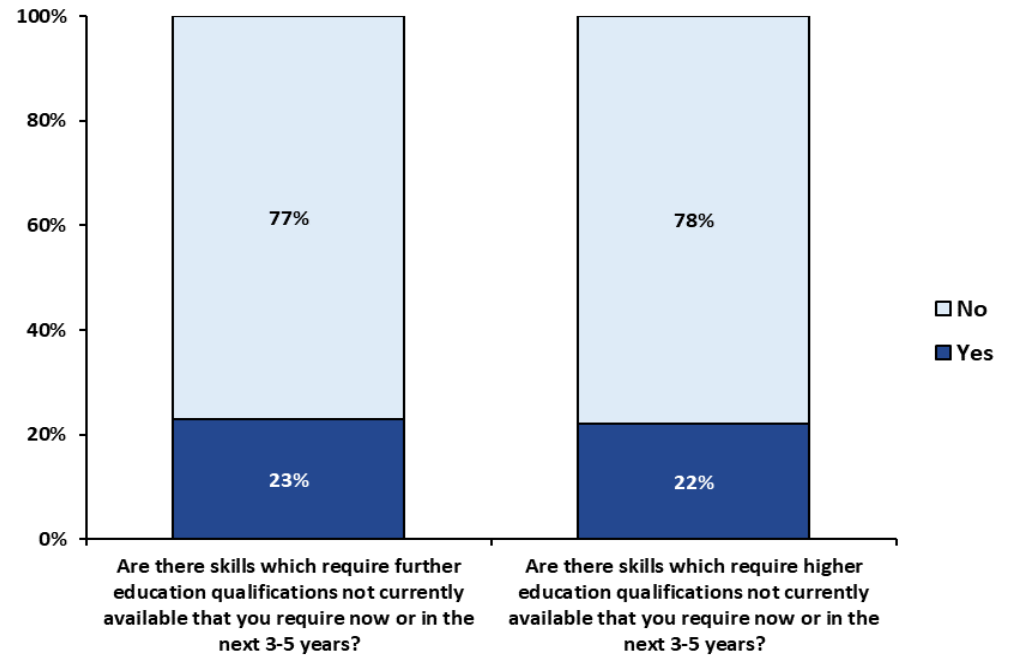
Table 9.3: Employer Satisfaction with HE Graduates Recruited by Your Company in Last 3-5 Years by Skills (Ireland and EU 27)

	Ireland		EU 27	
	Very satisfied	Rather satisfied	Very satisfied	Rather satisfied
Good reading / writing skills	63.2%	34.6%	34.0%	59.4%
Good with numbers	48.9%	48.9%	28.5%	66.9%
Computer skills	58.9%	38.9%	38.3%	56.7%
Team-working skills	56.3%	41.0%	31.5%	61.7%
Communication skills	53.3%	43.4%	27.2%	62.0%
Analytical and problem-solving skills	48.3%	47.2%	24.3%	62.5%
Decision-making skills	38.9%	56.1%	19.5%	63.4%
Ability to adapt to and act in new situations	39.6%	54.4%	24.7%	63.4%
Planning and organisational skills	40.9%	52.5%	22.8%	64.0%
Sector specific skills	45.6%	47.4%	30.7%	59.4%
Foreign language skills	31.9%	54.9%	23.8%	59.4%

Source: Flash Eurobarometer 304: Employers' perception of graduate employability

Whilst most employers indicated that they did not think that there were skills gaps in relation to HE or FET graduates either now or in the next three to five years. However, just over one fifth indicated that there may be skills that require HE or FET education to attain skills that are not currently available.

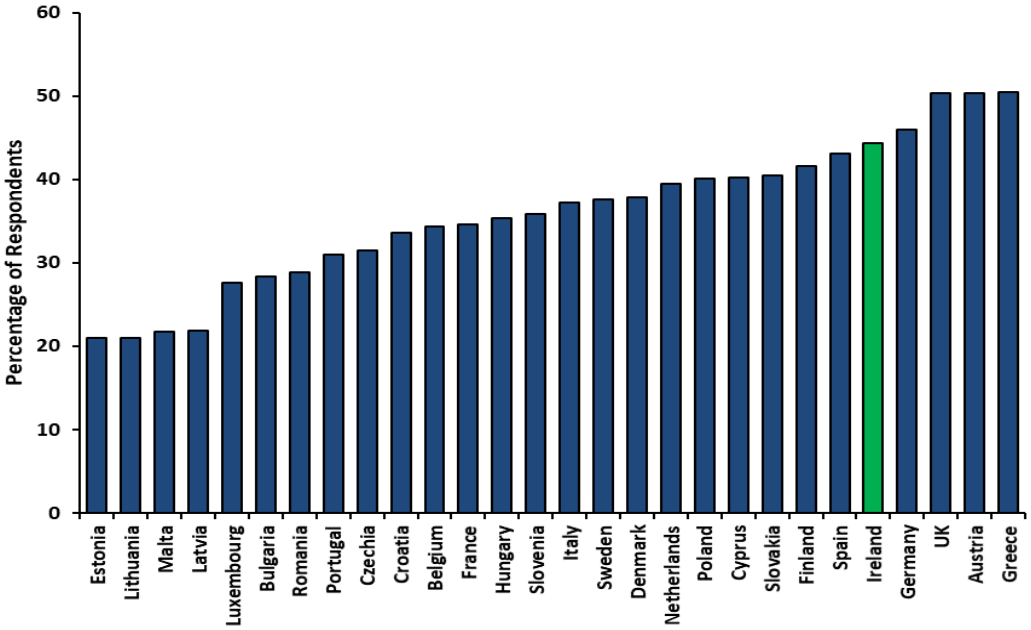
Figure 9.10: Irish Employers' Views on Skills Gaps



Source: Irish National Employer Survey (SOLAS, HEA, QQI and Fitzpatrick's Associates)

Having discussed the views of employers, Indecon will now present the views of employees, based on Cedefop and PIAAC surveys. The following figure shows that over 40% of responding employees believe their skills to be above those required for their job, one of the highest rates in the EU.

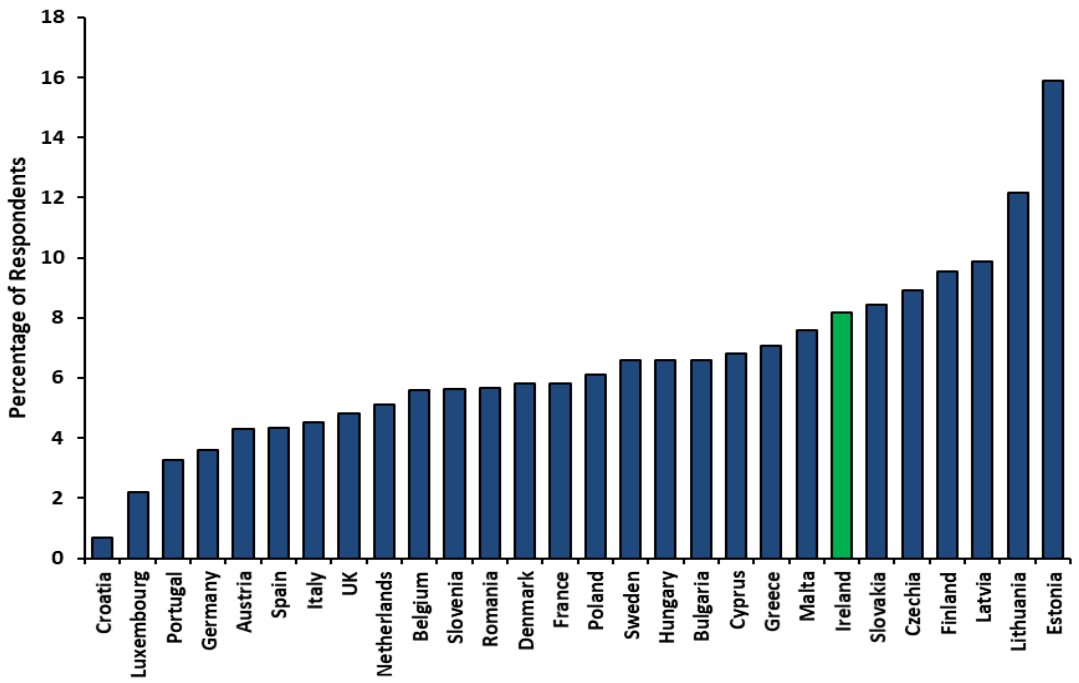
Figure 9.11: Percentage of Employees Saying Their Skills Are Above Those Required for the Job



Source: Analysis of Cedefop European Skills and Jobs Survey 2014

When asked whether some of their skills were below those required for the job, less than 10% of respondents indicated that they felt this was the case in Ireland. This was amongst the higher end when compared to other EU countries, but far below the percentage who deemed their skills to be above those required for the job.

Figure 9.12: Percentage of Employees Saying Some of Their Skills Are Below Those Required for the Job



Source: Analysis of Cedefop European Skills and Jobs Survey 2014

The following table breaks down responses of Irish employees by their level of education. Just under half of those with post-secondary education (either non-tertiary or tertiary) felt that their skills were higher than those required by their job. This was compared to 34.3% for those with a Leaving Certificate as their highest level of education.

Table 9.4: Cedefop Respondent Views on Skills Levels by Level of Education (Ireland)

	My skills are higher than required by my job	My skills are matched to what is required by my job	Some of my skills are lower than what is required by my job and need to be further developed
Junior Cert or Below	21.4%	68.6%	10.0%
Leaving Cert	34.3%	59.9%	5.8%
Post-Secondary (not tertiary)	49.0%	40.1%	10.9%
Third-level (Bachelor's, Master's or Doctoral)	49.0%	43.6%	7.4%

Source: Analysis of Cedefop European Skills and Jobs Survey, 2014

Amongst those who have attained third-level education, Ireland had a higher rate of respondents indicating that their skills are higher than those required by the job than the rest of the EU (49% v 42.4%).

Table 9.5: Cedefop Respondent Views on Skills Levels for Those Who Have Attained Third-level Education (Ireland and EU)

	Ireland	EU
My skills are higher than required by my job	49.0%	42.4%
My skills are matched to what is required by my job	43.6%	51.4%
Some of my skills are lower than what is required by my job and need to be further developed	7.4%	6.2%

Source: Analysis of Cedefop European Skills and Jobs Survey, 2014

The following table shows that amongst respondents who achieve higher education the majority of Irish and EU respondents believed their skill level to be higher than required for literacy, numeracy and ICT skills.

Table 9.6: Cedefop Respondents Views on Skill Level Amongst Higher Education Graduates (Ireland and EU 27)

	Ireland			EU 27		
	Skill Level Lower Than Required	Skill Level Matches What Is Required	Skill Level Higher Than Required	Skill Level Lower Than Required	Skill Level Matches What Is Required	Skill Level Higher Than Required
Basic literacy skills	1.4%	10.9%	87.7%	2.0%	10.1%	87.8%
Advanced literacy skills	2.0%	11.8%	86.2%	2.2%	12.9%	84.9%
Basic numeracy skills	3.2%	11.3%	85.5%	2.8%	15.7%	81.5%
Advanced numeracy skills	4.1%	12.2%	83.8%	2.9%	12.3%	84.8%
Basic ICT skills	6.8%	15.9%	77.3%	4.1%	14.9%	81.0%
Moderate ICT skills	0.9%	13.0%	86.1%	2.6%	13.4%	84.0%
Advanced ICT skills	7.0%	8.0%	85.0%	3.4%	11.3%	85.3%

Source: Analysis of Cedefop European Skills and Jobs Survey, 2014

The findings of the PIAAC survey in Ireland corroborates those of the Cedefop survey, indicating that respondents feel they have skills higher than those required by their jobs. Over 93% of those who studied social sciences, business or law felt that they have skills to cope with additional duties than they are currently required to perform.

Table 9.7: PIAAC Respondent Views On Whether They Have Skills to Cope With Additional Duties than They Are Currently Required To Perform		
Field of Study	**Yes**	**No**
Social sciences, business and law	93.4%	6.6%
General programmes	92.8%	7.2%
Services	92.3%	7.7%
Science, mathematics and computing	91.8%	8.2%
Engineering, manufacturing and construction	91.1%	8.9%
Agriculture and veterinary	90.6%	9.4%
Humanities, languages and arts	89.7%	10.3%
Health and welfare	87.1%	12.9%
Teacher training and education science	84.7%	15.3%
Source:Analysis of PIAAC data		

However, there were a significant minority of respondents, across the different fields of study, who indicated that they felt they need further training in order to cope with their present duties (Table 9.8).

Table 9.8: PIAAC Respondent Views On Whether They Need Further Training in Order to Cope Well with Present Duties		
Field of Study	**Yes**	**No**
Health and welfare	31.9%	67.7%
Teacher training and education science	30.7%	69.3%
Engineering, manufacturing and construction	30.0%	70.0%
Services	28.7%	71.3%
Humanities, languages and arts	27.2%	72.8%
Agriculture and veterinary	25.9%	75.3%
Social sciences, business and law	25.4%	75.0%
Science, mathematics and computing	24.6%	75.4%
General programmes	23.7%	77.6%
Source: Analysis of PIAAC data		

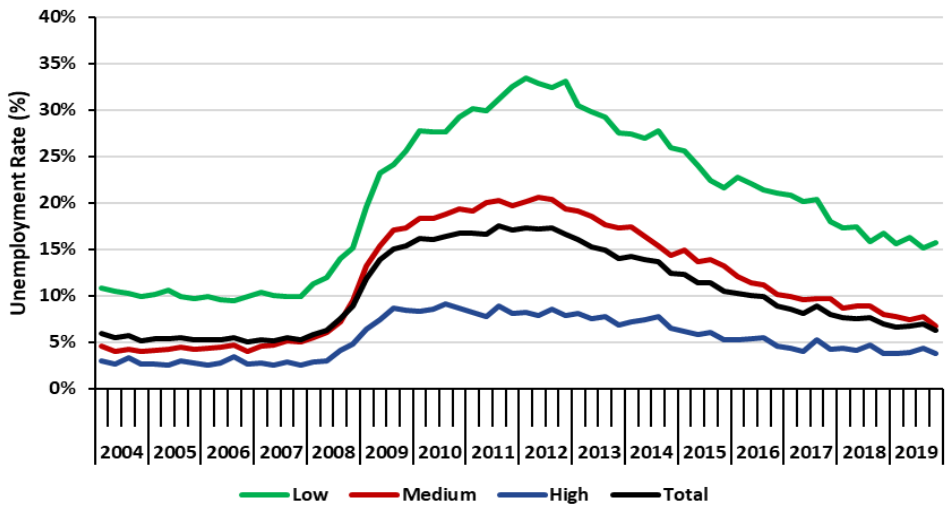
Table 9.9 shows that those with the lowest levels of education were least likely to state they felt they had skills to cope with more demanding duties than those they are currently required to perform. However, this cohort were also less likely to indicate that they need further training to cope with their present duties.

Table 9.9: PIAAC Respondents Views on Their Skill Levels and Ability to Deal with Current Duties				
Highest Education Level Attained	**Do you feel that you have the skills to cope with more demanding duties than those you are required to perform in your current job?**		**Do you feel that you need further training in order to cope well with your present duties?**	
	Yes	**No**	**Yes**	**No**
No formal qualification or below ISCED 1	60.0%	40.0%	20.0%	80.0%
Primary level of education	78.6%	21.4%	8.4%	91.6%
Lower secondary level of education	87.7%	12.3%	19.9%	80.1%
Upper secondary level of education	92.4%	7.6%	20.7%	79.3%
Post-secondary, non-tertiary education	90.2%	9.8%	24.7%	75.3%
Short-cycle tertiary education	93.0%	7.0%	26.0%	74.0%
Bachelor or equivalent	90.9%	9.1%	29.7%	70.3%
Master or equivalent	87.9%	12.1%	31.1%	68.9%
Doctoral or equivalent	87.8%	12.2%	31.7%	68.3%
Source: Analysis of PIAAC data				

9.3 Unemployment and Participation Rates

The following figure shows the trends in unemployment across the different education levels since 2004. Whilst there were increases in unemployment for each education level following the economic crisis the increase in unemployment rates was most pronounced amongst those with lower education levels. Unemployment rates did not exceed 10% for those with higher education qualifications in any quarter since 2004, compared to the low education cohort where the unemployment rate remained above 15% in 2019 following a peak of over 30% in 2011/12. The unemployment rate of those with medium qualifications was similar to the overall unemployment rate in the economy prior to the crash, but move slightly above it over the period of the crisis and recovery.

Figure 9.13: Unemployment Rate by Education Level (2004-2019)



Source: Analysis of LFS

Amongst those with higher education qualifications those who studied arts and humanities had the highest unemployment rate in 2019, as well as the highest unemployment rates during the recession. Those with engineering, manufacturing and construction degrees experienced very high rates of unemployment between 2009 and 2013 when compared to other field of study in higher education, but they had the lowest unemployment in 2019.

Table 9.10: Unemployment Rate Amongst Those with High Qualifications by Field of Study (2005-2019)

Field of Study	2005	2007	2009	2011	2013	2015	2017	2019
Arts and Humanities	5.1%	5.2%	12.7%	12.2%	11.5%	9.4%	7.8%	6.6%
ICT	3.9%	4.0%	8.1%	9.5%	7.9%	6.4%	5.1%	5.5%
General Programme	3.4%	6.2%	9.7%	8.6%	5.5%	14.5%	6.0%	5.2%
Services	3.8%	3.5%	9.8%	10.5%	9.5%	7.5%	7.0%	5.2%
Social Sciences, Bus. and Law	2.2%	2.5%	7.2%	7.8%	7.4%	5.3%	4.0%	4.0%
Natural Sciences, Math. and Statistics	2.9%	2.4%	8.0%	7.9%	6.7%	7.1%	5.2%	4.0%
Education	1.6%	1.3%	4.8%	6.9%	5.5%	4.5%	2.7%	3.6%
Agriculture, Forestry and Fishery	2.0%	3.0%	7.0%	7.0%	9.5%	6.5%	5.8%	3.2%
Health and Welfare	1.4%	1.9%	3.4%	4.0%	4.2%	3.0%	2.8%	2.7%
Engineering, Manuf., Constr.)	2.9%	2.3%	10.9%	11.6%	9.0%	6.9%	4.5%	2.5%

Source: Analysis of LFS data

Table 9.11 shows that those with medium-level qualifications in arts and humanities and ICT tended to have the highest levels of unemployment, with both fields of study having an unemployment rate of over 16% in 2019. Each of the other fields has an unemployment rate of below 9% for those with medium qualifications.

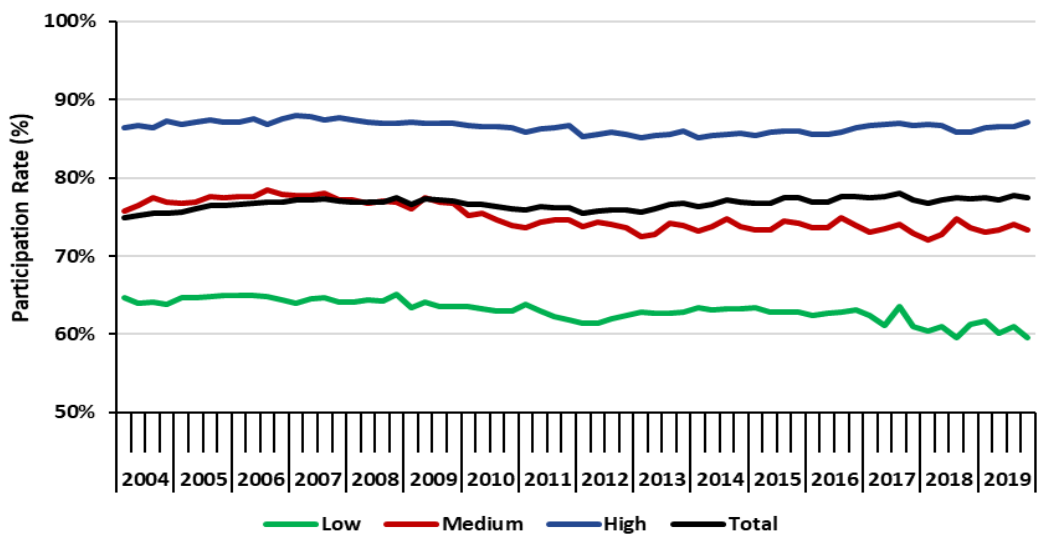
Table 9.11: Unemployment Rate Amongst Those with Medium Qualifications by Field of Study (2005-2019)

Field of Study	2005	2007	2009	2011	2013	2015	2017	2019
Arts and Humanities	6.5%	8.0%	24.8%	29.2%	30.1%	21.5%	14.7%	17.7%
ICT	5.7%	6.8%	22.4%	33.4%	34.2%	18.4%	23.5%	16.2%
General Programme	4.8%	5.7%	16.0%	20.1%	18.6%	14.6%	10.4%	8.5%
Health and Welfare	4.9%	4.9%	13.3%	18.2%	19.8%	12.2%	10.5%	8.1%
Social Sciences, Bus. and Law	3.8%	3.5%	11.6%	14.2%	15.9%	11.4%	9.1%	7.8%
Services	3.9%	6.5%	15.6%	22.4%	19.2%	16.7%	10.9%	7.5%
Education	3.4%	4.5%	15.6%	10.6%	15.5%	12.3%	11.0%	6.7%
Engineering, Manuf., Constr.)	4.3%	4.6%	25.8%	29.9%	23.4%	15.8%	7.7%	4.8%
Natural Sciences, Math. and Statistics	2.6%	12.0%	2.6%	24.2%	17.1%	18.7%	6.9%	4.1%
Agriculture, Forestry and Fishery	0.4%	0.6%	4.8%	7.0%	5.6%	5.5%	2.5%	4.0%

Source: Analysis of LFS data

The following figure shows clear differences in the labour force participation rates of those with low, medium and high qualification. Those with high levels of education had the most stable labour for participation rate between 2004 and 2019, with only a slight dip following the recession. Labour force participation amongst those with low levels of education has been trending downwards since 2004, falling below 60% in 2019.

Figure 9.14: Labour Force Participation Rate by Education Level (2004-2019)



Source: Analysis of LFS

Labour force participation rates were above 80% for those with high qualification across each of the different fields of study. Engineering, manufacturing, construction and ICT graduates had the highest participation rates with those who had studied in either field having a participation rate of over 90% in 2019.

