

Learning to grow

How to situate a skills strategy in an economic strategy

Rui Costa, Zhaolu Liu, Sandra McNally, Louise Murphy, Christopher Pissarides, Bertha Rohenkohl, Anna Valero & Guglielmo Ventura

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The Economy 2030 Inquiry

The Economy 2030 Inquiry is a collaboration between the Resolution Foundation and the Centre for Economic Performance at the London School of Economics, funded by the Nuffield Foundation. The Inquiry's subject matter is the nature, scale, and context for the economic change facing the UK during the 2020s. Its goal is not just to describe the change that Covid-19, Brexit, the Net Zero transition and technology will bring, but to help the country and its policy makers better understand and navigate it against a backdrop of low productivity and high inequality. To achieve these aims the Inquiry is leading a two-year national conversation on the future of the UK economy, bridging rigorous research, public involvement and concrete proposals. The work of the Inquiry will be brought together in a final report in 2023 that will set out a renewed economic strategy for the UK to enable the country to successfully navigate the decade ahead, with proposals to drive strong, sustainable and equitable growth, and significant improvements to people's living standards and well-being.

The Pissarides Review into the Future of Work and Wellbeing

Automation technologies are transforming work, society and the economy in the UK in ways comparable to the Industrial Revolution. The adoption of these technologies accelerated through the COVID-19 pandemic, with impacts unevenly distributed. The Pissarides Review into the Future of Work and Wellbeing will research the impacts of automation on work and wellbeing and analyse how these are differently distributed between socio-demographic groups and geographical communities in the UK. It is a collaboration between the Institute for the Future of Work (IFOW), Imperial College London and Warwick Business School, and supported financially by the Nuffield Foundation. See pissaridesreview.ifow.org.

The Nuffield Foundation

The Nuffield Foundation is an independent charitable trust with a mission to advance social well-being. It funds research that informs social policy, primarily in Education, Welfare, and Justice. It also funds student programmes that provide opportunities for young people to develop skills in quantitative and scientific methods. The Nuffield Foundation is the founder and co-funder of the Nuffield Council on Bioethics and the Ada Lovelace Institute. The Foundation has funded this project, but the views expressed are those of the authors and not necessarily the Foundation. Visit www.nuffieldfoundation.org.

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Executive summary

Investing in human capital is a crucial aspect of building an economy that is both more productive and fairer, and any growth strategy must incorporate an agenda for increasing human capital and workforce skills within that. But this way of thinking about skills policy – i.e. explicitly in the context of a broader economic strategy – means doing more than simply seeking to accommodate evolving demand.

So how should we approach the task of developing a skills strategy that complements a broader economic strategy? In this report, we address this issue by focussing on a set of sectors – Financial and business services, The creative and cultural sectors and Life sciences industries – and technologies – clean technologies and artificial intelligence – that are of strategic importance for the UK. We set out whether the UK has an appropriate skill base given our existing strengths, and ask whether the future demand and supply of skills will need to change given these strategic sectors and technologies, and what policies will be needed to make this happen. Two companion reports focus on skills policy for young people who do not go to university, and on essential reforms for higher education.

The strategic sectors are good places to work for everyone

Previous Economy 2030 Inquiry analysis has identified a range of key sectors of strategic importance for the UK's future growth. These 'strategic sectors' – Financial and business services, The

creative and cultural sectors and Life sciences industries –are areas where the UK has longstanding strength and areas that are projected to grow globally. Crucially, it is striking – and very welcome for a country striving to achieve growth that benefits all parts of society –that wages are higher, and wage-experience trajectories steeper, for workers at every level of educational qualification in these strategic sectors than in the rest of the economy. For example, workers in these sectors with no more than GCSEs (i.e. Level 2 or below) earn more than someone with sub-degree level qualifications (Level 4-5) in other sectors, and there is more progression too (average annual earnings for Level 2-skilled workers in these sectors more than double over the course of their careers, growing by 2.1 times against only 1.7 times if employed in the rest of the economy). This suggests that these ‘strategic sectors’ are a source of ‘good jobs’ even for low-educated workers, and is another reason to welcome growth of these sectors in the economy.

The strategic sectors have higher skill requirements and tend to employ more highly educated workers

Supporting the expansion of these strategic sectors to boost growth and spread good jobs means ensuring that current and future workers across the country possess the right mix of skills to effectively perform the required tasks. Within these sectors, there is a particularly strong emphasis on ‘analytical tasks’ (e.g. data analysis and interpretation or thinking creatively) and ‘personal tasks’ (e.g. personal relationships, coaching others). This reflects the occupational profile of these sectors, where half of those employed are either in managerial or professional roles associated with higher levels of education; the importance of these roles has grown across the economy, but particularly within the strategic sectors.