Table 9.12: Labour Force Participation Rate Amongst Those with High Qualifications by Field of Study (2005-2019)

Field of Study	2005	2007	2009	2011	2013	2015	2017	2019
Engineering, Manuf., Constr.)	92.5%	93.0%	90.9%	90.4%	89.7%	90.0%	92.2%	92.1%
ICT	88.7%	90.0%	88.9%	90.4%	89.3%	87.1%	89.2%	90.7%
Agriculture, Forestry and Fishery	93.3%	91.5%	92.3%	89.4%	88.7%	87.3%	90.6%	89.2%
Social Sciences, Bus. and Law	87.9%	87.9%	87.6%	86.3%	86.1%	86.8%	87.7%	87.7%
Health and Welfare	85.5%	87.7%	86.2%	87.5%	85.2%	85.9%	86.1%	85.7%
Natural Sciences, Math. and Statistics	87.0%	85.9%	84.0%	86.2%	82.1%	82.6%	85.4%	85.5%
Services	85.7%	85.3%	85.3%	83.3%	83.4%	85.0%	84.9%	84.8%
Education	85.7%	85.6%	86.4%	84.4%	84.6%	83.8%	83.9%	83.8%
General Programme	84.1%	87.2%	81.4%	84.6%	79.4%	80.2%	83.3%	82.6%
Arts and Humanities	81.7%	81.0%	81.9%	78.8%	80.1%	80.5%	80.7%	81.4%

Source: Analysis of LFS data

Amongst those with medium qualifications, the labour force participation rate was also highest for those who studied in the field of engineering, manufacturing and construction. As was the case for those with high qualifications, those with medium qualifications who studied arts and humanities had the lowest participation rate. It is interesting to note that labour force participation was low in ICT for those with medium qualifications, but amongst the highest for those with high qualifications.

Table 9.13: Labour Force Participation Rate Amongst Those with Medium Qualifications by Field of Study (2005-2019)

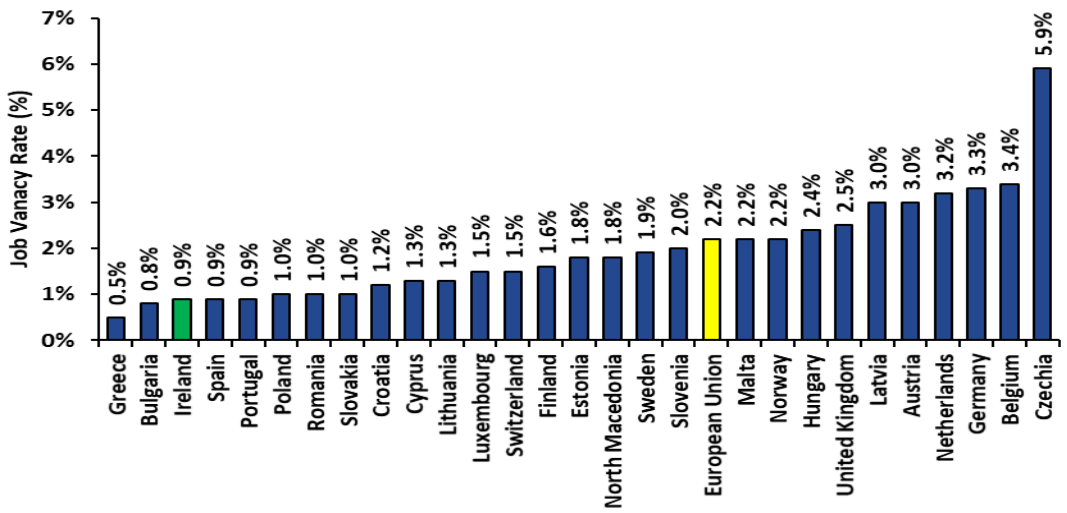
Field of Study	2005	2007	2009	2011	2013	2015	2017	2019
Engineering, Manuf., Constr.)	93.0%	93.1%	92.8%	90.7%	88.7%	90.2%	90.2%	92.6%
Agriculture, Forestry and Fishery	96.2%	95.9%	93.6%	90.9%	94.2%	89.7%	93.6%	91.9%
Natural Sciences, Math. and Statistics	81.1%	85.7%	85.5%	71.8%	81.8%	79.6%	73.4%	88.7%
Services	82.6%	82.3%	79.0%	74.8%	76.1%	74.4%	80.2%	81.1%
Health and Welfare	78.9%	76.6%	74.6%	75.5%	72.5%	76.6%	77.7%	75.4%
Education	81.5%	78.7%	83.2%	78.6%	84.0%	70.2%	71.7%	73.5%
Social Sciences, Bus. and Law	75.6%	72.4%	72.3%	67.0%	67.5%	69.2%	71.0%	71.5%
ICT	79.3%	78.1%	74.1%	69.4%	70.2%	67.3%	73.0%	68.8%
General Programme	71.8%	72.4%	70.3%	68.4%	66.7%	66.9%	65.3%	65.2%
Arts and Humanities	73.3%	72.0%	75.6%	65.5%	68.2%	66.9%	70.1%	63.1%

Source: Analysis of LFS data

9.4 Job Vacancy Rate

When compared against other EU Member States Ireland had one of the lowest job vacancy rates, measured at 0.9% in Q4 of 2019. This was less than half of the vacancy rate across the European Union as a whole (2.2%), as shown in the following figure.

Figure 9.15: Job Vacancy Rate (% 2019 Q4)



Source: Analysis of LFS

The following table shows the job vacancy rate over time in Ireland for the different economic sectors. Transportation and storage had the lowest job vacancy rate in 2019, with construction, wholesale and retail trade, and human health and social work activities also having low job vacancy rates. Financial, real estate and insurance activities; and professional, scientific and technical activities consistently had some of the highest job vacancy rates over the five-year period.

Table 9.14: Job Vacancy Rate in Irish Economy – Sector Breakdown – 2015-2019

	2015	2016	2017	2018	2019
Transportation and storage (H)	0.4	0.4	0.6	0.8	0.5
Construction (F)	0.8	0.4	0.4	0.7	0.6
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)	0.7	0.7	0.6	0.6	0.6
Human health and social work activities (Q)	0.9	1.2	1.3	1.0	0.6
Industry (B to E)	0.6	0.7	0.6	0.8	0.8
Accommodation and food service activities (I)	0.7	0.6	0.8	0.7	0.9
Education (P)	0.5	0.6	0.8	0.7	0.9
Administrative and support service activities (N)	1.3	1.3	0.9	1.1	1.0
Arts, entertainment, recreation and other service activities (R,S)	0.9	0.9	0.9	0.7	1.0
Public administration and defence; compulsory social security (O)	1.1	1.2	1.3	1.4	1.6
Information and communication (J)	2.6	1.9	1.8	1.8	1.7
Financial, insurance and real estate activities (K,L)	2.1	2.3	2.4	2.4	1.9
Professional, scientific and technical activities (M)	1.6	1.7	2.6	2.8	2.8
All NACE economic sectors	**1.0**	**1.0**	**1.1**	**1.0**	**1.0**

Source: CSO
**** Annual figures are based on averages over four quarters in each year.***

9.5 Summary of Key Findings

- Different concepts of skill misalignment are interlinked. While the empirical focus has been mainly on vertical over-education/horizontal skills mismatch, the policy focus has been on skill gaps. We also note that there has been relatively little emphasis in empirical research on under-education.[183] The methodological techniques used to measure skill mismatches have deficiencies and alternative approaches often suggest different rankings.
- Alignment of skill provision with future demand rather than existing demand is of fundamental importance.

[183] This was also highlighted in research by the ESRI and others.

- Some evidence of macroeconomic skill mismatches in the Irish economy but issues re methodologies used and such mismatches exist in all countries.
- There is also evidence that 49% of graduates suggested they had skills higher than required by their jobs compared to 42.4% average for EU and this has implications for the utilisation of human capital.
- The importance of responding to mismatches in terms of under-education is also important.
- Job vacancy rates in Ireland prior to the COVID-19 pandemic were only 0.9% compared to EU average of 2.2%, which may suggest that the HE and FET system have been successful in meeting current needs but there is a challenge of responding to future requirements.

10 Conclusions and Recommendations

10.1 Conclusions

The key conclusions for the detailed evidence on any mismatch between the qualifications and skills provided by higher education and FET in Ireland and the skills demand of the labour market are presented in the table below.

Table 10.1: Summary of Conclusions
1. **Higher education and FET provision has in general been successful in meeting skills and human capital requirements of Ireland's labour market to date.** 2. **There is evidence of misalignment between output of the HE and FET system in terms of specific skills, existing and potential future labour market needs.** 3. **Effective pathways required between further and higher education remain underdeveloped.** 4. **Expected changes in future labour market, skills and human capital requirements will require continued and fundamental reform of the HE and FET system.** 5. **COVID-19 has had an unprecedented impact on job losses in labour intensive sectors and highlights essential features of future model of HE and FET.** 6. **Significant intensification of employer engagement is essential to development and implementation of required further education and training model.** 7. **HE faces major challenges in responding to rapidly changing labour market, educational, and socio-economic trends while maintaining quality and securing excellence.**

1. Higher education and FET provision has in general been successful in meeting skills and human capital requirements of Ireland's labour market to date.

The Irish economy has in recent years been one of the fastest growing economies in the EU and has performed very well in per capita output and this could not have been achieved without the improvements in the labour force in which the Irish HE and FET system played a key role. Very high levels of employment outcomes have been achieved by HE and FET graduates in line with economic growth and there has been a strong income premium obtained by Irish higher education graduates. Employers indicated high levels of satisfaction with skills of HE and FET graduates and levels of satisfaction were much higher than average for EU countries. Job vacancy rates in Ireland have been among the lowest in Europe though the strength of the economy was an important factor.

2. There is evidence of misalignment between output of the HE and FET system in terms of specific skills, existing and potential future labour market needs.

The research completed for this project shows that the percentage of employees who reported education or skill levels in excess of those required to do their job was higher in Ireland than in many of the other EU countries. The available evidence indicates a concern over the under-utilisation of human capital in the Irish economy.

There is also evidence that some employees have higher qualifications than the average/mode in their sector and this may indicate potential vertical mismatch. However, methodological issues arise concerning interpretation of the evidence.

A significant percentage of graduates' work in areas not directly related to their field of study and research suggests that such graduates secure lower incomes than if a horizontal match occurs. Determinants of income variance, however, include many other factors.

Some cohorts in the Irish labour market are assessed to be under-skilled relative to labour market needs and while this mismatch has been given less attention in empirical studies it is a very important area for policymakers.

3. Effective pathways required between further and higher education remain underdeveloped.

Irish higher education is very concentrated at the point of school leaving and pathways between further and higher education remain underdeveloped despite a significant policy focus.

There has been significant progress made in enhancing access pathways but only a small percentage of new entrants to higher education came from the further education sector. In some parts of HE system greater progress has been made and around one-fifth of annual intake of institutes of technology represent transitions from FET.

Overall progression from FET to HE remains low and requires significant additional policy focus. The Action in the European Skills Agenda to develop a European approach to micro-credentials will be of value but reforms within Ireland are also urgently needed to ensure effective pathways.

4. Expected changes in future labour market, skills and human capital requirements will require continued and fundamental reform of the HE and FET system.

New modelling completed for this study demonstrates that the shift in labour demand towards higher qualifications is likely to continue and become stronger.

Emerging sectors and technologies including AI will likely result in fewer jobs in low skilled sectors but will open up opportunities for significant expansion in high skilled internationally traded sectors.

There will be an imperative for the entire education and training sector to respond proactively to the rapidly changing requirements in all sectors including where substantial new opportunities exist (e.g. in sectors related to climate adaption).

The scale and nature of changes which are very likely will require significantly enhanced flexibility, responsiveness to change and reform in HE and FET.

5. COVID-19 has had an unprecedented impact on job losses in labour intensive sectors and highlights essential features of future model of HE and FET.

Job losses have been concentrated in younger age cohorts with lower levels of educational qualifications in lower productivity labour intensive sectors.

COVID-19 will require major adjustments in the model of HE and FET to include greater utilisation of online/blended education and part-time options.

While there is uncertainty on the impact of COVID-19 on the operation of HE sector, there are likely to be constraints on the utilisation of existing facilities and this will impact on the ability to accommodate increased student numbers.

The transition of workers from low productivity declining sectors into higher productivity growing occupations and sectors should build on the skills profile of workers in these sectors. Ways to ensure that the FET and training sector responds to the rise in youth employment is also needed. This should build on the European Commission's recent youth employment and skills package.

6. Significant intensification of employer engagement is essential to development and implementation of required further education and training model.

Employers and employees currently play an important role in shaping and supporting the education and training sector but this role needs to be enhanced and mainstreamed. This is aligned with the European Skills Agenda which inter alia plans to promote the participation of social partners in labour market projects and the identification of training needs to develop skill intelligence.

This arises in relation to providing advice and information on existing and future skills, education and training and human capital requirements.

Employers play a critical role in offering work placements and apprenticeship opportunities that strengthen links between education and training and employment.

Employer investment in training in internationally traded sector has increased significantly but ongoing investment in all sectors is required.

7. HE faces major challenges in responding to rapidly changing labour market, educational, and socio-economic trends while maintaining quality and securing excellence.

The long-term financial sustainability of Ireland's higher education system is at risk in view of projected demographic trends and the need to invest to enhance quality and excellence of HE provision in key areas such as teaching and learning and research.

These challenges will be further exacerbated by the rapidly changing needs of the labour market demand which evidences a continued strong shift towards higher qualifications.

Emerging sectors and technologies will also result in transformed environment for HE.

COVID-19 has exacerbated challenges facing the sector but also highlighted opportunities in particular to digitalisation of HE system and greater flexibility in delivery options.

10.2 Recommendations

In line with the terms of reference to the project, we outline below preliminary draft recommendations which are designed to improve the co-ordination and the match between the skills demand and supply.

Table 10.2: Summary of Recommendations
1. Higher education and FET system working preliminary draft with employers, employees and other stakeholders should implement measures to reduce underutilisation of human capital while also tackling undereducation in specific cohorts of Irish society and labour market through targeted and accelerated upskilling programmes.
2. The HE and FET system should be strongly encouraged and supported to continue to respond to the significant shift in future labour market requirements towards high skilled employment and the rapidly changing needs of emerging sectors and technologies.
3. Resources should be allocated to further strengthen predictions of demand for skills and qualifications on an integrated and cohesive basis.
4. Investment and a strong additional emphasis should be given to putting in place seamless pathways between and further and higher education.
5. Focused, flexible, agile and responsive education and training measures should be introduced as a priority to reskill and upskills those who have lost employment in COVID-19 pandemic.
6. Employers should have an enhanced role in shaping and delivering the education and training system reflecting the prioritisation of skills and human capital development and securing greater socio-economic equality.
7. **A sustainable model of financing for the HE and FET system should be prioritised to support the future development of the HE and FET system in meeting the economy's human capital and skills needs.**

1. Higher education and FET system working with employers, employees and other stakeholders should implement measures to reduce underutilisation of human capital while also addressing undereducation in certain groups in Irish society.

Enhanced information on the skills and qualification requirements of different occupations should be developed as a priority to ensure greater alignment of education and training with skills and human capital requirements in the labour market.

A particular focus is required on the introduction of flexible modular HE programmes yielding 'stackable' micro-credentials meeting targeted human capital and skills needs required for the future world of work

Higher education work placements and high skilled apprenticeship programmes should be given greater emphasis within the HE system.

Labour market intelligence, career guidance and job placement programmes to assist HE and FET students and learners should be expanded.

2. The HE and FET system should be supported to adjust to the significant shift in future labour market requirements towards high skilled employment and the changing needs of emerging sectors and technologies.

Securing the substantial adaption in the HE and FET system to meet the future skills of the economy will require significant policy and financial measures.

These measures should be designed to ensure greater flexibility, agility and responsiveness of the sector to changing needs and a commitment to reform and transformation.

Support for two-way pathways between FET and HE will also be essential.

3. Resources should be allocated to further strengthen predictions of demand for skills and qualifications.

Very important work has been undertaken by the National Skills Council and Skills and Labour Market Research Unit in SOLAS and the Expert Group on Future Skills Needs in examining future skills gaps.

Significant academic and policy research has also been undertaken into potential areas of education mismatches including vertical mismatches in terms of over education. Less empirical research has been undertaken into areas of undereducation.

Some of the subjective research on vertical skills mismatches for Ireland are based on small sample surveys as part of wider international surveys. Testing of results with larger Irish surveys would be useful.

More emphasis is needed on future demand for qualifications and this has been a relatively underdeveloped area in Ireland. While there are inevitable uncertainties inherent in any future predictions of demand in potential high productivity and high growth sectors and occupations is a key area for further research. This proposed work is directly aligned with the European Skills Agenda and in particular Action 2 which is focused on strengthening skills intelligence.

4. Investment and substantial additional emphasis should be given to enhancing pathways between further and higher education.

Standardisation of entry requirements to higher education system for FET awards including integration with the CAO points system to achieve a more level playing field should be implemented, as well as significantly greater flexibility in access in terms of location, mode and timing of participation. This will be particularly important in the context of COVID-19. It will also assist in increasing participation in higher education by mature students and in particular, NAP target groups.

Introduction of short-cycle flexible co-provision within higher education institutions in co-operation with FET providers should be implemented.

Shortened and elongated programmes to suit differential needs of FET graduates should be expanded.

An enhanced role for FET in improving learner standards with lower education attainment and requiring significant support prior to entering higher education should be a focus of investment, and a seamless pathway to transfer non-completing HE course participants to FET. This would enhance the efficiency and cost effectiveness of higher education.

HE outreach and support programmes including foundation courses should be expanded.

Specific targets should be set for learner access numbers between FET and HE sector.

5. Short-term targeted education and training measures should be introduced to assist those who have lost jobs arising from COVID-19.

Particular focus will be needed to assist those in sectors or demographic or social groups which will not recover quickly to obtain skills needed in emerging high-growth and high-productivity sectors and occupations.

Targeted access pathways into higher education including focused on flexible modular programmes should be designed to assist individuals who have lost jobs and who have potential for upskilling to transition into growth sectors. This should include measures targeted at youth unemployment.

An early action and a proactive approach are required in order to maximise the probability of returns to employment on a sustained basis. The co-ordination of labour market activation system with education and training opportunities will be critical. This should be aimed at reducing long-term unemployment.

6. Employers, employees and other stakeholders should have an enhanced role in shaping and delivering the education and training system.

Successful models in place in the internationally traded sector delivering high levels of quality training outcomes should be identified and implemented more broadly across the SME sector of the economy.

A national target should be set for investment in training by employers and examination undertaken of the supports that may underpin the achievement of the national targets. The use of National Training Fund resources or funding arising from PRSI income should be also considered.

Work based learning with support of the HE and FET system should be strongly promoted and encouraged.

Measures to assist employers to facilitate work placements and apprenticeship programmes should be supported by the National Training Fund.

7. A sustainable model of financing for the HE and FET system should be introduced.

Careful evidence-based consideration by policymakers of the impacts of various alternative funding models is needed. The extensive work undertaken in other deliverables as part of this study on developing a model to test the impact of alternative funding approaches will assist in this work.

It is essential that that HE system is not expected to accommodate additional students in the absence of putting in place a sustainable funding model as this creates significant risks in terms of standards and the quality of provision.

Sustainable model of funding should be underpinned by examination of the appropriate mix of HE and FET provision in meeting future skills and human capital needs and ensuring alignment of HE and FET provision with labour market requirements.

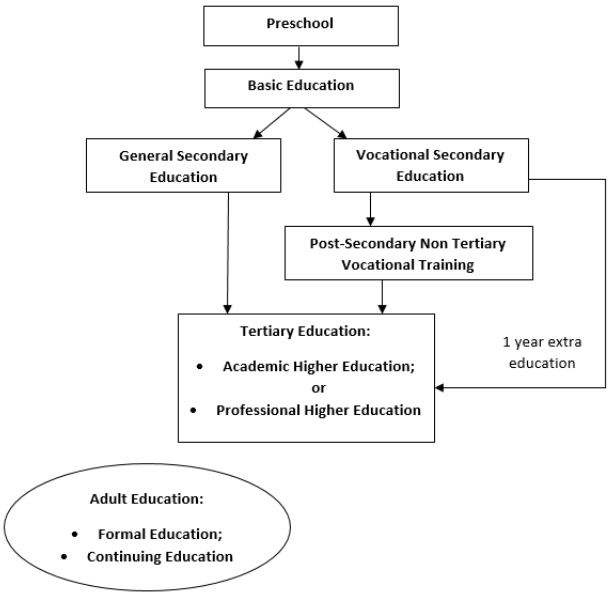
Annex 1 Case Studies on Policy Approaches in Other Countries

Case Study 1: Estonia

Overview of Education System

Educational provision in Estonia is decentralised with clearly defined responsibilities for the state, local governments and schools.[184] The state maintains national standards and defines the national curriculum at preschool, basic school and upper secondary school/vocational studies levels, and standards of higher and vocational education. The Estonian Lifelong Learning Strategy 2020 guides long-term educational development in Estonia, encouraging learning at all stages of a person's life, by aligning learning opportunities with labour market development needs.[185] It aims to provide equal opportunities to those wishing to partake in learning activities, ensure modern digital technologies are fully used to allow for effective and efficient learning and increase professional and vocational education qualifications to meet labour market needs. It also commits to assessing teachers and headmasters to ensure they are competent, motivated and provide sufficient school leadership, as well as ensuring that teachers' salaries reflect their qualification level, making teaching employment opportunities more appealing. The figure below outlines the structure of the Estonian education system.

Structure of the Estonian Education System



Source: Indecon Analysis of Eurydice

Local governments maintain preschools, basic schools, the majority of upper secondary schools, and some VET schools. Professional higher education institutions are half state, half private owned. Schools develop their own curricula based on national curriculum standards. VET curricula are developed in line with the Vocational Education Standard and the relevant professional standard.[186] Schools ultimately have decision-making powers in applying the curriculum and in organising teaching and education and are allowed flexibility to organise a student-centred approach to teaching and learning, accounting for characteristics and resources.[187] Estonian is the language of instruction in most schools, but some use Russian, to accommodate the Russian minority's needs. Upper secondary

[184] https://eacea.ec.europa.eu/national-policies/eurydice/content/estonia_en
[185] https://www.hm.ee/sites/default/files/estonian_lifelong_strategy.pdf
[186] https://eacea.ec.europa.eu/national-policies/eurydice/content/estonia_en
[187] https://eacea.ec.europa.eu/national-policies/eurydice/content/teaching-and-learning-single-structure-education-10_en

education is divided into general secondary acquired in upper secondary schools, which allows for continuation of education through higher education institutions, and vocational secondary, acquired in vocational schools, which provides a basis for working in the professional/vocational field acquired, as well as allowing for continuation into higher education.[188]

There are four Levels (2-5) of study in the Estonian VET system based on the Estonian Qualifications Framework (EQF), the Eesti kvalifikatsiooniraamistik.[189] Vocational certificates at Levels 2-3 are equivalent to EQF basic education, while Level 4 is vocational secondary education (secondary education with vocational and professional competencies.[190] The new Level 5 certificate is a post-secondary non-tertiary qualification which initial VET students must have secondary education,[191] and continuing VET students must have secondary education and professional training equivalent to Levels 4-5 or corresponding competencies, to commence.[192] Post-secondary non-tertiary education organised differently to vocational secondary education in undertaking and admission criteria, and is more flexible and workplace based, with initial and continuing VET provided at Levels 2-5 and 4-5, respectively.[193] The table below shows that VET enrolments after basic schooling have increased slightly, but total VET enrolments are stagnant, and as noted by the OECD, VET dropout rates remain high.[194]

Estonian Vocational Education Enrolments and Dropouts by Study Level, 2013-2018

Vocational course type	2013	2014	2015	2016	2017	2018
Enrolments						
Courses after basic education	14,250	14,541	16,360	17,982	18,237	18,296
Courses after secondary education	11,078	10,248	7,731	5,969	4,840	3,908
Courses with no previous education requirement	371	448	816	1,120	1,066	1,183
Total enrolments	***25,699***	***25,237***	***24,907***	***25,071***	***24,143***	***23,387***
Dropouts						
Courses after basic education	3,211	3,132	3,080	3,561	3,776	4,132
Courses after secondary education	2,792	3,046	2,652	1,888	1,506	1,372
Courses with no previous education requirement	210	230	235	351	489	434
Total dropouts	***6,213***	***6,408***	***5,967***	***5,800***	***5,771***	***5,938***
Source: Statistika andmebaas						

While the OECD regards recent VET reforms, such as the Level 5 certificate's introduction and the transformation of qualifications to reflect occupational standards agreed with employers, as being beneficial, it notes that challenges remain in improving VET's status for it to play a greater role in meeting the needs of a fast-growing and dynamic economy.[195] Though young Estonians receive upper secondary education, only 26.2% of students chose to enter VET in 2016 in comparison to 71.1% who continued in general education, with VET perceived as a less favourable option in the context of almost universal aspirations to continue in higher education.[196] Vocational education is viewed as a

[188] https://eacea.ec.europa.eu/national-policies/eurydice/content/upper-secondary-and-post-secondary-non-tertiary-education-10_en
[189] https://www.kutsekoda.ee/eesti-kvalifikatsiooniraamistik-ekr/
[190] https://eacea.ec.europa.eu/national-policies/eurydice/content/organisation-vocational-upper-secondary-education-14_en
[191] Musset, P., et al. (2019), *Vocational Education and Training in Estonia*, OECD Reviews of Vocational Education and Training, OECD Publishing, Paris, https://doi.org/10.1787/g2g9fac9-en.
[192] https://eacea.ec.europa.eu/national-policies/eurydice/content/organisation-post-secondary-non-tertiary-education-6_en
[193] https://eacea.ec.europa.eu/national-policies/eurydice/content/organisation-post-secondary-non-tertiary-education-6_en
[194] Musset, P., et al. (2019), *Vocational Education and Training in Estonia*, OECD Reviews of Vocational Education and Training, OECD Publishing, Paris, https://doi.org/10.1787/g2g9fac9-en.
[195] Musset, P., et al. (2019), *Vocational Education and Training in Estonia*, OECD Reviews of Vocational Education and Training, OECD Publishing, Paris, https://doi.org/10.1787/g2g9fac9-en.
[196]Ministry of Education and Research (2017), *Background Report for OECD on Vocational Education and Training (VET) in Estonia*, http://www.hm.ee/sites/default/files/uuringud/oecd_vet_background.pdf.

direct route into the labour market and not into higher education. Those who obtained upper vocational education qualifications are considerably less likely to graduate from a bachelor's programme (45%) compared to those who obtained general upper secondary education (60%).[197] Personal circumstances such as gender, ethnicity and geographic location reflect education and career thinking and choices, which is reflected by male Russian-speakers' over-representation in VET.[198] Only 21 students in 2016 chose to take an additional optional year of education intended to help upper VET graduates qualify for higher education. Higher education is also associated with higher earnings, greater employment opportunities and better social outcomes for people.[199]

Higher education in Estonia is at EQF Levels 6-8 and is divided into **Academic Higher Education** (bachelor's, master's and doctoral studies) and **Professional Higher Education** (similar to bachelor's level but providing access to further education opportunities, i.e,. master's).[200] Admission is based on the completion of the state examinations, where students must complete three mandatory exams in Estonian (as a first or second language), maths and a foreign language. General upper secondary students are required to sit the state exams to graduate but vocational secondary students are not. Therefore, the former appear to have a clearer path to higher education, but the latter can also sit state examinations, in the year a VET programme is completed, or after an additional year of general education studies.[201] The two types of higher education institution subject to the standards of higher education set by the Estonian government are universities, which provide professional and bachelor's, master's and doctoral degrees, and institutions of professional higher education, which provide professional higher education and Level 5 VET in some cases in the same study programme group as studies in professional higher education.[202] The table below shows that while total enrolments in higher education have been greater than in VET, they have decreased since 2013. The OECD's Education at a Glance Indicators note that tertiary education enrolment of Estonians aged 20-29 declined from 23% to 19% in 2010-2017, below the OECD average of 22%.[203]

Enrolments in Higher Education in Estonia 2013-2018						
	2013	**2014**	**2015**	**2016**	**2017**	**2018**
Professional Higher Education	17,878	15,749	14,235	13,414	12,900	12,601
Bachelor's study	22,661	20,550	18,899	16,849	16,059	15,830
Integrated Bachelor's/Master's study	3,731	3,589	3,344	3,308	3,172	3,189
Master's study	12,746	12,423	11,781	11,588	11,533	11,783
Doctoral study	2,982	2,903	2,833	2,635	2,490	2,412
Total Enrolments	**59,998**	**55,214**	**51,092**	**47,794**	**46,154**	**45,815**
Source: Statistika andmebaas						

Adult education is widely encouraged in Estonia and is provided as formal, where or continuing education. Formal education concerns adults acquiring basic education/general secondary education through non-stationary studies or external students, or the pursuance of VET or higher education. Continuing education is governed by the Adult Education Act, and refers to professional development

[197] Education at a Glance: OECD Indicators (OECD, 2019) Estonia- Higher Education <https://www.oecd.org/education/education-at-a-glance/EAG2019_CN_EST.pdf>
[198] Musset, P., et al. (2019), *Vocational Education and Training in Estonia*, OECD Reviews of Vocational Education and Training, OECD Publishing, Paris, https://doi.org/10.1787/g2g9fac9-en.
[199] Education at a Glance: OECD Indicators (OECD, 2019) Estonia- Higher Education <https://www.oecd.org/education/education-at-a-glance/EAG2019_CN_EST.pdf>
[200] https://eacea.ec.europa.eu/national-policies/eurydice/content/higher-education-24_en
[201] Musset, P., et al. (2019), *Vocational Education and Training in Estonia*, OECD Reviews of Vocational Education and Training, OECD Publishing, Paris, https://doi.org/10.1787/g2g9fac9-en.
[202] https://eacea.ec.europa.eu/national-policies/eurydice/content/higher-education-24_en
[203] Education at a Glance 2019: OECD indicators (Estonia)

and informal education, undertaken as targeted and organised study outside of formal education.[204] As of 2014, adult education has developed in line with the Estonian Lifelong Learning Strategy 2020, which has priorities of improving access to learning for adults with lower levels of education and competitiveness, modernisation of laws regulating non-formal training and the establishment of requirements to provide high quality training, and the development and implementation of structures and systems for determining training needs in an updated and appropriate manner.[205] The table below shows the numbers participating in adult education and training in the past 12 months in 2007, 2011 and 2016, indicating an increase in participation in adult education but a decline in training. In 2018, 24.1% of Estonians aged 18-64 participated in adult education and training in the previous four weeks, well above the EU average of 16.1%, indicating a desire for continuous learning and skills development amongst the Estonian adult population.[206]

Participation of Estonians Aged 20-64 in Education or Training in the Past 12 Months in Selected Years (000's)				
		2007	**2011**	**2016**
Adult education	Participated	516.0	590.7	673.6
	Did not participate	294.8	241.3	115.4
Adult training	Participated	323.7	401.0	324.5
	Did not participate	487.1	431.0	464.4
Participants and non-participants total		**810.8**	**831.9**	**789.0**
Source: Statistika andmebaas				

The Estonian education system aims to provide education and training opportunities to people of all ages, backgrounds and capabilities. The division of education into general and vocational tracts is meant to ensure the skills supply entering the labour market is diverse enough to meet development needs and to provide every citizen the opportunity to pursue employment suitable to them.

Evidence on Skills Gaps and Mismatch

In general, schooling in Estonia is considered to be of extremely high quality. Most children acquire some form of pre-school education, participation in basic education is almost universal and second-level student's literacy and numeracy skills are amongst the highest in Europe.[207] In 2018, Estonian second-level students took part in the Programme for International Student Assessment (PISA), which is designed to rank students' science, mathematics and reading skills across OECD countries, with Estonia ranking first in science and reading, and third in mathematics.[208] Adults have high levels of educational attainment,[209] with the table below showing that from 2016 to 2019 almost 90% of 25-64 year olds had completed at least upper secondary level education. The share of adults attaining a tertiary level qualification rose to over 41% in 2017 and 2018, well above the EU average of 33%.[210]

[204] https://eacea.ec.europa.eu/national-policies/eurydice/content/adult-education-and-training-24_en
[205] https://eacea.ec.europa.eu/national-policies/eurydice/content/developments-and-current-policy-priorities-23_en
[206] Eurostat
[207] OECD, 2019. "PISA Results 2018 – Country Report Estonia". Available at: https://www.oecd.org/pisa/publications/PISA2018_CN_EST.pdf
[208] OECD (2019), *PISA 2018 Results (Volume I): What Students Know and Can Do*, PISA, OECD Publishing, Paris, https://dx.doi.org/10.1787/5f07c754-en.
[209] OECD Reviews of School Resources: Estonia 2016 https://www.oecd-ilibrary.org/docserver/9789264251731-5-en.pdf?expires=1587044077&id=id&accname=guest&checksum=0B22A7F04F66986FF8B478697E3F1657
[210] Eurostat

Percentage of Estonian Population Aged 25-64 by Educational Attainment Level (%)				
Level of Education	**2016**	**2017**	**2018**	**2019**
Less than primary, primary and lower secondary (levels 0-2)	10.9	11.2	10.8	10.1
Upper secondary and post-secondary non-tertiary (levels 3-4)	50.2	49.1	48.1	48.7
Tertiary (levels 5-8)	38.9	39.7	41.2	41.2
Source: Eurostat				

Estonia is an e-society, with 99% of its state services provided online.[211]Consequently, it is unsurprising that most of its citizens (61%) have either basic or above basic digital skills, as the table below shows.

Estonian Individuals' Level of Digital Skills, 2019				
No Overall digital Skills	**Low Overall Digital Skills**	**Basic Overall Digital Skills**	**Above Basic Overall Digital Skills**	**Unassessed***
1%	28%	25%	36%	10%
Source: Eurostat ***Note:* For this group digital skills could not be assessed as the had not used the internet in the past 3 months.***				

Estonia, like its fellow Baltic states, has a low birth rate and experienced significant out-migration (particularly of working age people) after its EU accession in 2004. However, since 2010 the economy has improved and this combined with the aforementioned population decline has resulted in skills shortages in the population.[212] There has also been significant structural change in the economy with employment being increasingly focused in knowledge intensive high-tech industries, changing the skills demanded and making older skills obsolete. In 2014 Estonia had the largest share of workers among EU countries believing that some of their skills would be obsolete in the next five years.[213]

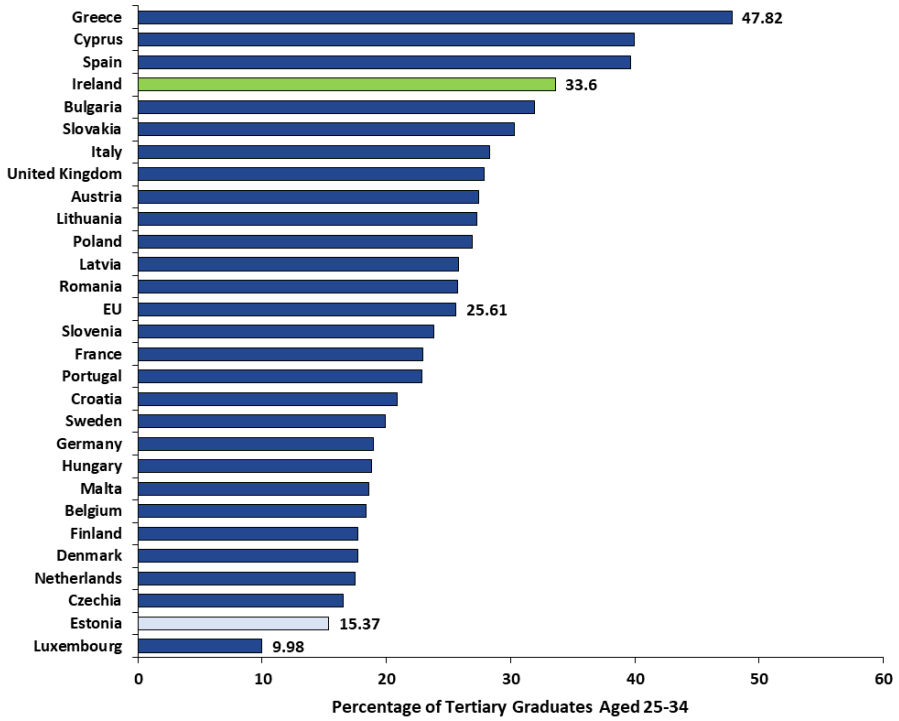
Despite high levels of educational attainment, participation in adult education and overall digital skills in Estonia, skills gaps and skills mismatches still exist. In 2020, Cedefop estimated that 26%-32.9% of the adult Estonian population had upskilling and reskilling potential.[214] A skills gap is defined by Cedefop as a situation where the type of skills provided for the labour market are misaligned with the type of skills it requires. In 2018 the employment share of VET occupations in Estonia was 57.6%, indicating a strong need for those with VET qualifications.[215] However, as outlined above, the majority of Estonian students prefer to pursue higher education rather than undertake VET, therefore resulting in a surplus of HE graduates and a deficit of VET graduates being supplied. VET's lack of popularity is seen as a contributor to skills gaps in Estonia.[216]

Cedefop's Skills Panorama defines Skills mismatch as a situation where the level of skills provided in the labour market does not match the level of skills required to undertake the activities of the job. Mismatch can result from people being over skilled or overqualified for the tasks they are performing,

[211] E-estonia (2019), *We have built a digital society and so can you*, https://e-estonia.com/
[212] Cedefop, 2020. "Strengthening skills anticipation and matching in Estonia Capitalising on OSKA's potential to realise national ambitions".
[213] https://skillspanorama.cedefop.europa.eu/en/indicators/skills-obsolescence
[214] Cedefop, 2020. "Estonia Country Fact Sheet: Adult population with potential for upskilling and reskilling". Available at: https://www.cedefop.europa.eu/files/estonia_country_factsheet.pdf . This is based on the Cedefop study: *Empowering Adults through Upskilling and Reskilling Pathways. Volume 1: Adult Population with Potential for Upskilling and Reskilling*
[215] https://skillspanorama.cedefop.europa.eu/en/indicators/future-vet-occupations
[216] Cedefop, 2020. "Strengthening skills anticipation and matching in Estonia Capitalising on OSKA's potential to realise national ambitions".

or from people being under skilled or underqualified and being unable to undertake required tasks. Cedefop's ESJ survey found that almost 40% of Estonians felt that they were under skilled when starting their new job, the highest in Europe, suggesting a gap between skill requirements in the workplace and acquired education in Estonia.[217] Overqualification is a major forms of skill mismatch identified across Europe by Cedefop, and its European Skills and Jobs Survey, finds that a relatively large share of employees in Estonia were overqualified in 2014, based on comparing an individual's highest educational qualification with their self-perceived educational qualification level actually needed to do their current job. [218] The figure below shows that in 2018, the average over qualification rate of tertiary graduates aged 25-34 across Europe was 24.7%, but only 15.4% in Estonia.[219]

Overqualified Estonian Tertiary Education Graduates aged 25-34 years, 2018 (%)



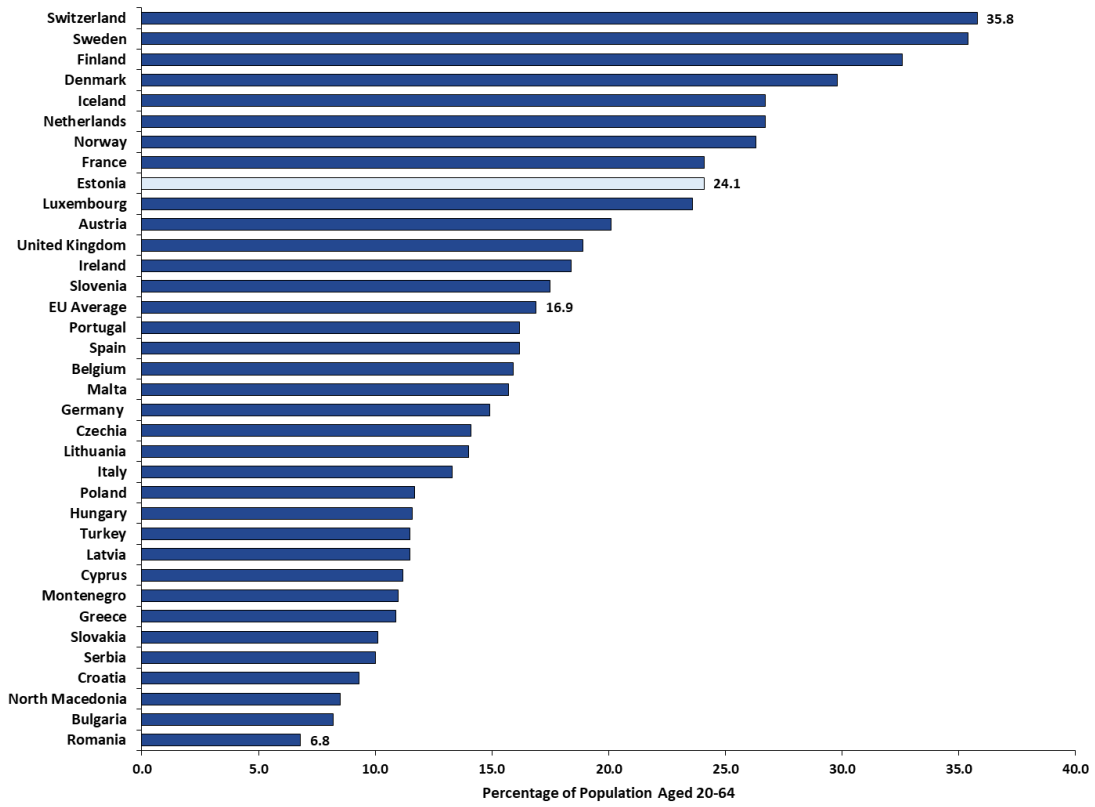
Source: Eurostat
Note: Overqualified taken as not employed as managers, professionals or associate professionals

According to Eurostat, in 2018, almost 25% of people aged 20-64 in Estonia who had a tertiary education were overqualified, as demonstrated in the figure overleaf. The OECD has identified skill mismatch as being an issue in Estonia, suggesting that 34% of men and 35% of women were mismatched in education, while 16% and 17% are mismatched in skills.[220] The OECD splits skills mismatch into field-of-study mismatch, where workers are employed in different fields from that of which they have studied and specialised in, and qualification mismatch, where workers have an educational attainment that is higher (overqualification) or lower (underqualification) than their job

[217] https://www.cedefop.europa.eu/files/esjinsight_no_7_underskilling_il_final.pdf
[218] http://publications.europa.eu/resource/cellar/d0b7da52-9988-11e5-b3b7-01aa75ed71a1.0001.02/DOC_1
[219] https://skillspanorama.cedefop.europa.eu/en/indicators/over-qualification-rate-tertiary-graduates
[220] Flisi, S. et al. (2016), "Measuring occupational mismatch: Overeducation and overskill in Europe - Evidence from PIAAC", *Social Indicators Research*, Vol. 131/3, pp. 1211-1249, http://dx.doi.org/10.1007/s11205-016-1292

requires.[221] In 2016, the OECD found that 30.7% of workers aged 15-64 in Estonia were working in a different field than that which they studied in to be compared to 33.1% average in the OECD.[222] Additionally, the percentage of workers aged 15-64 in Estonia experiencing qualification mismatch was 38%, compared to an EU average of 33.5%. This was mainly a result of Estonian workers being overqualified. While 18.7% of EU citizens aged 15-64 are overqualified for their current job, this figure is 23.8% in Estonia.[223] The OECD's 2019 skills strategy report recognised Estonia's top performance in developing the skills of its youth and adult populations, while noting that there were significant imbalances in skills in the labour market.[224] The OECD's Skill Strategy Dashboard for 2019 ranked Estonia in the bottom 40% of EU countries in terms of the alignment between skills supply and labour market demand. Furthermore, there is an ongoing shortage in cognitive and other transversal skills; while also a surplus in technical skills in Estonia.[225]

Percentage of Population Aged 20-64 in Estonia Overqualified in 2018

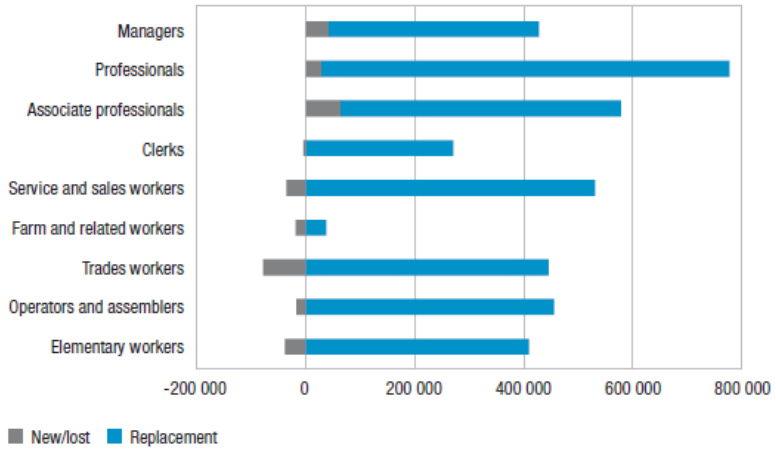


Source: Eurostat
Note: Percentage of people aged 20-64 with tertiary education and working in an ISCO 4-9 classified occupation.

[221] https://stats.oecd.org/Index.aspx?DataSetCode=MISMATCH#
[222] https://stats.oecd.org/Index.aspx?DataSetCode=MISMATCH#
[223] https://stats.oecd.org/Index.aspx?DataSetCode=MISMATCH#
[224] OECD, 2019. "2019 OECD Skills Strategy; Estonia". Available at: https://www.oecd.org/estonia/Skills-Strategy-Estonia-EN.pdf
[225] OECD, 2019. "2019 OECD Skills Strategy; Estonia". Available at: https://www.oecd.org/estonia/Skills-Strategy-Estonia-EN.pdf

In terms of future skills, the Cedefop skills forecast for Estonia estimates that around 373,000 job openings will occur between 2018 and 2030. The professions where these are projected to arise are displayed in the figure below, with a distinction being made between openings that are a consequence of new job creation, or the loss of existing jobs, and the replacement of workers who leave due to retirement or other reasons. The latter outstrips the former, and even in professions where employment is forecast to drop, such as skilled trades, there will be lots of job openings.

Projected Job Openings in Estonia 2018-2030



Source: Cedefop

Policy Responses/Initiatives

In terms of assessing the demand for skills, OSKA (Oskuste Arendamise koordinatsioonisüsteem) is the analytical tool used to monitor labour market trends and forecast future labour market skill requirements in Estonia. OSKA's goal is to better align educational provision with the labour market needs to reduce skills gaps and mismatches.[226] By understanding where labour market gaps exist now, and where they are likely to emerge in future, OSKA provides evidence to base the provision of education and training on. Prior to OSKA's introduction in 2015, skills prediction was based on annual employment forecasts produced by the Ministry of Economic Affairs and Communications.[227] OSKA is governed by the OSKA Coordination Council, comprising representatives from government and various stakeholder organisations, which is designed to engage all relevant stakeholders in the analysis and anticipation of future skill requirements to ensure the most relevant skills are provided. The council has the power to offer policy recommendations and to determine the sectors to be analysed in annual sectoral reports. OSKA produces five to six in-depth sectoral reports annually, with each sector being analysed every five to six years. The table overleaf shows the sectors analysed from 2016 to 2020.

[226] https://www.cedefop.europa.eu/en/tools/matching-skills/all-instruments/development-oska-system-labour-market-monitoring-and-future-skills-forecasting

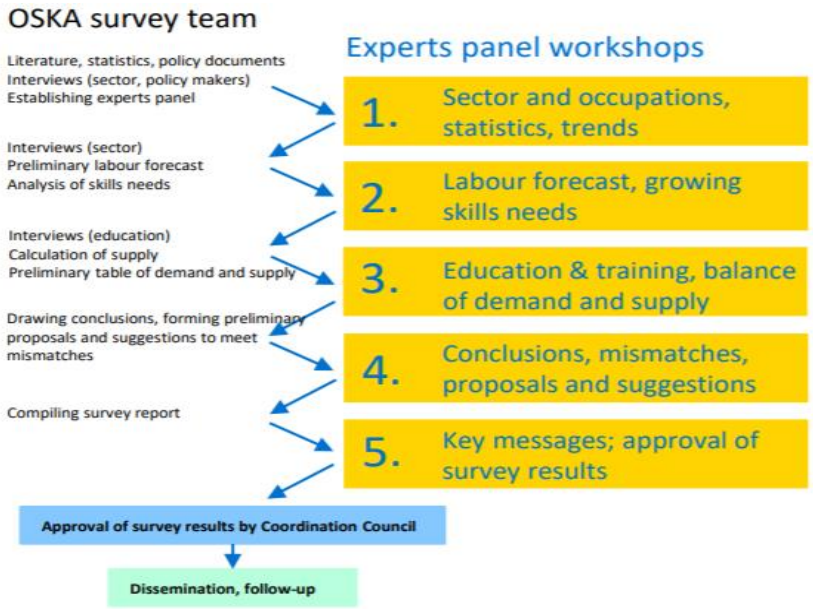
[227] Skills Panorama (2017), *Skills anticipation in Estonia*. Analytical highlights series. Available at: /en/analytical_highlights/skills-anticipation-estonia

List of Sectors Analysed by OSKA 2016-2020	
Year of Analysis	**Sector**
2020	Banking and Insurance
	Personal Services
	Public Administration
2019	Film and Video, Art and Design, Journalism, Content Creation and Language, Marketing and Communications and Printing
	Performing Arts, Music, Libraries, Museology, Crafts, and Sport
	Real Estate Services and Facility Maintenance
	Security and Law
	Water, Waste and Environmental Management
2018	Accommodation, Catering and Tourism
	Apparel, Textile and Leather Industry
	Education and Research
	HR, Administrative Work and Business Consultation
	Trade, Rental and Repairs
2017	Agriculture and Food Industry
	Construction
	Energy and Mining
	Healthcare
	Production of Chemicals, Rubber, Plastics and Construction Materials
	Transportation, Logistics, Repair of Motor Vehicles
2016	Accounting
	Forestry and Timber Industry
	Information and Communication Technology
	Manufacturing of Metal Products, Machinery and Equipment
Source: OSKA	

In addition to the sectoral reports, general OSKA report predicting changes in labour requirements, labour market developments and trends over the coming ten years is published annually.[228] To produce reports, OSKA conducts research through sectoral surveys designed to assess sectoral labour and skill needs. These apply a mixed methods approach (combining qualitative and quantitative methods) to analyse professional qualifications across all educational levels.[229] Quantitative data is collected from relevant registers and surveys including the EHIS, the Labour Force Survey, the Population and Housing Census 2011, sectoral surveys, EKOMAR and by analysing the Ministry of Economic Affairs and Communications' labour market forecasts. Qualitative data is gathered through one on one interviews with stakeholders and sectoral experts and through group discussions designed to examine future economic trends and the changes needed worker and skills supply and the provision of education and training in each sector.

[228] https://www.cedefop.europa.eu/en/tools/matching-skills/all-instruments/development-oska-system-labour-market-monitoring-and-future-skills-forecasting
[229] https://oska.kutsekoda.ee/en/oska-management-methodology/oska-methodology/

OSKA Survey Process



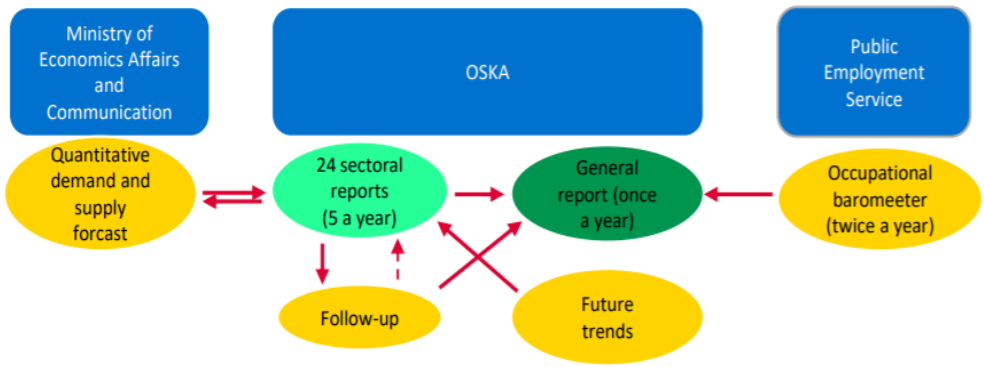
Source: OSKA presentation by the Estonian Qualification Framework, Milan, 2019

A National Skills Council set up in Estonia has determined that while there is a lot to be praised with the mix-methods approach employed in the OSKA, there is a need for further development in coming years, particularly concerning data issues, so that more updated data is used in forecasts and that data that is currently unused (such as linking with register data and big data analysis) is utilised.[230] Forecasts are developed by Sectoral Expert Panels and are based on the analysis of survey results. These panels exist under each OSKA field and consist of 20-30 people, including representatives of employers and professions, the education system (vocational and higher education institutions in the field) and the public sector (implementers of sectoral and education and training policies). Each panel meets five times throughout the research process, allowing members the chance to evaluate data collected, analysis undertaken, and conclusions made and to make reasoned suggestions for adjusting results or changing the analysis process. After dissemination of results, the panel is expected to reconvene for a results-monitoring meeting, discussing the implementation of OSKA's proposals and the need for additional activities. Panels are given a large role in the process of developing policy. Field experts take part in OSKA's research as participants and reviewers in individual and focus group interviews, providing them the chance to discuss field developments.[231]

In addition to the sectoral reports produced by the Expert Panels, the Ministry of Economic Affairs and Communication's quantitative demand and supply forecasts are also considered. These forecasts rely primarily on data from Statistics Estonia (*Statistikaamet*) and quantify the total employees needed in the labour market, but do not predict the skill requirements of these employees. The general forecast model of OSKA is shown in the figure overleaf while the forecasted change in employment by sector from OSKA is shown in the subsequent figure.

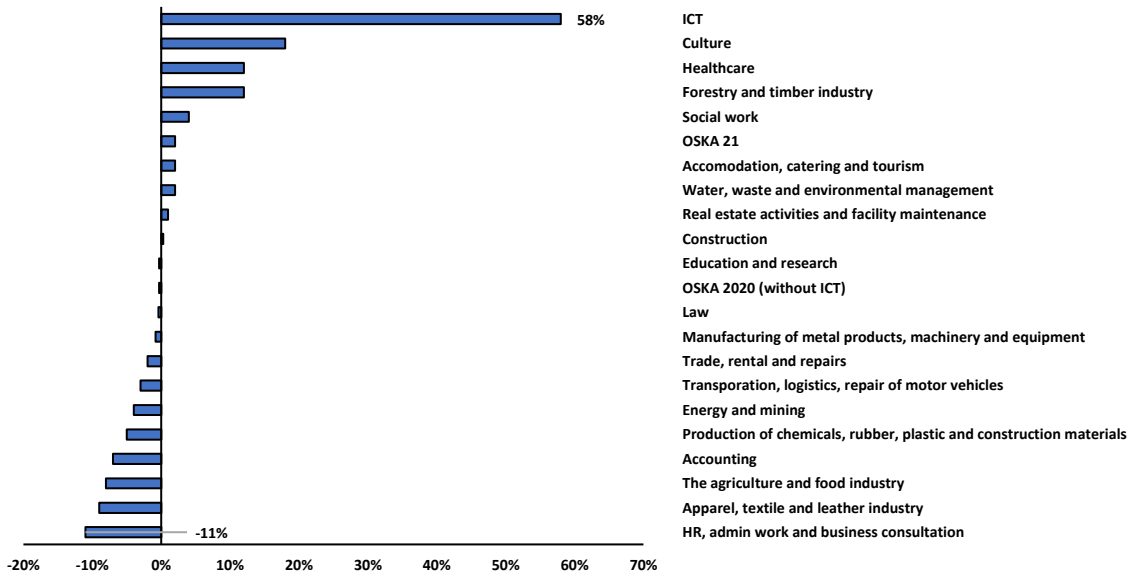
[230] Cedefop, 2020. "Strengthening skills anticipation and matching in Estonia Capitalising on OSKA's potential to realise national ambitions".
[231] Melesk, Kirsti; Haaristo, Hanna-Stella and Haugas, Sandra. 2018. Analysis of the implementation of the labor demand monitoring and forecasting system OSKA. Tallinn: Center for Policy Studies Praxis.

General Forecast Model Estonia



Source: OSKA presentation by the Estonian Qualification Framework, Milan, 2019

2020 OSKA Forecasted Change in Employment in Estonia in the Next 10 Years



Source: TMK Chain 5 seminar 12.03.2020 Presentation

As noted by the authors of an analysis of OSKA,[232] having high-quality labour market intelligence is merely a single component of skills governance, and countries must ensure that the conclusions reached in analysis of skill needs and gaps are translated into measures and actions in labour market and education policies. This can be achieved through monitoring, though monitoring of OSKA results is still in its infancy, with the first monitoring data being collected in 2017.[233] Cedefop has conducted

[232] Melesk, Kirsti; Haaristo, Hanna-Stella and Haugas, Sandra. 2018. "Analysis of the implementation of the labor demand monitoring and forecasting system OSKA." Tallinn: Center for Policy Studies Praxis.
[233] Pouliakas, K. 2017. Making labor market and skills intelligence policy relevant: How Cedefop supports countries. Skills Panorama, 10/17/2017 http://skillspanorama.cedefop.europa.eu/en/blog/making-labour-market-and-skills-intelligencepolicy-relevant-how-cedefop-supports-countries

an analysis of OSKA and among the measures identified by stakeholders by which OSKA could be improved was to have its results validated against different data sets and where possible the integration of these into OSKA so that less qualitative data would be used (despite some stakeholders seeing the mixed methods approach as an advantage).[234] It was also felt that the sectoral focus of OSKA needed to be broadened to focus on the wider economy and that its methodology needed to be enhanced so trends concerning migration, technological change and globalisation are better accounted for. It was felt that the inter-sectoral focus of the OSKA needed to better account for inter-sectoral labour flows. The following key developmental policies for OSKA were identified:

- Clear identification of additional groups that OSKA should directly target beyond policy makers and experts, especially young people and parents, so such groups can make informed decisions on fields of study to better match skills to demand. This will involve better dissemination and communication of OSKA findings and results using the Estonian education portal. Already it has being reported that progress has been made towards advancing this.
- Development of a dissemination that is more targeted in nature so that target groups can be reached effectively and that their decision making can be influenced.
- Improvements in OSKA methodology through integration of major trends affecting future labour and skills demand, particularly trends in technology, demographics and globalisation.

These findings raise some important implications for the development of a skills anticipation system similar to OSKA in Ireland. Ireland like Estonia is a small open economy that is heavily dependent on external factors for economic growth. It is also subject to variations in demographics, with Ireland, like Estonia, experiencing out migration at times in its history when economic downturns occurred. Therefore, a data-based skills anticipation system for Ireland would have to be linked into projections for demographics and the general economy, so that it could effectively determine where future skills are needed and where they may arise. Additionally, it is of paramount importance that the findings of skills anticipation systems such as OSKA be effectively communicated and disseminated to the general population, students and their parents, as well as the labour force more generally. Effective dissemination can mean that that data collected can be used to better guide and influence the behaviour of those choosing careers and which tracks in the education system to follow.

One way that policymakers in Estonia are addressing the balance between higher and vocational education is through the introducing of amendments to their laws governing vocational institutions. In December 2018 the Estonian Parliament amended the Vocational Educational Institutions Act to better link vocational programmes with the labour market, to renew vocational schools' founding principles and to have more flexible ways of accessing vocational training and an updated quality assessment.[235] This enabled the needs of local employers and the labour force to be better accounted for, with state-commissioned education abolished so that schools quickly to education demands and labour market needs locally. Schools' operating expenses are covered up to 20% by performance-based financing determined by their results, which is aimed at motivating them to complete their main tasks. Schools are able to open study programmes that are not connected to specific vocational studies but which prepare students for selecting their speciality. These are aimed to increase access to vocational education for those who do not have the ability to select a speciality after graduating from basic schooling or who have dropped out of education. The current methods of accrediting vocational education are to be changed to more quality-based assessments to develop a study-centred approach in schools and increase trustworthiness in vocational education.

[234] Cedefop, 2020. "Strengthening skills anticipation and matching in Estonia Capitalising on OSKA's potential to realise national ambitions".
[235] https://www.cedefop.europa.eu/es/news-and-press/news/estonia-vet-law-amendments-bring-better-vocational-training-and-labour-market-links

The Estonian Lifelong Learning Strategy as published in 2014 takes account of changes in the nature of employment and the digitalisation of society and had the five key goals outlined in the list below.

Goals of the Estonian Lifelong Education Strategy 2020
1. **Change in the approach to learning** to an approach that supports the individual and social development of each individual learner, and the acquiring at all educational types and levels of learning skills, creativity and entrepreneurship. 2. **Competent and motivated teachers and school leadership** to be ensured via assessments of teachers and headmasters, including their salaries, and making sure these are consistent with qualification requirements for the job and the work-related performance. 3. **Concordance of lifelong learning opportunities with the needs of labour market be making** learning opportunities and career services to be diverse, flexible and of good quality. This is intended to result in an increase in numbers of individuals with professional or vocational qualifications in different age groups, as well as an increase across Estonia in overall in lifelong learning participation. 4. **A digital focus in lifelong learning** by effectively and efficiently using technology for learning and teaching. Already digital literacy is high in Estonia and access is ensured to the new generation of digital infrastructure. 5. **Equal opportunities and increased participation in lifelong learning** are to be created for everybody.
Source: Estonian Lifelong Education Strategy

The new Education and Research Strategy for 2021-2035 is currently being drafted, and a preliminary overall objective for this strategy has been developed by the expert groups tasked with compiling it, which can be summarised as ensuring that Estonians have the necessary knowledge, skills and attitudes to fulfil themselves both personally and in their work lives in Estonian society. There are a number of sub-objectives to this strategy namely providing diverse, accessible and permeable learning opportunities for students to allow for a smooth transition between different types of education, and to ensure that teaching and learning are centred around both the learner and orientated around the future, thereby helping the learner to succeed in life. Additionally, there is the objective that lifelong learning opportunities must match labour market needs. This education strategy will support the broader aims of the Estonia 2035 strategy, also under development, which focuses on the strategic socio-economic direction for Estonia in the coming years.[236]

Focusing further on the transition of learners between different systems and pathways, there are no national targets in Estonia concerning the transition from FET/VET to higher education and measures have not been taken to standardise university entry requirements for FET/VET graduates.[237] The Higher Education Act gives legal effect to the procedures for the recognition of prior learning and work experience, which are contained in Section 4 of the Higher Education Standard. This allows an institution of higher education to establish provisions for recognition of prior learning in order to satisfy admission conditions and to take account of credits acquired in previous courses. On a practical level, previous studies are attested to by a diploma, certificate or other document accrediting education, while previous work experience is attested by descriptions of work experience, a professional certificate and other documents. HE institutions can legally set their own entry requirements and can group their applicants by prior experience or special education needs, with some of them releasing entry requirements for VET graduates if they have undertaken the same field in VET as they plan to do in HE. An example of this is where graduates from agricultural, horticultural or forestry VET can continue to study in the same field in the University of Life Sciences in Tartu. VET

[236] https://www.riigikantselei.ee/et/Eesti2035
[237] Correspondence with the Estonian Ministry of Education and Research

students also have relaxed entry requirements if they are continuing studies at professional HE institutions in the same field as they undertook in VET.

While there is no short-cycle VET provision offered by universities in Estonia as they have no right to provide such courses, professional HE Institutions can and in some cases do, provide VET courses.[238] To assist in the transition between VET and HE, HE educational institutions offer preparatory courses for possible VET entrants, with some having additional customised courses in their subject areas.[239] Additional HE institutions are flexible when structuring studies with cycle-learning, part-time and blended learning methods being offered, as there are more adult HE learners every year.[240]

Estonian government policy has also been directed towards enhancing the role played by apprenticeships, which are defined as workplace-based learning (*Töökohapõhine õppevorm*) vocational education where the share of learning in a company or institution makes up at least two thirds of the total volume of learning, being conducted with the co-operation of a student, an employer and a vocational school.[241] This definition was enshrined in law under Article 28 of the Vocational Education Institutions Act of 2013. Apprenticeships can be implemented at all VET levels including vocational education without the requirement for basic education (EQF Level 2), vocational education based on basic education (EQF Level 3), vocational secondary education or vocational education based on secondary education (EQF Level 4) and specialised vocational training (EQF Level 5).[242] Estonian apprenticeships were established in 2006, with numbers increasing since, but in the past it proved difficult to attract young apprentices and at one stage they involved adults entirely.[243] The OECD noted in 2017 that options needed to be developed to overcome barriers to attracting young people to apprenticeships and that targets for employer/work based learning within VET programmes be set for more effective measurement of results.[244] Governmental policy was directed towards the establishment of more apprenticeships, and a plan was launched to create nearly 4,600 additional apprenticeships between 2015 and 2018 using supports from the European Social Fund. Apprenticeships were introduced in new areas such as aviation (in 2016).[245]

When HE institutions are opening new courses, it must be demonstrated that they are supported and needed by employers.[246] From 2020 onward the majority of university governing board members must be from outside the university, in order to better link HE to society.

There has been an increase in the number of vocational students undertaking apprenticeships, and by 2017/18 and 2018/19, over 1700 students, or approximately 7% of all VTE students, were engaged in apprenticeships, up from 5.5% in 2016.[247] By the end of 2018, 4,141 students had participated in apprenticeships with the support of the labour market and education cooperation programme, with a target of 7,200 by 2021. 75% of vocational educational institutions offered apprenticeships/work-based training in 2018 and pilot work-based learning programmes in higher education have commenced, with three higher education institutions, namely the Estonian Entrepreneurship University of Applied Sciences, Tallinn Health Care College and Tallinn University of Technology.[248]

[238] Correspondence with the Estonian Ministry of Education and Research
[239] Correspondence with the Estonian Ministry of Education and Research
[240] Correspondence with the Estonian Ministry of Education and Research
[241] https://www.hm.ee/et/opipoiss
[242] https://www.cedefop.europa.eu/en/publications-and-resources/data-visualisations/apprenticeship-schemes/country-fiches/estonia
[243] Musset, P., et al. (2019), Vocational Education and Training in Estonia, OECD Reviews of Vocational Education and Training, OECD Publishing, Paris. https://doi.org/10.1787/g2g9fac9-en.
[244] Musset, P., et al. (2019), Vocational Education and Training in Estonia, OECD Reviews of Vocational Education and Training, OECD Publishing, Paris. https://doi.org/10.1787/g2g9fac9-en.
[245]https://www.baltictimes.com/estonian_s_very_first_apprenticeship_program_for_aircraft_mechanics_celebrates_student_graduation/
[246] Correspondence with the Estonian Ministry of Education and Research
[247] https://www.hm.ee/sites/default/files/htm_aruanne_2018_en.pdf
[248] https://www.hm.ee/sites/default/files/htm_aruanne_2018_en.pdf

In terms of the future world of work, Estonia's labour market, like in all countries, will be affected by globalisation, technological change including increased automation, climate change in the future. As previously stated, there is a high degree of digital literacy among the Estonian population. This awareness of and interaction with digital technology is perhaps why many Estonians see their skills as becoming obsolete for their roles in the near future. Between 2012 and 2017, the proportion of the employed people employed in high-tech and mid-high-tech sectors in Estonia rose from 6.7% to 8.3%.[249] with the government setting a target of 9% to be achieved by 2020 The OSKA forecast highlights that the number of jobs, focus is placed on nurturing transversal skills in the labour force, with the ten universal skills for future work displayed in the figure below. These key skills include the ability to adapt to rapidly changing job content and environments as well as the ability to work effectively in teams and networks, with the necessary analytical, understanding, problem solving, and decision-making skills. Additionally, focus is placed on increasing the proportion of project-based work, remote working with decentralised, mobile staff and "soft" packages to motivate and stimulate work. These packages would consist of better working conditions, more job flexibility and better access to healthcare. With the shortening of the life cycle of jobs, people need a broader and diverse range of skills. Increasing globalisation means that there more demand for language skills and the ability to adapt successfully in different cultural contexts, which underscores the need for virtual collaborative skills to work across such different contexts and higher education teaching methods will need to adapt to this future reality.

Universal Skills for the Future Labour Market in the Work and Skills Report 2025
❑ **Reflection:** the ability to understand and value the meaning of what is expressed; ❑ **Social intelligence:** ability to sense communicating people's needs and desires; and establish a relationship of trust with them; ❑ **Creativity and adaptability:** the ability to react quickly to an unexpected situation and find it non-standard solutions; ❑ **Intercultural Competence:** the skills needed to succeed in different cultural environments; ❑ **Programmable Thinking:** the ability to transform large amounts of data into abstract concepts and understand data-driven (evidence-based) decision making; ❑ **New Media Literacy:** the ability to critically evaluate and create new content in social media; and use it for persuasive communication; ❑ **Transdisciplinary:** the ability to understand the concepts of different disciplines (subject areas) and their interrelationships; ❑ **Design-Thinking:** the ability to plan, visualize and communicate activities (processes necessary for work) in a purposeful way (aimed at achieving the desired goal); ❑ **Self-management and cognitive burden management**: The ability to filter data by importance and maximize cognitive performance using a variety of methods; and ❑ **Virtual Collaboration:** the ability to work effectively in diverse (including virtual) teams, to keep people engaged and motivated, and to build a collective feeling within them.
Source: Töö ja Oskused 2025[250]

[249] Cedefop, 2020. "Strengthening skills anticipation and matching in Estonia Capitalising on OSKA's potential to realise national ambitions".
[250] Pärna, O. 2016 "Töö ja Oskused 2025". Available at: https://oska.kutsekoda.ee/wp-content/uploads/2016/04/Tulevikutrendid-1.pdf

Case Study 2: Canada

Overview of Education System

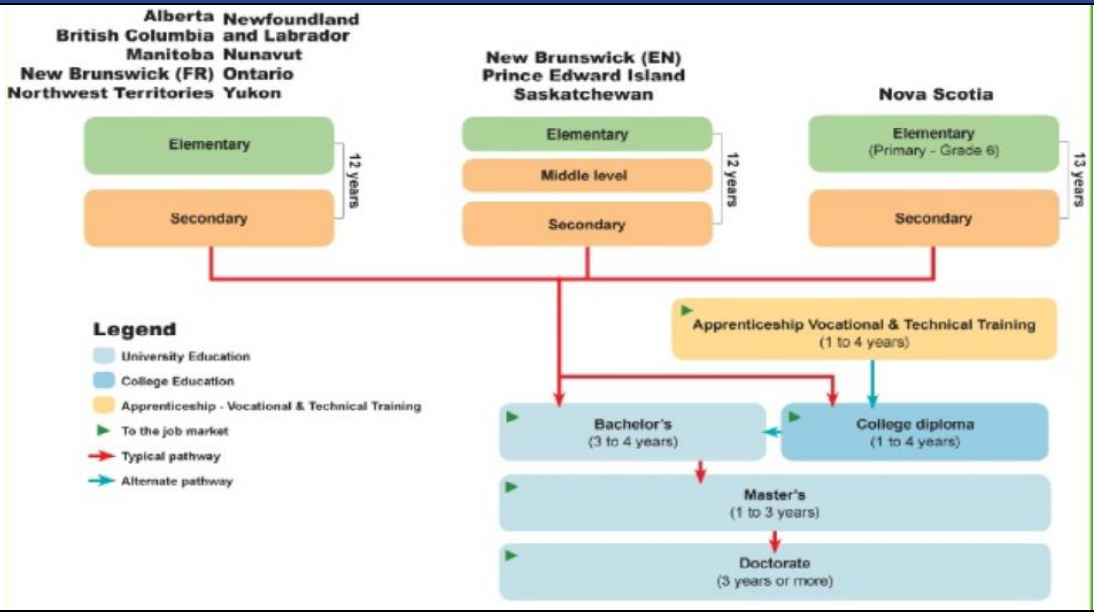
Canadian educational provision is decentralised, being the responsibility of each of the 13 provincial and territorial governments.[251] As there is no federal ministry/department of education, there are multiple education systems which differ significantly across provinces. The Council of Ministers of Education, Canada (CMEC), founded in 1967, is an intergovernmental body providing leadership in education at pan-Canadian and international levels, which contributes to provinces' and territories' exercising exclusive jurisdiction over education, and where education policy issues are discussed and consultations between federal government, provinces and educational organisations are facilitated.[252] To enhance Canada's education systems, learning opportunities, and overall outcomes and to ensure quality lifelong learning opportunities for all, the CMEC developed the pan-Canadian *Learn Canada 2020* education framework, with four pillars and goals:[253]

- **Early childhood learning and development**: Ensuring all children have access to high quality early education so they begin school ready to learn;
- **Elementary to high school systems:** Ensuring children in elementary and high schools have teaching and learning opportunities allowing for the development of high-quality literacy, numeracy, and science skills, while ensuring systems are inclusive of all students;
- **Postsecondary education**: Increasing the quality and accessibility of postsecondary education in order to increase the number of students pursuing it; and
- **Adult learning and skills development:** Developing an accessible (training can be accessed as/when required), diversified, and integrated skills development and adult learning system.

Though systems vary by province, education is generally offered along the lines of these four pillars at early childhood level, primary and secondary level, post-secondary level (vocational education and training and higher education) and adult education level. The figure overleaf shows primary to post-secondary educational level structures in Canada's provinces.

[251] Education Policy Outlook: Canada (2015) OECD http://www.oecd.org/education/EDUCATION%20POLICY%20OUTLOOK%20CANADA.pdf
[252] https://www.cicic.ca/1302/the_council_of_ministers_of_education_canada_(cmec).canada
[253] http://cmec.ca/Publications/Lists/Publications/Attachments/187/CMEC-2020-DECLARATION.en.pdf

Structure of the Canadian Education System



Source: AGS

Vocational education and training (VET) is offered at upper secondary level either alongside academic courses in a comprehensive schools or in separate vocational schools.[254] An illustrative example of the vocational education system in Ontario is provided in the box below.

Vocational Secondary Education in Ontario

The Specialist High Skills Major (SHSM) programme in Ontario is a specialized program offered to grade 11 and grade 12 secondary school students to allow them the opportunity to focus their learning on a specific economic sector and gain credits toward their Ontario Secondary School Diploma. The SHSM is a Ministry of Education approved vocational education programme. By taking part in the SHSM programme, students are given the chance to tailor their education towards their interests. Furthermore, the accreditation is recognized at post-secondary level and by employers and allows for a smoother transition into further education and training or directly into the labour market.

In order to receive the SHSM seal on their secondary school diploma students are required to complete a set number of courses, usually between 8-10, in the selected field, earn specific industry certifications, for example a qualification in first aid training, and to undertake a cooperative education placement in which they have the opportunity to gain important on the job skills. SHSMs are available in the 19 sectors, including agriculture, manufacturing, health and wellness and many more.[255] The SHSM is very popular and according to the Ontario Ministry of Education, they can be credited with raising the secondary school graduation rate from 68% in 2004 to 86% in 2017.[256]

Source: Government of Ontario and NCEE

[254] http://ncee.org/what-we-do/center-on-international-education-benchmarking/top-performing-countries/canada-overview/canada-school-to-work-transition/
[255] https://www.ontario.ca/page/specialist-high-skills-major
[256] http://ncee.org/what-we-do/center-on-international-education-benchmarking/top-performincountries/canada-overview/canada-school-to-work-transition/

Secondary VET in Canada can be delivered via three main pathways, which vary by province and territory, namely, credentials below the high-school-diploma benchmark, applied and vocational high school tracks leading to a vocational high school diploma, and dual-track programs that allow pupils to begin apprenticeships or gain credit towards vocational credentials while still enrolled in high school.[257] The average age of graduates from upper secondary vocational programmes is 32.[258] The table below shows that since 2015, the numbers registered in vocational secondary programmes have declined while the percentage of graduates from upper secondary education who obtained a vocational qualification in 2017 was 6%, indicating that few take vocational education at upper secondary level.

Number of Graduates from Secondary Schools (2013-2017)					
	2013	**2014**	**2015**	**2016**	**2017**
Number of Elementary and Secondary School Students*	5,454,678	5,470,701	5,493,858	5,552,178	5,609,007
Number of Secondary School Graduates	390,282	384,180	382,608	382,038	379,893
Vocational Programmes for Adults and Youth Numbers**	128,817	130,167	129,699	128,376	123,027
Vocational Programmes for Adults and Youth Graduates**	21,549	23,703	23,541	24,072	23,094
Source: Statistics Canada ***Notes:*Total numbers are displayed for both elementary and secondary schools as data could not be disaggregated. **"Vocational programs for youth and adults" are professional and technical training programs designed for students to acquire the practical skills, know-how and understanding necessary for employment in a particular occupation or trade or class of occupations or trades, offered at the secondary level***					

At post-secondary level, VET is offered in public and private technical and vocational colleges and institutes, or through apprenticeship programs offered by workplaces.[259] Publicly funded colleges providing VET tend to be managed at government level, with governments being involved in admissions, programme approvals and designing and deciding on curricula.[260] Colleges across Canada offer a variety of post-secondary programs, ranging from short-term, entry-level certificate programs which last between one and two semesters, to diploma programs lasting two to three years.[261] These courses take place in the context of wither a vocational or pre-university academic path, with the latter being most commonly taken by those looking to attend university. However one can still attend university if they have undertaken vocational studies as the college diploma issued upon completion of them entitles an individual to progress to higher education.[262] In Quebec, such colleges offering both academic and vocational studies are termed *Collège d'enseignement général et professionnel* (CEGP), and form a compulsory transitional period of educational instruction between secondary school and university. In the CEGP system, academic courses are usually selected by those looking to attend university, but one can still attend university if they have undertaken vocational studies as the college diploma issued upon completion of them entitles an individual to progress to higher education.[263] In other Canadian provinces, colleges are not a compulsory period between secondary education and university, and largely offer vocational courses but an individual can still opt to attend

[257] https://wenr.wes.org/2017/09/education-in-canada
[258] Education at a Glance (2019) Canada Country Specific Note <http://www.oecd.org/education/education-at-a-glance/EAG2019_CN_CAN.pdf>
[259] Education Policy Outlook: Canada (2015) OECD <http://www.oecd.org/education/EDUCATION%20POLICY%20OUTLOOK%20CANADA.pdf>
[260] Education Policy Outlook: Canada (2015) OECD. Available at: http://www.oecd.org/education/EDUCATION%20POLICY%20OUTLOOK%20CANADA.pdf
[261] https://wenr.wes.org/2017/09/education-in-canada
[262] https://www.sram.qc.ca/international-student/curricula-and-levels
[263] https://www.sram.qc.ca/international-student/curricula-and-levels

university upon completion of such courses instead of the usual path of heading into the labour market as is usual.

While apprenticeship programmes were initially developed for adults, vocational secondary graduates have chosen to undertake apprenticeships in recent years. However, the design of apprenticeship programmes aimed at adults often differs to those aimed at younger individuals, as older and more experienced workers often have stronger literacy and numeracy skills and technical knowledge required in a job, therefore allowing productive skills to be developed more rapidly.[264] To incentivise apprenticeship uptake, the government offers small grants of up to 2,000 Canadian dollars to registered apprentices via the Apprenticeship Incentive Grant and Apprenticeship Completion Grant.[265] The Interprovincial Standards Red Seal Program developed by standardizes the skills and competencies required to become a qualified apprentice in a number of specified trades across provinces and territories, setting and providing tools to support standard examinations to assess skills and competencies.[266] These standards ensure consistency of both in-class and on-the-job training resources and allow for increased industry involvement in standard development.[267] The table below shows a fall in both the total numbers of people taking part in registered apprenticeship programmes and the number of certificates being granted to registered apprentices and trade qualifiers, bar in 2018.

Total Number of Apprenticeship Registrations and Certificates (2014-2018)					
	2014	**2015**	**2016**	**2017**	**2018**
Total Number of Apprentice Registrations	454,008	455,856	417,306	405,699	392,202
Apprentice and Trade Qualifier Certificates*					
Certificates Granted to Red Seal trades	*41,550*	*40,659*	*39,744*	*36,963*	*39,222*
Certificates Granted to Non-Red Seal trades	*17,859*	*15,969*	*15,483*	*14,187*	*15,297*
Total Certificates	*59,409*	*56,628*	*55,230*	*51,150*	*54,522*
Source: Statistics Canada					
Note: Trade Qualifiers are persons who have worked in a specific trade for a number of years, without necessarily having ever been an apprentice, and have chosen to write the required skills assessment examination in their trade.					

Postsecondary education is offered in universities, colleges, community colleges, polytechnics, and university colleges.[268] As with other forms of education in Canada, the provision and management of post-secondary education is the responsibility of provincial and territorial governments and there is no federal accreditation higher education regulating standards.[269] Public institutions are funded through federal government transfer payments to provinces and territories combined with provinces' and territories' own post-secondary education supports and tuition fees.[270] Private institutes are funded via wealthy alumni's donations, faculty research grants and tuition fees.[271] Universities offer three types of degrees: Bachelor's, Master's and Doctoral, whereas colleges and polytechnics

[264] OECD (2019), OECD Skills Strategy 2019: Skills to Shape a Better Future, OECD Publishing, Paris, https://doi.org/10.1787/9789264313835-en.
[265] http://ncee.org/what-we-do/center-on-international-education-benchmarking/top-performing-countries/canada-overview/canada-school-to-work-transition/
[266] http://www.rvcareers.ca/red-seal-apprenticeship-program/; Education Policy Outlook: Canada (2015) OECD Available at: http://www.oecd.org/education/EDUCATION%20POLICY%20OUTLOOK%20CANADA.pdf
[267] http://www.red-seal.ca/resources/wh.1t.3sn.4.1-eng.html
[268] Ensuring Inclusive and Equitable Quality Education (CMEC) 2020 https://www.cmec.ca/Publications/Lists/Publications/Attachments/407/Sustainable%20Development%20Goal%204%20in%20Canada%20EN.pdf
[269] https://www.hotcoursesabroad.com/study-in-canada/applying-to-university/the-canadian-higher-education-system-simplified/
[270] Education Policy Outlook: Canada (2015) OECD http://www.oecd.org/education/EDUCATION%20POLICY%20OUTLOOK%20CANADA.pdf
[271] https://www.hotcoursesabroad.com/study-in-canada/applying-to-university/the-canadian-higher-education-system-simplified/

traditionally provide programs of shorter duration such as diplomas and certificates.[272] As the table below shows, university is the preferred route of post-secondary level education in Canada, with total enrolments increasing year on year between 2013-2017. Despite greater numbers of students enrolling in universities than in colleges, differences in graduation numbers between them are small.

Total Post-Secondary Enrolments, Canada (2013-2017)						
		2013	**2014**	**2015**	**2016**	**2017**
Enrolments	**University**	1,298,961	1,303,743	1,306,035	1,320,558	1,341,351
	College	754,692	747,645	748,017	755,883	774,654
	Total	2,053,653	2,051,388	2,054,052	2,076,441	2,116,002
Graduates	**University**	290,415	297,000	309,036	308,334	315,630
	College	213,951	218,553	224,952	223,194	227,694
	Total	504,363	515,550	533,985	531,528	543,321
Source: Statistics Canada						

Adult education is another responsibility of provincial/territorial governments and every jurisdiction has their own legislation regarding adult education and the continuation of skills development which vary widely, depending on the populations needs. Programmes offered to adult learners include basic skills and learning programs, second language programmes in English and French, community and volunteer-tutor adult-literacy programs, vocational education and training, apprenticeships, and workplace and workforce learning.[273]

Evidence on Skills Gaps and Mismatch

Canada is recognized worldwide as having a highly educated workforce with a large share of Canadians having completed tertiary education. The table below shows that 62% of Canadians had a tertiary degree in 2018, compared to the OECD average of 44%.[274]

Percentage of 25-34-Year-Olds by Educational Attainment (2018)		
Below Upper Secondary	**Upper secondary or Post-Secondary non-Tertiary**	**Tertiary Education**
6%	32%	62%
Source: OECD Education at a Glance		

Of the 62%, the table overleaf shows the majority had completed either a short-cycle tertiary degree or a bachelor's degree. However, despite strong attainment at tertiary level, graduate skills were found to be lower in comparison with their similarly educated peers in other OECD countries.[275]

[272] Ensuring Inclusive and Equitable Quality Education (CMEC) 2020 https://www.cmec.ca/Publications/Lists/Publications/Attachments/407/Sustainable%20Development%20Goal%204%20in%20Canada%20EN.pdf>

[273] Council of Ministers of Education Canada (2012) Adult Education and Learning: Canada progress report for the UNESCO Adult Learning and Education (GRALE) and the end of the United Nations Literacy Decade <https://www.cmec.ca/Publications/Lists/Publications/Attachments/283/GRALE_EN.pdf>

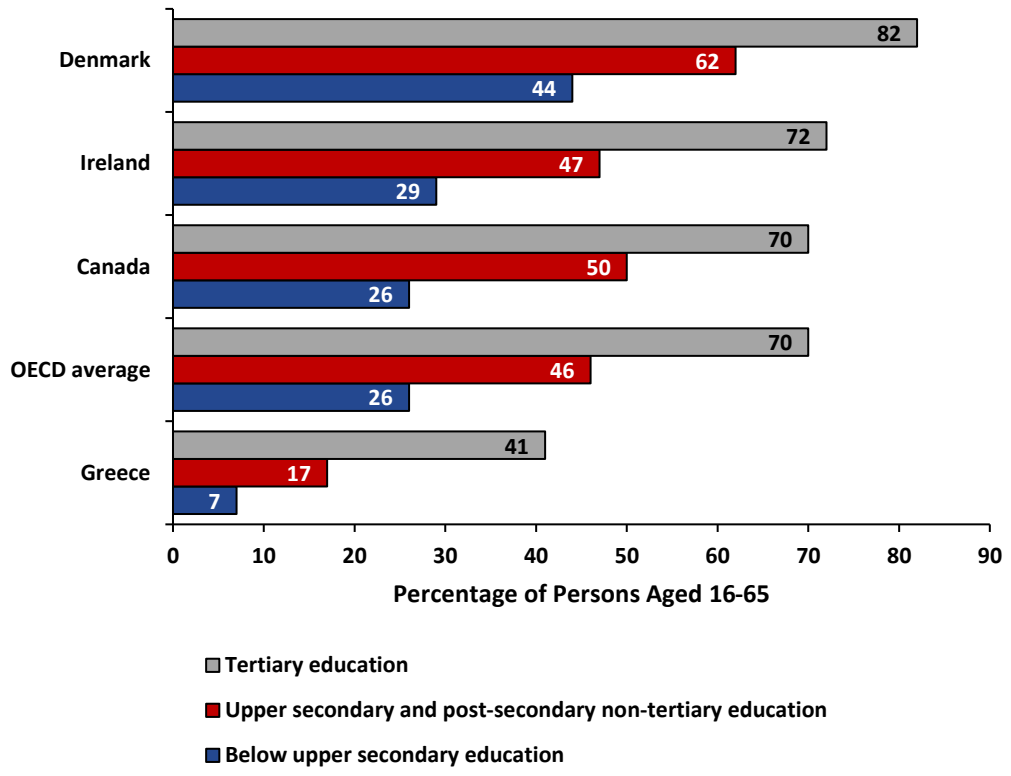
[274] Education at a Glance (2019) Canada Country Specific Note <http://www.oecd.org/education/education-at-a-glance/EAG2019_CN_CAN.pdf>

[275] OECD Skill Strategy: Canada https://www.oecd.org/canada/Skills-Strategy-Canada-EN.pdf

Percentage of 25-34-Year-Olds with Tertiary Education, by Level (2018)		
Bachelor's or Equivalent	**Short Cycle Tertiary**	**Master's or Equivalent**
41%	39%	17%
Source: OECD Education at a Glance		
Note: Data on Doctoral or equivalent is included under Master's or equivalent for Canada		

In addition to high educational attainment, the OECD's *Survey of Adult Skills (PIAAC)* found that Canadian adults had strong literacy and numeracy skills, scoring above the OECD average in both sections. Additionally, the percentage of adults with no computer experience was 4.5%, well below the OECD average of 11.7%[276] and the *Skills Outlook Scoreboard: Thriving in a Digital World* highlighted that few Canadians had low cognitive and digital skills, regardless of age.[277] The PIAAC also found that participation in formal and non-formal training in Canada was equal to the OECD average for two of three categories, as seen in the figure below, which shows the highest (Denmark) and lowest (Greece) participation rates, and the participation rates for the OECD and Ireland. There is scope for improvement in increasing lifelong learning participation rates in Canada.

Participation rate in formal and/or Non-formal Education, by Education Level, 16-65 Year Olds, 2012/15



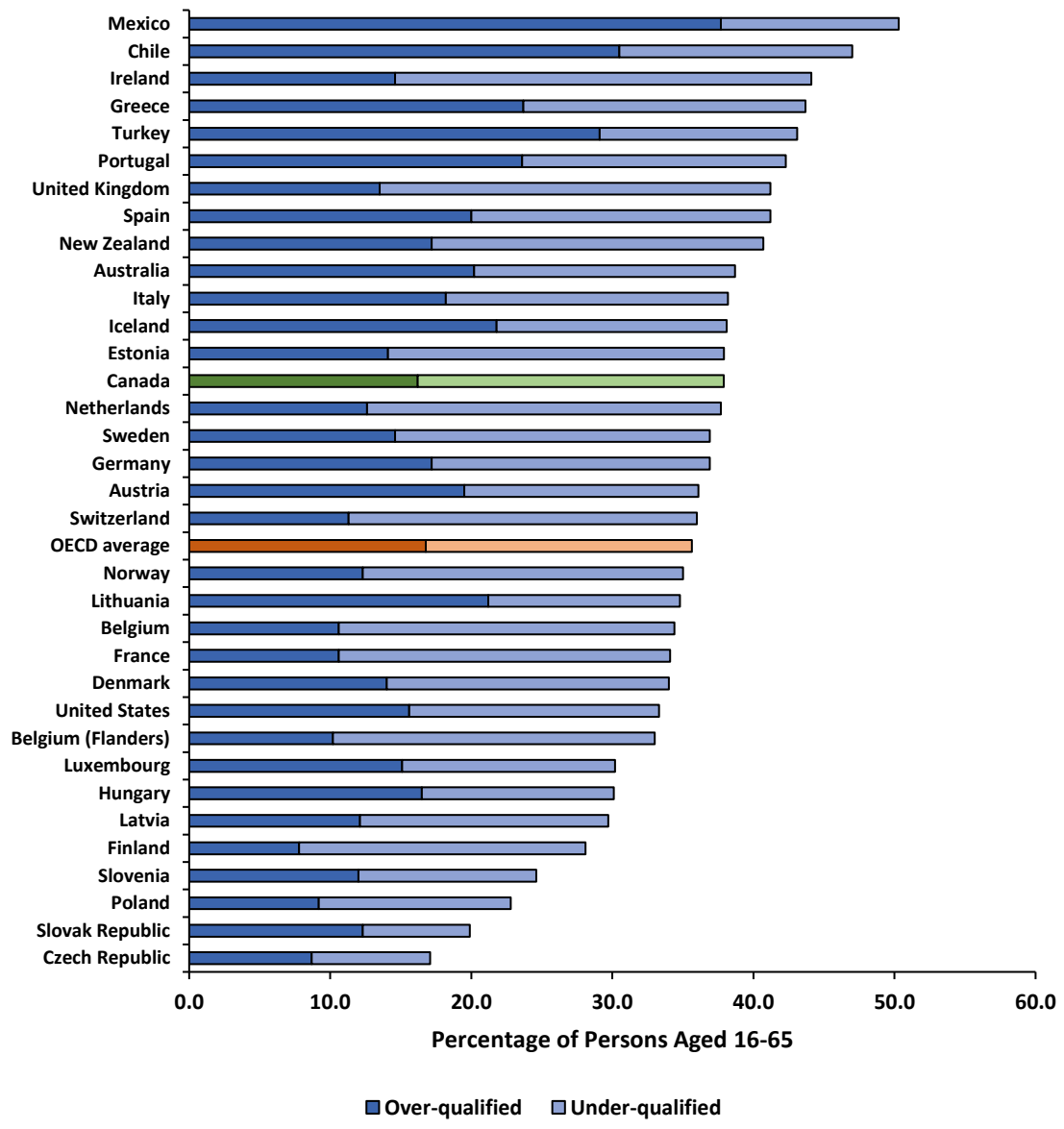
Source: OECD 2019 Skills Strategy

[276] Survey of Adult Skills (PIAAC) indicators.
[277] https://www.oecd.org/canada/Skills-Outlook-Canada-EN.pdf

According to the *OECD's Skill Strategy 2019,* Canada ranked one of the highest of OECD countries in relation to successfully aligning the supply of skills with demand for skills in the labour market,[278] but there was still persistent skills mismatch, both in under- and over-qualification of workers and in over- and under-skilling of workers.

The figure below gives the percentage of over-qualified and under-qualified workers across 34 countries as measured by the OECD. Of the 34, Canada had the 15th highest rate of over-qualification at 16.2%, just under the OECD average of 16.8%. Canada had the 12th highest rate of under-qualification at 21.7%, compared to the OECD average of 18.9%. Canada appears to have high levels of qualification mismatch, particularly in the form of under-qualification, despite having a highly educated workforce.

Percentage of Mismatched Workers by Qualification Mismatch

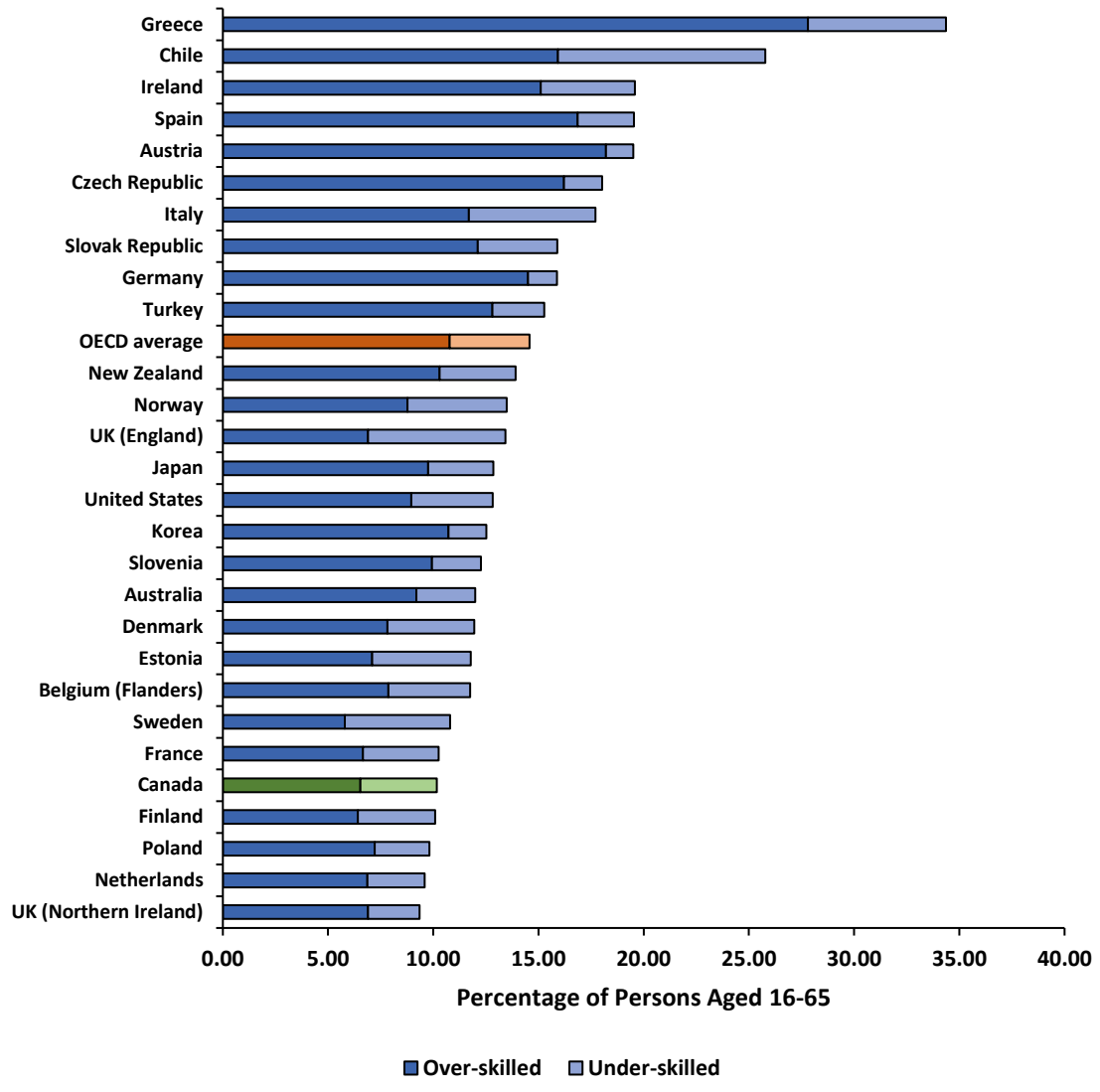


Source: OECD 2019 Skills Strategy

[278] https://www.oecd.org/canada/Skills-Strategy-Canada-EN.pdf

The figure below illustrates the percentage of mismatched workers in 28 countries across the OECD as measured by literacy mismatch, with Canada ranked low on both counts. Canada had the third lowest rate of over-skilled workers at 6.54%, with the OECD average being 10.78%, and the fifth lowest rate of under-skilled workers at 3.63%, with the OECD average being 3.8%.

Percentage of Mismatched Workers by Type of Mismatch, Literacy Mismatch



Source: OECD 2019 Skills Strategy

In 2019, it was estimated that 13% of Canadian workers have skills mismatched to their employment.[279] One of the problems highlighted in skills gaps and mismatches assessments in the Canadian labour market relates Canada lacking "an open, credible data source that contains reliable information on the skills associated with job."[280] Consequently, it is difficult to assess where skill gaps exist and which skills will likely be needed in the future. Efforts are being made by the Canadian Labour Market Information Council (LMIC) to create a system; however, one does not yet exist.

[279] Parisa Mahboubi (2019) C.D. Howe Commentary No.552: Bad Fits: The Causes, Extent and Costs of Job Skills Mismatch in Canada
[280] LMI Insights No. 16 (2019) Bridging the Gap between Skills and Occupations: A Concept Note to Identify the Skills Associated with NOC

Policy Responses/Initiatives

As outlined in the overview of the Canadian education system, developed the *Learn Canada 2020* education framework to enhance the education in Canada and to provide a national vision across provinces. Among the four pillars of this framework was to enhance postsecondary education, and to increase numbers presuming this option they outlined the key areas in the box below to be targeted.

Five Key Areas Outlined by the CMEC to Improve Postsecondary Education
❑ **Access and affordability**: address how governments support the transition of an increasingly diverse student population to postsecondary education; attempt to find a balance between tuition costs and student financial aid; and, address the impact that unexpected tuition costs could have on affordability while also addressing known affordability challenges that exist. ❑ **Higher education and the labour market**: Assess the role of employers with the aim of encouraging their participation in preparing students for employment; discover how delivery of learning in higher education can be improved upon to encourage the continuation of education and to allow students a seamless transition to the labour market. ❑ **Postsecondary learning outcomes**: Examine learning outcomes that are most relevant to postsecondary education and develop instruments which can be utilised by governments to measure these outcomes. ❑ **Postsecondary sustainability and accountability**: Understand and manage the key factors which may affect the sustainability of higher education, such as increasing costs, changing demographics, fiscal context, tuition or debt levels, and institutional specialization or differentiation. ❑ **Student transitions**: The ability to transition from secondary school to postsecondary education and into the workforce is a key measure of the success of education systems and should be assessed persistently to identify if this transition is successful, particularly in relation to for students from underrepresented groups and those with complex needs.
Source: Council of Ministers of Education, Canada[281]

As stated previously, there is no formal database of skills in Canada that has been formally endorsed by federal government in Canada. However, attempts have been made to standardise the measurement of skills by bodies such as Employment and Social Development Canada (EDSC). EDSC is a department of the federal government of Canada concerned with social programmes and the labour market, with the aim to develop a highly skilled labour force and promote labour market inclusivity to improve the living standards of and quality of life of all Canadians.[282] In 1998 its predecessor organisation, Human Resource and Social Development Canada, funded SkillPlan (British Columbia Construction Industry Skills Improvement Council) and Bow Valley College to develop the Test of Workplace Essential Skills (TOWES), to respond to the employers needs in developing an assessment which to measure individuals' skills performance.[283] TOWES measures nine essential skills, namely reading, document use, numeracy, writing, oral communication, working with others, thinking skills, digital technology, continuous learning.

[281] https://www.cmec.ca/158/Postsecondary_Education.html
[282] https://www.canada.ca/en/employment-social-development.html
[283] http://www.towes.com/en/about-towes/our-history

The ESDC also developed an Essential Skills Profile Database that has more than 350 essential skills profiles containing information on how workers in a particular occupation use each of the nine essential skills measured in TOWES in their work. These profiles describe the complexity of the skills needed to successfully work in a particular occupation that is linked to an occupation or occupational group in the National Occupational Classification (NOC).[284]

Additionally, the ESDC established the Office of Literacy and Essential Skills (OLES) to assist Canadian adults in developing literacy and essential skills, by working alongside provincial and territorial governments in developing employment and training programmes incorporate essential skill components. This is done with the aim of supporting individuals with limited skillsets and who tend to face multiple barriers to employment, such as Indigenous people, youth, and Official Language Minority Communities (OLMCs).[285] The ESDS runs numerous other programmes, including the Aboriginal Skills and Employment Training Strategy, the Youth Employment Strategy and the Enabling Fund for OLMCs, and the OLES works horizontally with these programme to ensure supports are in place to help those in need of assistance. Through the OLES, the "Consolidated Revenue Fund – Adult Learning, Literacy and Essential Skills (ALLESP) and Employment Insurance Part II" and the National Essential Skills Initiative (NESI) are used to finance strategic investments in projects aimed at transforming and improving employment and training supports by replicating and increasing the number of supports already proven to be responsive to employer and worker needs.[286]

The Forum of Labour Market Ministers (FLMM), established in 1983, is a platform made up of federal, provincial and territorial ministers responsible for creating labour market policies and programmes, with the aim of promoting cooperation between ministers by collaborating on mutual issues. [287] As labour market ministers are concerned with meeting the needs of an ever-changing labour market and creating an inclusive and efficient workforce, it is important they align the supply of skills with labour market needs, and the therefore the FLMM Strategic Plan 2017-2020 identified five priority areas to achieve this, which are outlined in the box below.

The FLMM's Five Priority Areas to Align Skills Supply and Demand
❑ Ensuring the next generation of Labour Market Transfer Agreements are focused on outcomes, are inclusive, flexible and responsive to citizen's needs, and are based on reliable evidence; ❑ Optimizing the mobility of certified workers and apprentices across the labour market and ensuring smooth integration of internationally trained workers into the Canadian labour market; ❑ Promoting employer involvement and creating demand-led training initiatives which meet employers' needs; ❑ Strengthening knowledge transfer and engagement between stakeholders; ❑ Promoting the sharing of best practices and innovative practices across Canada.
Source: The Fourm of Labour Market Ministers Strategic Plan 2017-2020[288]

The FLMM has endorsed the Labour Market Information Council (LMIC), a not-for-profit organisation in April 2017, which aims to "improve the timeliness, reliability and accessibility" of information on the labour market to "facilitate decision-making by employers, workers, job seekers, academics, policy makers, educators, career practitioners, students, parents and under-represented populations."[289] To achieve this, the LMIC collects, analyses and distributes labour market

[284] https://www.canada.ca/en/employment-social-development/programs/essential-skills/profiles/guide.html
[285] https://www.canada.ca/en/employment-social-development/programs/literacy-essential-skills.html
[286] https://www.canada.ca/en/employment-social-development/programs/literacy-essential-skills.html
[287] http://flmm-fmmt.ca/about-us/
[288] https://www.cmec.ca/158/Postsecondary_Education.html
[289] https://lmic-cimt.ca/about

information, providing up to date data on their website and publishing analysis and research findings in the form of The Future Work Annotated Bibliography and LMI Insights. They identify and analyse labour shortages, skills shortages and skills mismatches as follows:

- **Labour shortages** refer to a **lack of candidates for a specific job** in a **specific labour market.**
- **Skills shortages** refer to a **lack of candidates with the skills** required **by particular employers.**
- **Skills mismatches** refer to situations in which an employee's **current skills are not well suited** to their current job. [290]

The LMIC proposes analysing skill gaps/mismatches through two potential methods proxy approaches (via educational qualifications, fields of study, and occupations) and the self-reporting approach with big-data (taken from job seeker profiles (skills supply) and employer job postings (skills demand)).[291] The LIMC notes that change is occurring at an unprecedented pace in Canada's labour market and workplaces, driven by technological and business model innovations, population ageing, evolving global trading patterns, and climate change, increasing uncertainty around employment, job quality, skill requirements, and the ability to form, attract, and retain talent.[292]

The LMIC also produced information on the Future World of Work[293] through its annotated bibliography of reports on the future of work. This report contains annotations of reports published by various sources, including Accenture, the Advisory Council of Economic Growth, and various other researchers. Most reports indicate an evolution of skills requirements as a result of automation/computerization, technological change and advancement (the 4th Industrial Revolution), demographic changes such as aging population and slowing population growth, adapting to climate change and the green economy, the increase in precarious employment, the rise flexible, non-standard, informal work arrangements (remote working), the cruciality of soft skills and how online platforms will transform the nature of the workplace and how organizations hire new talent.

In order to enhance the responsiveness and agility of the education system to meet skills needs as they evolve, the LMIC has contributed to developing, in conjunction with Statistics Canada and ESDC, a pan-Canadian mapping system that links skills to occupations. They propose a five-phased plan to assess, develop, and maintain mapping between the ESDC's recently developed Skills and Competencies Taxonomy and the National Occupational Classification (NOC) system.[294]

The Canadian federal government launched the Future Skills initiative in spring 2018, as part of their plan to ensure that Canada's skills development policies and programs are prepared to meet Canadians' changing needs. Future Skills will examine major trends that will impact on national and regional economies and workers, and identify emerging skills that are in demand now and into the future. It will also develop, test and evaluate new approaches to skills development and share results and best practices across the public, private and not-for-profit sectors to support broader use of innovative approaches across Canada. Future Skills will include the Future Skills Council and the Future Skills Centre. The Future Skills Council, staffed by technical and subject matter experts from the public, private and not-for-profit sectors, will consult and gather perspectives on how technologies and other emerging trends are creating new opportunities for Canadians. It will then advise the Minister of Employment, Workforce Development and Labour on national and regional skills development and training priorities. The Future Skills Centre, run independently of government by Ryerson University, the Conference Board of Canada and Blueprint ADE, will partner with and fund

[290] LMN insight No.3 – https://lmic-cimt.ca/wp-content/uploads/2019/02/LMI-Insights-No-3-v2.pdf
[291] LMN insight No. 14 – https://lmic-cimt.ca/wp-content/uploads/2019/06/LMI-Insights-No-14-2-1.pdf
[292] LMN Insight No.1 – https://lmic-cimt.ca/wp-content/uploads/2018/10/LMI-Insights-No.-1.pdf
[293] LMIC Future of Work Annotated Bibliography - https://lmic-cimt.ca/wp-content/uploads/2020/02/LMIC_Future_of_Work-Annotated_Bibliography_Feb20.pdf
[294] LMI Insight No. 16 – https://lmic-cimt.ca/wp-content/uploads/2019/08/LMI-Insights-No-16.pdf

projects that are led by groups such as provincial and territorial governments, Indigenous governments and for-profit and not-for-profit organisations to help Canadians make informed training decisions by identifying emerging in-demand skills required now and in the future.

On a provincial level, since 1998, the government of Ontario has required publicly funded colleges to report on five key performance areas annually, specifically employment rates and graduation rates, student and graduate satisfaction rates, and employers' satisfaction rate with graduates.[295] By measuring performance in these areas, the benefits of lifelong learning are effectively communicated to individuals and firms, ultimately supporting skills development.

Turning to pathways between further and higher education, the educational systems in Canada generally allow, depending on circumstances and course content, progression from vocational studies in college to university once a student has completed their college study and received their diploma. In Alberta, British Columbia and Quebec, college systems were all designed to ensure that there vocational college systems articulated with their university systems, to allow for easy transfer to university.[296] In 2002, the Ontario Ministry of Training, Colleges and Universities developed the Ontario Qualifications Framework to set the standards for credentials and to ensure that there are visible pathways for students to navigate through the "jungle" of credentials to ensure a seamless transition from vocational to higher education. This was followed by the Ontarian Government's 2011 commitment to improving the credit transfer system between vocational qualifications in college and entry to university degrees, strengthening their pathways between vocational and higher education.[297] The ability to transfer credits between vocational and higher education is dependent upon the similarity of the courses in question and in some cases an in individual who transfers between one and another course may need to undertake a bridging course.[298] One of the policies adopted in this commitment was to strengthen the visibility of pathways between vocational and higher education through the development of an easy to access online interface called ONTransfer.ca.[299] Similar facilities have been developed in other provinces such as British Colombia.[300] In 2011, Ontario also established the Ontario Council on Articulation and Transfer (ONCAT) to enhance pathways to higher education and reduce barriers to transferring between Ontario's public colleges, universities and institutes for indigenous people.[301]

While small number of students in Canada do not complete high school secondary education, bridging programmes are also offered (by colleges and universities) for these to gain the necessary qualifications and knowledge to enter college or university.[302] Unlike other provinces such as British Colombia, the Ontarian system was not designed to take account of transfers between vocational and higher education and despite some pathways having being introduced transfer rates are lower than for other Canadian provinces.[303] The proportion of students choosing this route is small, with only 2% of those who entered Ontarian colleges not having completed high school in 2016-17.[304] It

[295] https://www.collegesontario.org/en/resources/2019-kpi-results
[296] Lennon, M. C,, Brijmohan, A., Lavigne, Eric., Yang, Jinli., Moodie, G., and, Wheelahan, Leesa; Moodie, 2016. Ontario Student Mobility: Carving paths of desire, Ontario Institute for Studies in Education, University of Toronto, Toronto, ON.
[297] Ministry of Training Colleges and Universities. 2011. Policy Statement for Ontario's Credit Transfer System. Toronto: Government of Ontario. Available at: https://collections.ola.org/mon/25005/309581.pdf
[298] https://oncat.ca/en/about-us/about-transfer
[299] This is for current and prospective postsecondary students to examine potential credit transfer opportunities or pathways, with over 1,900 credit transfer pathways and more than 800,000 distinct transfer opportunities available in Ontario. See: https://www.ontariocolleges.ca/en/apply/transfer-credits#:~:text=The%20term%20credit%20transfer%20simply,institution%20or%20a%20new%20one.
[300] https://www.bctransferguide.ca/
[301] https://oncat.ca/en/about-us
[302] For an example of a bridging programme at the University of Toronto see: http://sites.utoronto.ca/typ/faq.html
[303] Lennon, M. C,, Brijmohan, A., Lavigne, Eric., Yang, Jinli., Moodie, G., and, Wheelahan, Leesa; Moodie, 2016. Ontario Student Mobility: Carving paths of desire, Ontario Institute for Studies in Education, University of Toronto, Toronto, ON.
[304] Deller, F. and Tamburri, R. "*Early Supports for Accessing Postsecondary Education: Good, Bad or Indifferent?*". Higher Education Quality Council of Ontario. Available at: http://www.heqco.ca/SiteCollectionDocuments/Formatted-Access%20Early%20Interventions.pdf

must also be noted that in Ontario that often it was assumed that the development of pathways would lead to student using them, with the establishment of pathways not informed by evidence that there is a strong demand from students for them. [305] A 2016 review of Ontario's educational pathways recommended that routes and pathways from colleges to university (and vice versa) be created taking account of flows of students between qualifications, institutions and educational fields and that there be a greater focus on trying to increase the numbers using such pathways.[306] The table below provides the five most travelled flows between college and university and university and college, in 2009.

Five most travelled flows of Canadian College Graduates who Subsequently Received a University Credential and Vice Versa in 2009			
From College to University			
Field of prior credential (sending field	**No. of college graduates who obtained a 2009 university credential**	**Field of 2009 credential (receiving field)**	**Proportion who obtained their 2009 university credential in the receiving field**
Business, management and public administration	2,780	Business	55%
Social and behavioural sciences and languages	1,700	Humanities	60%
Business, management and public administration	2,780	Humanities	29%
Humanities	720	Social and behavioural sciences	56%
Personal services	820	Social and behavioural sciences	46%
From University to College			
Field of prior credential (sending field)	**No. of university graduates who obtained a 2009 college credential**	**Field of 2009 credential (receiving field)**	**Proportion who obtained their 2009 college credential in the receiving field**
Social and behavioural sciences and languages	**2,160**	**Business**	**32%**
Humanities	1,720	Business	37%
Social and behavioural sciences and languages	2,160	Social and behavioural sciences	25%
Physical and life sciences and technologies	1,040	Health medical assisting	42%
Social and behavioural sciences and languages	2,160	Human services	18%
Source: Lennon et al. 2016			

[305] Lennon, M. C, Brijmohan, A., Lavigne, Eric., Yang, Jinli., Moodie, G., and, Wheelahan, Leesa; Moodie, (2016) Ontario Student Mobility: Carving paths of desire, Ontario Institute for Studies in Education, University of Toronto, Toronto, ON.
[306] Lennon, M. C, Brijmohan, A., Lavigne, Eric., Yang, Jinli., Moodie, G., and, Wheelahan, Leesa; Moodie, (2016) Ontario Student Mobility: Carving paths of desire, Ontario Institute for Studies in Education, University of Toronto, Toronto, ON.

Additionally, many of students tend to study unreasonable proximity to their home, and therefore, a greater focus in Ontario needs to be placed on creating pathways between colleges and universities that are in close geographic proximity to one another.[307] The current situation is that universities have as many pathways with colleges that are located far away from them geographically as they have with those that are nearby. Forging clear pathways with neighbouring institutions may increase the numbers transferring between college and university and vice versa.

In Alberta, the Trade to Degrees programme, developed by the Northern Alberta Institute of Technology, allows recognised trade professionals the opportunity to progress from an apprenticeship credential, to the third year of their four year Bachelor of Business Administration Programme.[308] To qualify for the programme, individuals need a Red Seal Trade Certification (or equivalent recognised by the Government of Alberta – Apprenticeship and Industry Training (AIT) branch) and also to have three to five years of management experience in their designated trade. In future it is intended that this programme be expanded to cover entry to other degrees. Such a flexible pathway is designed to encourage more young people to apprenticeships and trade related careers, knowing they can further their education if going down that route, and therefore ultimately closing skills shortages in certain trades in the Albertan economy. The Blue Seal programme is in operation in Alberta and Saskatchewan and recognises and encourages business training among tradespeople.[309] To obtain such a certificate, applicants must complete 150 hours of study in one or more of 18 subject areas or a program of study approved by the Apprenticeship and Industry Training Board.[310]

Following the findings of the *OECD's 2019 Skill Strategy,* which suggested that tertiary graduates in Canada have low levels of basic skills compared to other OECD countries, the Government of Ontario committed to supporting the improved development of transversal and job-specific skills in tertiary education. Therefore, the Higher Education Quality Council of Ontario (HEQCO) committed to the roll-out of two large-scale pilot skills assessment studies, the Essential Adult Skills Initiative (EASI) and the Postsecondary and Workplace Skills (PAWS) assessment, to be trialled at 20 universities and colleges across Ontario. These assessments were undertaken to measure the literacy, numeracy and critical-thinking skills among students entering tertiary education and students graduating from university.[311] These assessments were intended to improve the general understanding of the skills gaps among Ontarian post-secondary graduates and to assess whether the post-secondary system is successful at providing graduates with the transversal, non-disciplinary skills necessary to be successful in the labour market. Ultimately, institutions will be encouraged to teach, measure and credential skills that are employers and the labour market highly seek rather than just discipline-specific content.[312] The Assessments found that at aggregate level, final-year students were found to have higher scores than first-years, but once disaggregated, scores varied considerably across programmes. It was also found that one in four graduates scored below the bar in literacy and/or numeracy. As a result, the HEQCO recommended that skills assessments similar to EASI and PAWS should be carried out in all institutions and by all students and should be integrated into programme requirements.[313]

[307] Lennon, M. C, Brijmohan, A., Lavigne, Eric., Yang, Jinli., Moodie, G., and, Wheelahan, Leesa; Moodie, (2016) Ontario Student Mobility: Carving paths of desire, Ontario Institute for Studies in Education, University of Toronto, Toronto, ON.
[308] https://www.nait.ca/nait/admissions/transfer-and-credit-options/pathways/trades-to-degrees
[309] https://saskapprenticeship.ca/quick-links/blue-seal-program/
[310] These areas are: Accounting; Administration; Business Law; Business Mathematics; Communications; Economics; Entrepreneurship; Finance; Human Resource Management; Industrial Relations; Leadership; Management; Marketing; Project Management; Public Administration; Operations Management; Organisational Behaviour; Supervision.
[311] OECD 2019 Skills Strategy
[312] OECD 2019 Skills Strategy
[313] Summary of Findings from HEQCO's Skills Assessment Pilot Studies Harvey P. Weingarten and Martin Hicks Higher Education Quality Council of Ontario <http://www.heqco.ca/SiteCollectionDocuments/Formatted_EASI_PAWS%20Summary%20r2.pdf>

Ontario's Ministry of Training, Colleges and Universities requires that a Programme Advisory Committee, made up of various social partners including college staff, students and external personnel who are leaders in their fields and have a direct interest in the design and development of programmes, be set up for each college programme or cluster of programmes to ensure the curriculum is relevant to the needs of industry, business and society. These committees aim to identify current and future industry trends as well as the shifts needed in the skills and knowledge graduates need to meet employer requirements, ensuring curricula are designed to reflect this.[314]

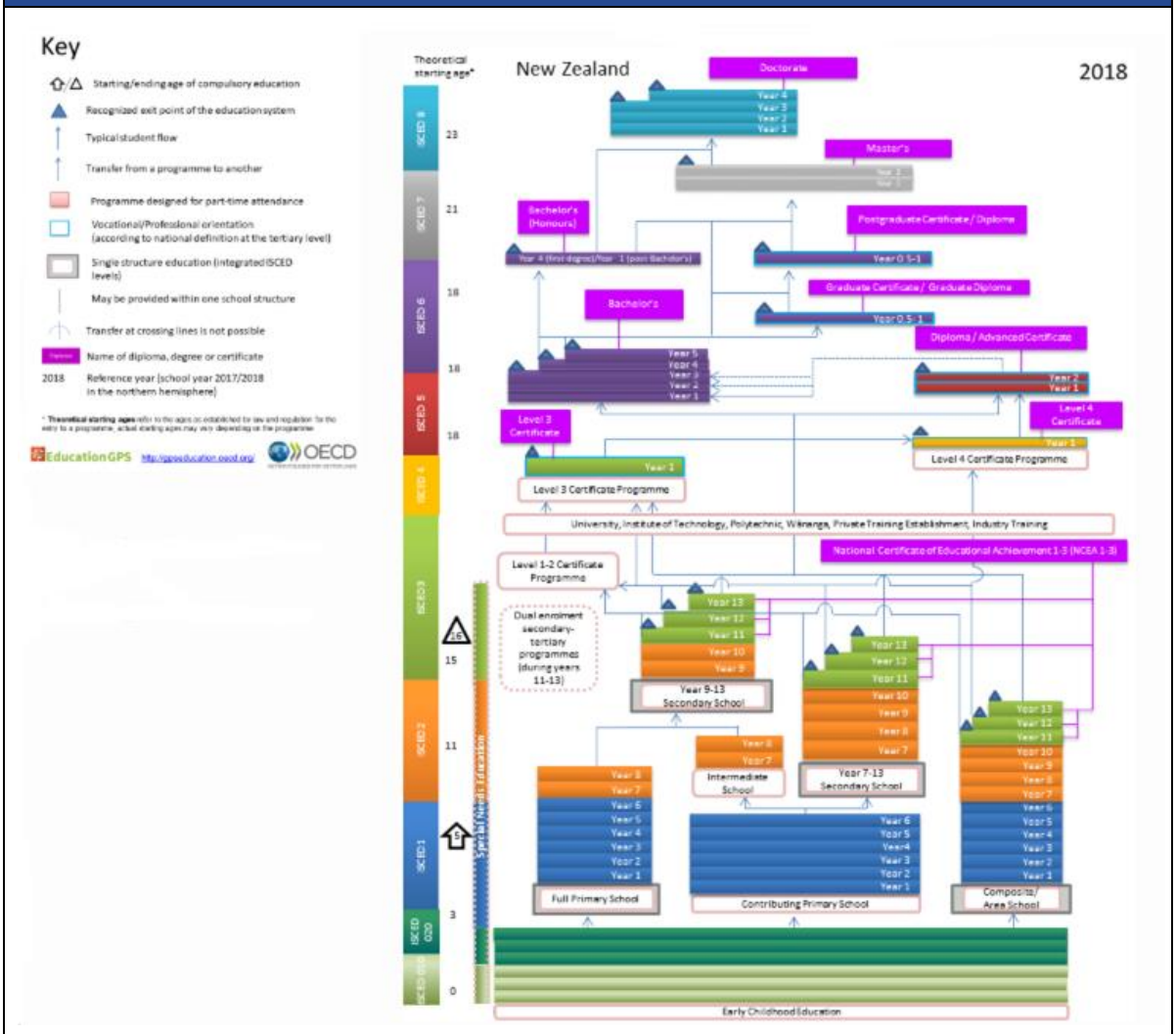
Case Study 3: New Zealand

Overview of Education System

Education is compulsory in New Zealand from the ages of 6 to 16, with primary education lasting from the ages of approximately 5 to 12 (Years 1 to 8) and secondary education lasting from approximately ages 13 to 17 (Years 9 to 13).[315] The majority of schools are state schools, which are owned and financed by the state, and are secular, with a national state mandated curriculum. These are free to attend. State integrated schools are funded by government, teach the national curriculum and have a particular religious or philosophical ethos – attendees must pay to attend. Private schools are mostly funded though fees charged to attendees' parents, but received some degree of state funding. They do not have to follow the national curriculum. An overview of the structure of New Zealand's education system is provided in the figure overleaf.

[314] https://www.senecacollege.ca/about/advisory/
[315] https://www.education.govt.nz/our-work/our-role-and-our-people/education-in-nz/

Structure of New Zealand's Education System



Source: OECD Education GPS[316]

There are two different types of national curricula, one for English language schools and the other for Māori schools where at least 51% of instruction is via the Māori language. At primary level the national curricula are focused on foundation learning across varied competencies, but with special focus on literacy and numeracy, while at second-level a broad range of subjects are studied until specialisation in Years 11 to 13. Students who complete second-level receive a National Certificate of Educational Achievement (NCEA), assessed from Years 11 to 13.[317] A range of internal and external assessments are used by schools to quantify how well students meet standards for various subjects. Upon achieving a standard, a student receives a number of credits, with a certain number to be reached to receive a NCEA. There are three NCEA levels depending on the difficulty of the standards.

[316] https://gpseducation.oecd.org/CountryProfile?primaryCountry=NZL&treshold=10&topic=EO
[317] https://www.nzqa.govt.nz/ncea/understanding-ncea/how-ncea-works/

In terms of the performance of the primary and secondary education system, New Zealand ranked 10th out of 76 countries in the 2018 PISA in terms of percentage of top performers in reading (proficiency Level 5 or 6), but ranked less favourably in terms of maths (only 11.8% were in the top performing levels compared to the OECD average of 10.9%).[318]

At senior secondary school level students can choose to specialise in vocational learning. Vocational Pathways is a programme instituted in New Zealand's secondary schools which assists students' transition to employment by making clear pathways to achieve a National Certificate of Educational Achievement to prepare them for employment in six industries, namely primary industries, services industries, social and community services, manufacturing and technology, construction and infrastructure, and creative industries.[319] Students can use the "Profile Builder" online tool to input skills or standards so that they can evaluate and plan the programme they are currently in or are interested in doing, and teachers can use the same tool to plan a student's pathway of programmes so that they can achieve an award.[320] Additionally, employers can view the vocational profile of a student to identify the pathway the student has undertaken, see if they have achieved an award and determine if the student's skills align with those they require.

Individuals can undertake vocational training while working, via an apprenticeship or traineeship. Qualifications for training in New Zealand are developed and managed by the 11 Industry Training Organisations (ITOs) outlined in the box overleaf, each representing a specific industry – though this is to change under new reforms discussed later. ITOs were introduced after 1992 as it was observed that training in New Zealand lacked flexibility to allow new industries to engage with it, did not adequately meet and adapt to the needs of changing industry and lacked connections between off-job training and on-job experience.[321] ITOs comprise of member companies and relevant stakeholders such as education and training providers and government. These work to provide information on skills demanded in the industry, define the national skill standards and qualifications that are required by industry thereby ensuring that education and training remains relevant and broker training to meet employees' needs in industry by linking national industry skills to individual workplace learning.[322]

Apprenticeships in New Zealand lead to either a Level 4 New Zealand Certificate comprising of a minimum of 120 credits or two or more qualifications that total to a minimum of 120 credits, provided this includes Level 3-4 qualifications only and at minimum 60 of the total credits are at Level 4.[323] Each industry has different entry requirements and the minimum age for joining an apprenticeship is 16 with no upper age limit.[324] Traineeships in New Zealand are smaller industry training programmes which to not meet the credits and qualification level criteria of New Zealand Apprenticeships.

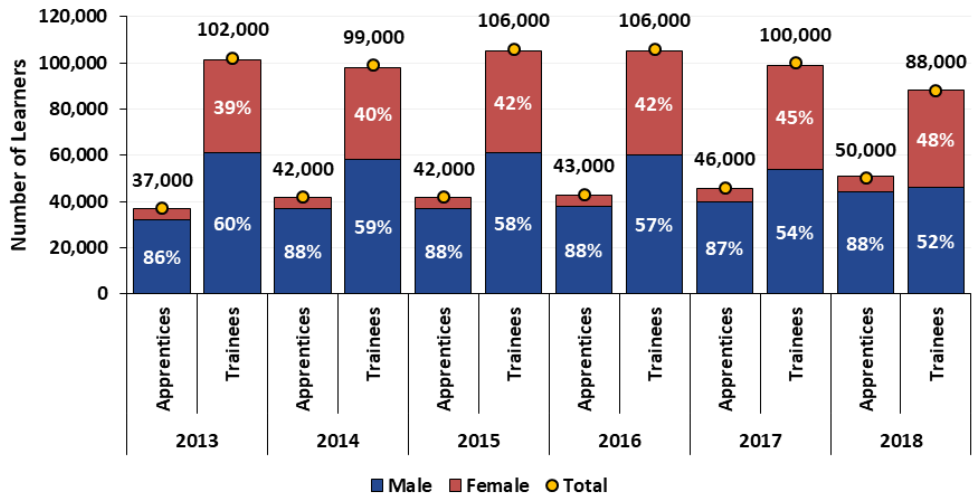
[318] 2018 PISA: https://gpseducation.oecd.org/CountryProfile?primaryCountry=NZL&treshold=10&topic=PI
[319] Education Review Office, 2016. "Vocational Pathways: Authentic and Relevant Learning". Available at: https://www.ero.govt.nz/assets/Uploads/Vocational-Pathways-PDF2.pdf
[320] http://ec2-13-54-195-74.ap-southeast-2.compute.amazonaws.com/vocational-pathways/employers-/
[321] Ministry of Education - "History of Industry Training". Available at: https://education.govt.nz/assets/Documents/Ministry/consultations/Review-of-industry-training/HistoryOfIndustryTrainingFINAL.pdf
[322] https://www.serviceiq.org.nz/about-us/what-is-an-ito/
[323] https://www.tec.govt.nz/teo/working-with-teos/itos/new-zealand-apprenticeships/?utm_source=newzealandnow.govt.nz
[324] https://www.careers.govt.nz/plan-your-career/find-out-about-study-and-training-options/apprenticeships/

Industry Training Organisations in New Zealand
❑ **Building and Construction Industry Training Organisation (BCITO):** Building, construction, flooring, masonry, glass and glazing, joinery, interior systems, and painting and decorating;
❑ **Community Support Services Industry Training Organisation Limited (Careerforce):** Health and disability support, social and community support, cleaning, caretaking, and pest management.
❑ **Competenz Trust (Competenz):** Engineering, manufacturing, forestry, communications and media, maritime and rail transport, and other trades (locksmithing, fire protection, refrigeration, heating and air conditioning).
❑ **Infrastructure Industry Training Organisation (Connexis):** Civil construction, electricity supply and transmission, water, and telecommunications.
❑ **New Zealand Hair and Beauty Industry Training Organisation Incorporated (HITO):** Hairdressing, barbering and beauty.
❑ **MITO New Zealand Incorporated (MITO):** Automotive, commercial road transport and logistics, stevedoring and ports, freight forwarding and distribution, industrial textile fabrication, extractives and drilling, gas, protective coating, and resource recovery.
❑ **Boating Industries Association of New Zealand Incorporated (NZ MAC ITO):** Boat building design and manufacturing, composite manufacturing, marine support services, and sail making.
❑ **Primary Industry Training Organisation Incorporated (Primary ITO):** Agriculture, horticulture, sports turf, equine, dairy manufacturing, meat processing and seafood, and petrochemical, energy and chemical plant.
❑ **ServiceIQ (Service Skills Institute):** Tourism, travel, retail, hospitality, museums, aviation and wholesale goods operations.
❑ **Skills Active Aotearoa Limited (Skills Active Aotearoa):** Sports, fitness and recreation, snow sport and performing arts.
❑ **The Skills Organisation:** Plumbing, gas fitting, drain laying, roofing, electrotechnology, real estate, financial services, local government, public sector (with some exclusions), security, contact centre, offender management, cranes and scaffolding, ambulance, emergency management, and fire services.
Source: Tertiary Education Commission[325]

The figure overleaf shows the trends in numbers in apprenticeships and traineeships in New Zealand between 2013 and 2018, and it can be observed that in that time [period the numbers undertaking apprenticeships in New Zealand have increased from 37,000 to 50,000, an increase of 35%. Males overwhelmingly dominate apprenticeship numbers with 88% of apprentices in 2018 being male – the proportion of apprentices that are female has remained stagnant at around 11-13% over the period. In 2019 1.9% of the workface were training as apprentices, with the male and female participation rates being 3.2% and 0.5% respectively.[326] The numbers undertaking traineeships declined 14% from 102,000 in 2013 to 88,000 in 2018. In contrast to apprenticeships, trainees have become more evenly split between genders in recent years, with 52% being male in 2018, down from 60% in 2013. In 2018, 3.3% of the New Zealand workforce were involved in traineeships, with the equivalent figure for the male workforce being 3.3% and the female workforce being 3.4%.[327]

[325] Tertiary Education Commission – Directory of Industry Training Organisations: https://www.tec.govt.nz/teo/working-with-teos/itos/directory/
[326] https://www.educationcounts.govt.nz/statistics/tertiary-education/new-zealands-workplace-based-learners
[327] https://www.educationcounts.govt.nz/statistics/tertiary-education/new-zealands-workplace-based-learners

Trends in Apprenticeships and Traineeships in New Zealand, 2013-2018



Source: Education Counts - Industry Training and Other Workplace-Based Trends[328]

Post-secondary VET qualifications are delivered by non-university Tertiary Education Organisations (TEOs) leading to certificates at Levels 3 to 7 on the New Zealand Qualifications Framework (NZQF).[329] Non-university TEOs include Wānanga (for Māori education), Institutes of Technology and Polytechnics, Industry Training Organisations, Private Training Establishments, regular schools, Rural Education Activities Programmes and Community Education Providers.[330] Vocational education provides pathways for students to progress from school (in some cases to progress to tertiary education), those seeking to change career and those who want to achieve a vocational qualification.

There are eight universities in New Zealand.[331] All universities set their own tuition fees, but from 2018 one year has been provided free by the government, with the intention to increase to three years by 2024.[332] In 2010 the New Zealand Qualifications Authority was established to standardise and accredit non-university post-secondary education, offered in private training establishments (PTEs), institutes of technology and polytechnics (ITPs), wānanga, universities and in the workplace. There are 10 levels on the framework, each with distinct educational outcomes and a minimum number of credits that have to be achieved at each level, and it enables easy transfer of credits between different strands of the education system.[333] NZQF Levels 3-4 qualifications are certificates and Levels 2-7 are certificates/diplomas, while bachelor's degrees are at Level 7 and postgraduate degrees are at Levels 8-10. The table overleaf shows the numbers in provider based tertiary education at Levels 3 and above on the NZQF. From 2015 to 2019 the total number in tertiary education declined slightly, by 4%. Universities accounted for 57% of tertiary students in 2019, with polytechnics accounting for just under a quarter. Most tertiary students were studying for bachelor's degrees (53%), with 16% studying for postgraduate degrees, up 8% on 2015 figures.

[328] https://www.educationcounts.govt.nz/statistics/tertiary-education/new-zealands-workplace-based-learners
[329] https://www.educationcounts.govt.nz/statistics/tertiary-education/vocational-education-and-training
[330] For more information on these types of institution please see: https://www.tec.govt.nz/teo/working-with-teos/about-teos/
[331] https://www.universitiesnz.ac.nz/universities
[332] https://www.timeshighereducation.com/student/advice/cost-studying-university-new-zealand
[333] The New Zealand Qualifications Framework: https://www.nzqa.govt.nz/assets/Studying-in-NZ/New-Zealand-Qualification-Framework/requirements-nzqf.pdf

Numbers in Provider-Based Tertiary Education at NZQF Level 3 and Above					
	2015	**2016**	**2017**	**2018**	**2019**
Total Level 3 and above	**209,470**	**209,340**	**204,040**	**203,400**	**201,540**
Sub–sector					
Universities	114,860	115,350	114,230	115,440	115,870
Polytechnics	54,470	53,600	51,090	50,140	47,620
Wānanga	17,240	18,630	18,300	17,610	16,800
PTEs	22,910	21,760	20,420	20,210	21,240
Qualification level					
Level 3–4 Certificates	47,830	47,580	44,910	43,250	42,380
Level 5–7 Certificates/Diplomas	23,360	23,040	21,930	21,920	21,120
Level 7 Bachelor's Degrees	109,020	108,230	106,180	106,240	106,030
Level 8–10 postgraduate Study	29,260	30,480	31,020	31,990	32,000
Source: Ministry of Education[334]					

In terms of educational attainment, in 2017 52% of New Zealanders aged 15 years and older had a tertiary qualification as their highest educational attainment level – this proportion split evenly between those with a bachelor's degree or higher and those with a third-level diploma or certificate as their highest educational level.[335] 28% had a school qualification.

Informal educational opportunities are offered through what is termed adult and community education in New Zealand, with a range of adult learning options from English language skill improvement and woodworking to computer courses.[336] Adult and community education can be offered in schools, in Wānanga (for Māori education), Institutes of Technology and Polytechnics and in the community through community organisations, private training establishments (PTEs) and rural education activity programme (REAP) providers.[337] The figure overleaf shows that the share of the adult population in New Zealand that participated in formal or non-formal adult education for job related reasons was higher than in other OECD countries. However, higher qualified workers are more likely to engage in adult education and training, hinting that the current system is not effective in enhancing the skills of less skilled workers.[338]

[334] Ministry of Education, 2020. "New Zealand tertiary education demand forecast 2020".
[335] Statistics New Zealand, Household Labour Force Survey.
[336] https://www.consumer.org.nz/articles/adult-and-community-education
[337]https://www.tec.govt.nz/funding/funding-and-performance/funding/fund-finder/ace/
[338] New Zealand Productivity Commission, 2019. Training New Zealand's workforce. Technological change and the future of work, Draft report 3

Share of Population Aged 25-64 that participated in Formal or Non-Formal Adult Education for Job Related Reasons in 2012 or 2015

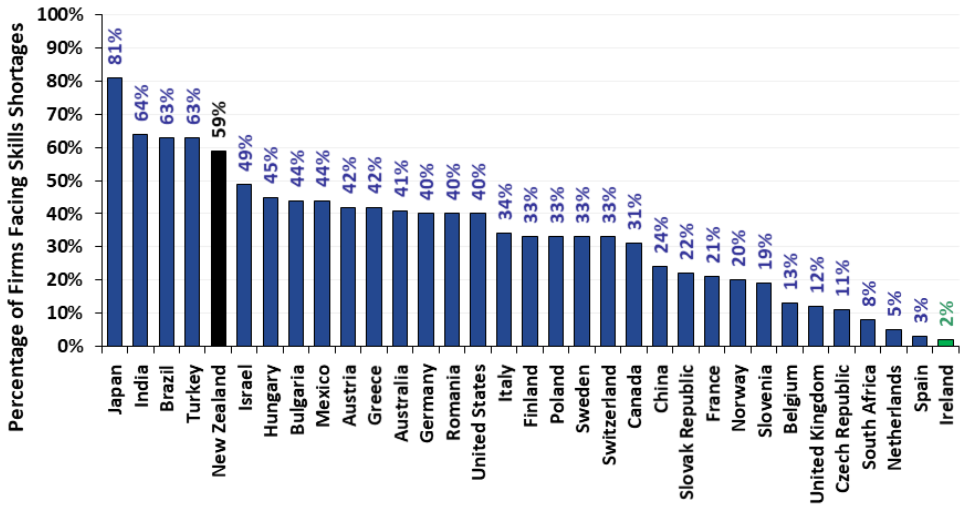
Source: OECD[339]

Evidence on Skills Gaps and Mismatch

New Zealand has historically had low unemployment levels, ranging between approximately 4% and 7% since 2010, though subsequent figures will be affected by the Coronavirus pandemic that was ongoing at the time of writing.[340] Despite the generally good structural and macroeconomic conditions, New Zealand's productivity levels and earnings are comparatively low, which the OECD ascribes to a lack of international connection and scale, skills and qualifications mismatches, weak competitive pressures and low capital investment and R&D rates.[341] In 2017 the OECD estimated that New Zealand's productivity growth could be 2.25% higher if mismatch in the labour force was addressed, while those working in jobs for which they were overqualified for earned on average 14% less than their "well-matched" counterparts. It is estimated that New Zealand's labour productivity would increase by 7% in gains in allocative efficiency if literacy skills mismatch was reduced to best practice minimum.[342] The figure overleaf shows that almost six in 10 managers in New Zealand find it difficult to fill jobs – the equivalent figure in Ireland is only two in 100 managers.

[339] These data come from the New Zealand
[340] Statistics New Zealand – Unemployment Rates: https://www.stats.govt.nz/indicators/unemployment-rate
[341] OECD, 2019. "OECD Economic Surveys: New Zealand". OECD, Paris.
[342] Adalet McGowan, M. and D. Andrews (2017), "Skills Mismatch, Productivity and Policies in New Zealand: Evidence from PIAAC", OECD Economics Department Working Papers; Calculations based on the OECD Survey of Adult Skills (PIAAC) (2012 and 2015).

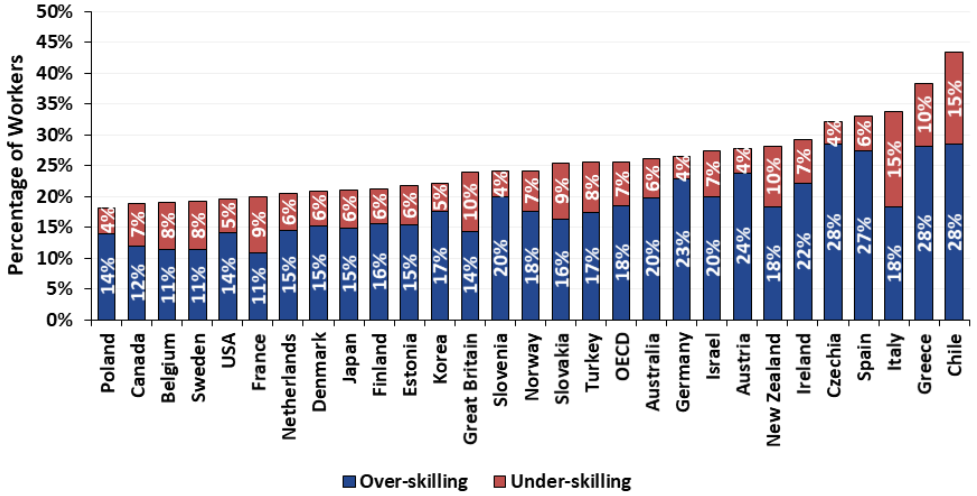
Firms Experiencing Skills Shortages in Various Countries in 2014



Source: Manpower Talent Shortage Survey (2014)[343]

The figure below shows the percentage of workers in New Zealand estimated to be either underskilled or overkilled for their job when their literacy skills accounted for, with 25% of New Zealand's works being mismatched compared to 7% in the OECD. New Zealand's proportion of overskilled is similar to the OECD average at 18%, whereas its percentage of underskilled is higher at 10% than the OECD's 7%.

Percentage of Workers with Literacy Skills Mismatch in 2012 and 2015



Source: Adalet McGowan and Andrews, 2017[344]

[343] OECD, 2016. "Getting Skills Right: Assessing and Anticipating Changing Skill Needs", OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264252073-en

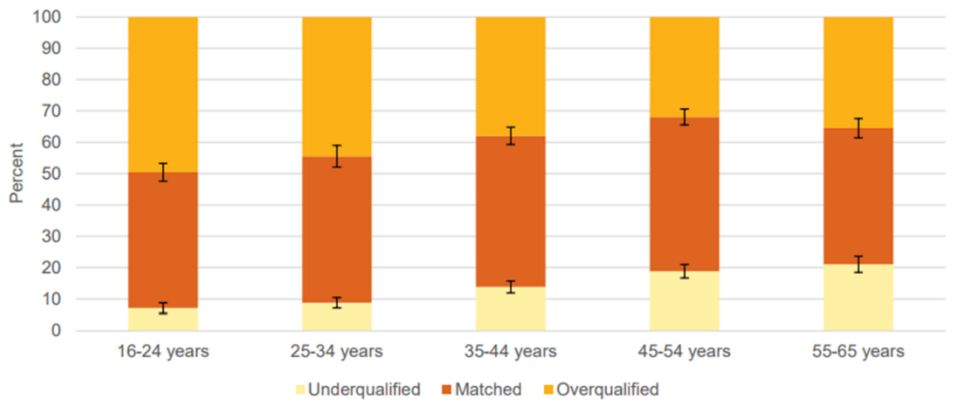
[344] Adalet McGowan, M. and D. Andrews (2017), "Skills Mismatch, Productivity and Policies in New Zealand: Evidence from PIAAC", OECD Economics Department Working Papers; OECD calculations based on the Survey of Adult Skills (PIAAC) (2012 and 2015).

A recent New Zealand Department of Education report has examined mismatch in the New Zealand Labour Market, finding that it is more concentrated at lower skill levels. The table below shows the distribution of underqualified, matched and overqualified New Zealanders by their highest qualification held, with 64% of the overqualified having upper secondary or Level 4 to 7 non-degree qualifications and 67% of the underqualified having no qualification or a school-level qualification.

Distribution of Matched and Mismatched New Zealanders by Highest Qualification			
	Underqualified	Matched	Overqualified
Lower secondary or below	36%	30%	NA
Upper secondary	31%	17%	25%
Level 4-7 non-degree	26%	17%	24%
bachelor's degree	7%	28%	21%
postgraduate	NA	9%	11%
Source: Ministry of Education New Zealand – Earle 2020[345]			

The figure below shows that younger workers aged 16-24 were most likely to be overqualified for their job compared to those at older ages, possibly reflecting younger works being in jobs they are overqualified for to gain more experience starting their careers. In contrast, older age groups more likely to be underqualified. Those aged 35-24 were the most likely to be matched to the qualification level needed to obtain their job.

Mismatching in New Zealand by Age Group

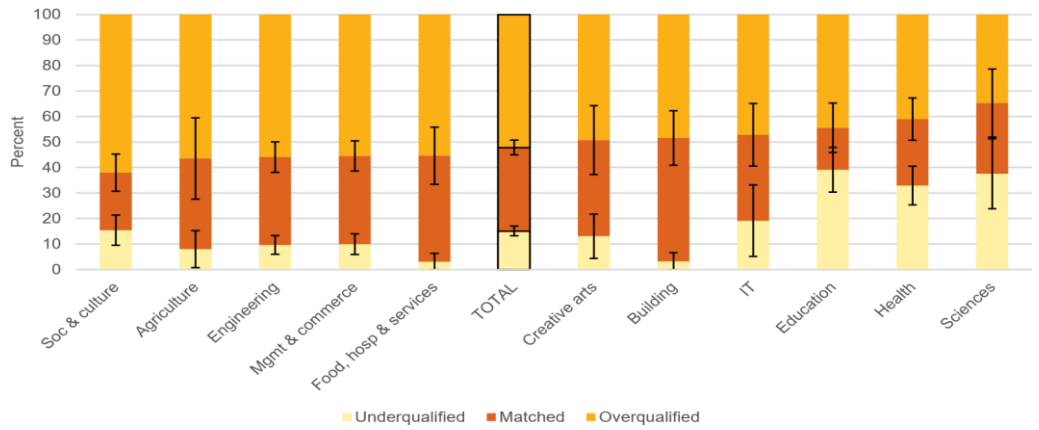


Source: Ministry of Education New Zealand – Earle 2020[346]

The figure overleaf shows the distribution of matched and mismatched employed New Zealanders with qualification levels from Level 4 to Level 7 non-degree by their field of study. Society and culture graduates were the most likely, and science graduates the least likely, to be overqualified, while health, education and science graduates were more likely to be underqualified for their job.

[345] Earle, D. 2020. "Qualification level match and mismatch in New Zealand Analysis from the Survey of Adult Skills". Available at: https://www.educationcounts.govt.nz/__data/assets/pdf_file/0006/198843/Qualification-match-and-mis-match-in-New-Zealand.pdf
[346] Earle, D. 2020. "Qualification level match and mismatch in New Zealand Analysis from the Survey of Adult Skills". See: https://www.educationcounts.govt.nz/__data/assets/pdf_file/0006/198843/Qualification-match-and-mis-match-in-New-Zealand.pdf

Distribution of Mismatched and Matched Employed with Level 4 to 7 Non-Degree Qualifications by Field of Study



Source: Ministry of Education New Zealand – Earle 2020[347]

Policy Responses/Initiatives

At the base of skills prediction in New Zealand is the use of a Computable General Equilibrium Model by the Ministry of Business, Innovation and Employment (MBIE) to develop yearly employment forecasts for industries, broad occupational and skills groups, which are underpinned by the macroeconomic outlook in the Consensus Forecasts of the New Zealand Institute of Economic Research.[348] These forecasts set the priorities for tertiary education and training for industry as well as the medium- to long-term employment outlook developed by the MBIE.[349] Essentially a Manpower Requirement Approach as used, in which forecasting the manpower needs of occupations is taken as a proxy for the forecasting of skill needs. Occupational shortages are identified via vacancy surveys, such as the Manpower Talent Shortage Survey[350] and New Zealand Quarterly Survey of Business Opinion,[351] wage pressure analyses and employer and stakeholder consultation, in ITOs and other fora.[352]

The skills information collected through vacancy surveys, consultative processes and through general labour market analyses, is used in New Zealand to update occupational standards, and to design vocational education and training programmes, such as apprenticeships.[353] Vacancy surveys are used in immigration policy, which is integrated into New Zealand's skills anticipation exercises.[354] New

[347] Earle, D. 2020. "Qualification level match and mismatch in New Zealand Analysis from the Survey of Adult Skills". See: https://www.educationcounts.govt.nz/__data/assets/pdf_file/0006/198843/Qualification-match-and-mis-match-in-New-Zealand.pdf
[348] These forecasts cover exports, imports and consumption growth. See OECD, 2017. "OECD Skills Strategy Diagnostic Report: Slovenia 2017."
[349] Ministry of Business, Innovation and Employment, 2019. "Medium to long-term employment projections: Looking ahead to 2028". Available at: https://www.mbie.govt.nz/assets/medium-to-long-term-employment-outlook-looking-ahead-to-2028.pdf
[350] http://downloads.manpowergroup.co.nz/talent-shortage-2018
[351] A New Zealand Institute of Economic Research survey of manufacturers, builders, architects, wholesalers and retailers, and service sector firms on general labour market and business conditions, including the difficulty in finding skilled and unskilled labour – https://nzier.org.nz/ABout%20QSBO/
[352] OECD, 2016. "Getting Skills Right: Assessing and Anticipating Changing Skill Needs", OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264252073-en
[353] OECD, 2016. "Getting Skills Right: Assessing and Anticipating Changing Skill Needs", OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264252073-en
[354] OECD (2016), Getting Skills Right: Assessing and Anticipating Changing Skill Needs, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264252073-en

Zealand has used migrants to fill skills shortages by advertising areas with shortages in the long-term, regional and construction and infrastructure skills shortage lists, briefly described in the box below.[355]

New Zealand Skills Shortages Lists
❑ **Long-Term Skills Shortage List:** identifies occupations with a sustained shortage of highly skilled workers across the entire country of New Zealand; ❑ **Regional Skills Shortage List:** identifies the regions with occupations experiencing immediate shortages of skilled workers. There are 15 regions in total; ❑ **Construction and Infrastructure Skills Shortage List:** identifies the immediate short-term skill shortages the construction labour market in the 15 regions that are used for the Regional Skills Shortage List and is designed to meet labour requirements of the construction industry across New Zealand
Source: Ministry of Education New Zealand – Earle 2020[356]

The production of these lists involves consultation with stakeholders such as employer groups, industry training organisations and trade unions, who submit proposals for areas where skills shortages need to be filled, which are then put on the relevant list if the MBIE believes there is sufficient evidence to support their inclusion. Evidence is compiled in a Preliminary Indicator Evidence Report for the occupation under consideration, or the occupation being reviewed if currently on the list, as the lists are updated twice annually.[357] Migrants with the skills in areas on the skills shortage lists are prioritised over those who do not have them.[358]

New Zealand Skills Strategy Action Plan launched in 2008, had goals including improving the use and retention of skills to transform workplaces, influencing the supply of skills through a more responsive education and training system, increasing employer and worker awareness of their skills needs and developing a unified approach to defining, valuing and measuring skills.[359] A number of initiatives were introduced in the following years, such as the Australian and New Zealand Standard Classification of Occupations (ANZSCO), a joint standard classification of occupations in New Zealand and Australia was created via a partnership between Statistics New Zealand and the Australian Bureau of Statistics to better define and measure skills and enable data between the two countries on areas with skills/jobs shortages to be compared.[360] The Labour Market Dashboard was developed, a publicly available database of information from 76 datasets various facets of New Zealand's labour market, including macroeconomic statistics (e.g., unemployment rates), workforce data (employment numbers by industry etc.) worker level data (employment and average income by age group, skills levels etc.), the amount of jobs advertised online both nationally and regionally.[361] Some initiatives were targeted at addressing skills shortages in specific areas, such as the Engineering e2e (education to employment) programme. This aimed to increase numbers of engineering graduates and people with engineering skills through the engineering pathways project in secondary education, degree courses in universities, degree apprenticeships in other training providers and micro-

[355] https://www.immigration.govt.nz/employ-migrants/explore-your-options/before-you-start-hiring-migrants/skill-shortages
[356] Van Breugel, G. 2027. "Identification and anticipation of skill requirements Instruments used by international institutions and developed countries". Available at: https://repositorio.cepal.org/bitstream/handle/11362/42233/S1700483_en.pdf?sequence=1&isAllowed=y
[357] https://www.immigration.govt.nz/about-us/policy-and-law/how-the-immigration-system-operates/skill-shortage-lists
[358] https://www.immigration.govt.nz/about-us/policy-and-law/how-the-immigration-system-operates/skill-shortage-lists
[359] New Zealand Skills Strategy Action Plan 2018 - https://www.beehive.govt.nz/sites/default/files/NZ-Skills-Strategy-Action-Plan-2008_0.pdf
[360] https://www.abs.gov.au/ausstats/abs@.nsf/0/8B1F5DDDD46033ABCA2575DF002DA75E?opendocument
[361] https://mbienz.shinyapps.io/labour-market-dashboard_prod/

credentials.[362] It achieved its initial target of 500 extra engineering graduates per annum by 2017.[363] New Zealand responded to shortages in STEM-related and other highly skilled professions resulted by expanding university places and reducing tuition fees for these areas.[364] The Vocational Pathways programme, outlined in the previous sub-section was also initiated.

The OECD believes that despite the Skills Strategy Action Plan and the actions arising from it, New Zealand needs a renewed strategic future vision to ensure all its people possess the skills enabling them to adapt to the challenges and opportunities of fast changing world.[365] The New Zealand vocational education system is currently undergoing major reform to create a "strong, unified, sustainable system for all vocational education that delivers the skills that learners, employers and communities need to thrive," the key elements of which are outlined in the box below.[366] There will be a stronger focus on employers to ensure the skills they require are delivered and that they are better supported in so that more of them engage in the vocational education system. The reforms intend to generate a greater consistency in vocational education across New Zealand, provide learners more support while training, and make learners movement between regions and from work based to provider-based training easier. Work-integrated learning is to be an increasingly important part of the vocational education system, granting learners the opportunity and flexibility to earn while in education and training that is more relevant to the constantly changing needs of the workplace.

Key Elements in the Reform of the Vocational Education System in New Zealand
❑ Creation of 4-6 industry governed Workforce Development Councils (WDCs) to provide greater leadership across vocational education; ❑ Establishment of Regional Skills Leadership Groups to give advice concerning regional skills needs to the Tertiary Education Commission (TEC), WDCs, and local VET providers; ❑ Establishment of Te Taumata Aronui to ensure that reform of vocational education reflects the Government's commitment to Māori Crown partnerships; ❑ The New Zealand Institute of Skills & Technology (NZIST) will merge the existing 16 Institutes of Technology and Polytechnics into one national body that is unified, sustainable, public network of regionally accessible vocational education. ❑ The role of supporting workplace learning will shift from ITOs to providers, with the NZIST and providers supporting workplace based, on-job training to ensure seamless integration between settings and industry needs. ❑ Centres of Vocational Excellence (CoVEs) will be established, bringing together the NZIST, providers, WDCs, industry experts and leading researchers to advance excellent provision of vocational education and share high-quality curriculum and programme design across the system. ❑ A unified funding for vocational education will be established and will involve all provider-based and work-integrated education at certificate and diploma qualification Levels 3 to 7 (the latter excluding degree study) as well as the entirety of industry training.
Source: https://conversation.education.govt.nz/conversations/reform-of-vocational-education/ ***Note: A number of other reform changes are being designed with engagement and input from stakeholders.***

[362] http://engineeringe2e.org.nz/assets/e2e/infosheetpdfs/adea0b034d/e2e-who-we-are-jul-2018.pdf
[363] http://engineeringe2e.org.nz/about/background-and-issues/
[364] OECD, 2016. "Getting Skills Right: Assessing and Anticipating Changing Skill Needs", OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264252073-en
[365] OECD, 2019. "OECD Skills Strategy 2019 – Skills to Shape a Better Future: New Zealand".
[366] https://conversation.education.govt.nz/conversations/reform-of-vocational-education/

A 2016 survey of New Zealand workers found that 87.5% either disagreed or strongly disagreed that "smart technology, artificial intelligence, robotics or algorithms" would take their jobs.[367] This is despite a 2015 estimate that up to 46% of jobs in New Zealand are at risk from automation by 2030, with 60% of Jobs having at least 30% of activities that could be automated, with construction, retail, administration, and healthcare and social services most likely to be affected.[368] A more recent estimate puts the number of jobs at risk from automation at 24% by 2030, the 6th lowest of the 28 countries analysed, largely due to a high concentration of jobs in areas that are difficult to automate.[369] Despite this, the same research estimates that 39% of jobs for those low education levels are at risk from automation by 2030, in contrast to 11% of jobs for highly educated people, underscoring the importance of re-orientating the education and training system to cope with technology and the challenges posed by climate change. Construction, retail, administration, and healthcare and social services are likely to be most affected by automation.[370]

Recently the New Zealand Productivity Commission produced a report highlighting the importance of technological change to the future of work,[371] along with a series of reports including one on reforming New Zealand's tertiary education to reflect the future world of work.[372] The latter found that New Zealand's current tertiary education system is not sufficient to respond to uncertain future trends and greater learner diversity, does effectively engage with those in the workforce who have missed tertiary education and is not sufficiently student focused, with over-centralisation stifling freedom to innovate. It recommended that New Zealand's government create a funding system more reflective of student demand, rewarding providers that perform well in adding value to students. To do this, funding should be extended to providers for students not perusing full qualifications, in order to further the uptake up training schemes and micro-credentials, as well as a lifting of restrictions on loan applications for students studying part time or for small courses (such as micro-credentials).

As stated previously, the NZQF was partially designed to allow for easy transfer of credits between different types of education provider.[373] Providers are required to have systems in place for recognising previous education and training and that any credits they award should be portable by learners from one qualification to another. Courses should be designed in order to take account of this. When deciding on issues surrounding the transfer of credits, the key consideration should be how the decision benefits learners and enhances pathways. In some areas, links have been forged between New Zealand universities and vocational education providers. An example of this is the Bay of Plenty Tertiary Education Partnership between the Te Whare Wananga o Awanuiarangi (a Māori institution) the Toi Ohomai Institute of Technology and the University of Waikato.[374] This enables these institutions to explore opportunities to work collaboratively to provide higher education pathways, increase the range of educational programmes and qualifications offered, and work together on research that is relevant to its region. Individuals can also transfer credits obtained at other institutions towards a University of Waikato qualification.[375]

[367] https://www.massey.ac.nz/massey/about-massey/news/article.cfm?mnarticle_uuid=66BFEE31-CEA2-AC52-7029-08F2998BAB8D
[368] NZIER and Chartered Accountants Australia and New Zealand, 2015. "Disruptive Technologies, Risks and Opportunities – Can New Zealand Make the Most of Them?"
[369] PWC, 2018. "Will robots really steal our jobs? An international analysis of the potential long term impact of automation".
[370] The Sustainable Business Council, 2019. "Future of Work: are you equipped to lead your organisation to thrive in the new realities of work?" Available at: https://www.sbc.org.nz/__data/assets/pdf_file/0009/162495/14022019-FoW-Boardroom-think-piece.pdf
[371] New Zealand Productivity Commission, 2019. "Training New Zealand's workforce. Technological change and the future of work," Draft report 3
[372] New Zealand Productivity Commission, 2017. "New Models of Tertiary Education". Available at: https://www.productivity.govt.nz/assets/Documents/2d561fce14/Final-report-Tertiary-Education.pdf
[373]https://connections.etf.europa.eu/wikis/home?lang=en#!/wiki/Wf591e43b607e_4ccf_8d94_a3256a255147/page/New%20Zealand%20-%20NQF%20Inventory
[374] https://www.toiohomai.ac.nz/about/our-partnerships
[375] https://www.waikato.ac.nz/study/apply/credits-and-transfers

In 2018 the New Zealand Qualifications Authority introduced training schemes and micro-credentials to the tertiary education system. Training schemes are a set of coherent learning or training, based on linked aims, outcomes, content and assessment practices, worth up to 40 credits, leading to an award but not a qualification on the NZQF.[376] A micro-credential is a certificate of achieving a specific set of currently unmet skills and knowledge, worth 5-40 credits. To create a new micro-credential, an education/training provider submits a proposal, which includes evidence that the micro-credential is required or supported by relevant industries, employers and communities, that it is meeting a specific unmet skill need and is not duplicating an existing NZQF qualification.[377] Names of training schemes and micro-credentials must not include protected qualification terms such as "New Zealand Certificate", "diploma" or "degree". Micro-credentials are reviewed annually to see if the skills shortage they are purporting to address have been met – if so, they are discontinued. Though micro-credentials are seen to provide greater incentives to workers to upskill, some New Zealand universities have expressed concern that such courses are making the qualifications system opaque, affecting foreign students' ability to discern between full degrees and micro-credit courses.[378]

Conclusions

New Zealand's has historically had a tight labour market characterised by low unemployment levels, which has in part resulted in skills shortages, which New Zealand traditionally turned to emigration to meet. Skills anticipation is largely based on predicting needs in different occupations and industries, and heavily involves employers, either through surveys or consultations. Employers have historically, via ITOs, had a key role in the selection and design of areas where training courses and apprenticeships should arise, which is to be enhanced in the new vocational education system reforms in the creation of WDCs. Micro-credentials have been formally integrated into the official qualifications system in New Zealand, in order to meet current skills gaps, confront automation risks and enhance lifelong learning. Care must be taken to ensure that micro-credentials are not "diluting" the value of traditional qualifications and are not causing confusion among perspective international students, given the importance of international students in the funding of universities in countries such as Ireland.

[376] https://www.nzqa.govt.nz/providers-partners/approval-accreditation-and-registration/micro-credentials/guidelines-training-scheme-micro-credential/
[377] NZQA, 2020. "Guidelines for applying for approval of a training scheme or a micro-credential". Available at: https://www.nzqa.govt.nz/assets/Providers-and-partners/Micro-credentials/guidelines-training-schemes-micro-credentials.pdf
[378] https://www.stuff.co.nz/national/education/109497958/nzqa-wants-to-make-microcredentials-official-what-are-these-nanodegrees-worth

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