Additionally, certain ‘common’ skills categories that are emphasised in job adverts across the economy are particularly important within the strategic sectors, and increasingly so. These include skills such as initiative and leadership, critical thinking and problem solving and social skills. Looking in more depth at categories of specialised skills which, by their nature, vary more across sectors, we again find that these are in general in higher demand in the strategic sectors. As we might expect, skills such as

IT, marketing, media and communications particularly important in The creative and cultural sector; finance, business and customer support standing out in Finance and business services; and IT, engineering, law, regulation, analysis, manufacturing and science and research are particularly prevalent in Life sciences industries.

Overall, our analysis points to the growing importance for these sectors of both general and specific skills that are typically acquired with more formal education. It is thus unsurprising to see that workers employed in the strategic sectors are much more educated than average, with the proportion of workers holding a university degree almost twice as high as the rest of the economy and growing over the last years.

There are challenges that need to be overcome to ensure the right skills are in place, as indicated by the enormous wage premium attached to university degrees

However, there are worrying signals that the current skill mix of workers in the sector may not be adequate. The clearest indicator that demand exceeds supply for skills is the high wage premium associated with higher levels of education. This is clear throughout the educational distribution, and reflects the ongoing need for educational upgrading, such that more people leave the education system with higher education and skills. There are also steeper returns to labour market experience in the strategic sectors compared to the rest of the economy.

The large gap in the wage-experience trajectory for workers with university degrees compared to workers with education below that shows that the skills possessed by graduates are particularly in high demand. Of course, there will be variation by type of degree and differences in the trend of the grade wage premium across regions, but the most salient fact when considering the future needs of the economy is that the average wage premium attached to a university degree is enormous, and is even higher within strategic sectors. Without a sustained upgrading of the education and skills of workers, the economy will be unable to grow, especially in strategic sectors.

There is also evidence of a need for more sub-degree qualifications

There is also a wage premium associated with doing sub-degree qualifications, which in the English context are qualifications at Level 4 (e.g. Higher National Certificate,) and Level 5 (e.g. Higher National Diploma). This premium is more modest and varies between sectors, being relatively high within Life sciences industries but very small within Finance and business. For The creative and cultural sector, the premium exists for the first 10 years of workers' careers, before it becomes aligned with the level below (i.e. A-levels or equivalent, or Level 3).

The potential need for more of these sub-degree qualifications is seen more clearly when we benchmark the qualifications actually held by workers in these sectors against the underlying educational requirements, as measured in the skills taxonomy derived in the US (O*NET) and translated to UK occupations. This suggests a massive shortage of people with sub-degree qualifications in the strategic sectors and an oversupply of people whose highest qualification is at most A-Levels or equivalent qualifications. Based on the educational requirements measured in O*NET, the current share of workers qualified at sub-degree level in these sectors (7 per cent) should be almost three times higher. The sorts of occupation where too few people have sub-degree qualifications include managerial roles within business and finance, ICT professionals and IT technicians within the creative and cultural sector, and technical roles within Life sciences industries.

The shortage of people with sub-degree qualifications is not confined to the strategic sectors. In the UK, only 9 per cent of 25-64-year-olds hold a sub-degree qualification, and this figure is much lower among younger cohorts. This is lower than in other countries with a similar economic profile in Europe such as France (15 per cent) and in other Anglo-Saxon countries such as Australia (18 per cent) and Canada (36 per cent).

Strategic technologies require high skill levels as well as adaptability

Apart from the focus on strategic sectors, a consideration of broader trends and transitions in the UK's economy also highlight the need for workers with higher levels of skill. In particular we look at the challenges presented by decarbonisation of the economy, in line with net zero commitments; and ongoing digitalisation, in light of the latest wave of generative AI.

As we saw in the case of the strategic sectors, green occupations – those jobs involving new tasks and skills due to the net zero transition – tend to involve a relatively high share of analytical tasks and personal tasks, which are in turn associated with occupations requiring a higher level of education. This is in contrast to 'brown jobs' – jobs prevalent in high emissions sector that urgently need to change – in which routine and physical tasks have a higher prevalence. Analysis of job adverts also reveals that specialised skill requirements are also more prevalent in green jobs than non-green jobs, in areas such as science and research, the environment and energy and utilities. But there are some exceptions for brown jobs, where engineering, manufacturing and construction skills stand out. This suggests that ensuring that skills needs are met will be key to delivering net zero, ensuring that transitions (particularly for those exiting 'brown' jobs) are managed well, and for realising new opportunities for firms producing innovative net zero goods and services to meet growing global demand.

AI is likely to imply change across a broad range of occupations. First, looking at job adverts shows that IT skills are the category that sees the highest share of new skills being demanded (those that appear for the first time or seeing a particularly rapid increase in demand) and also of old skills disappearing. Within IT, AI is one of the largest categories of new skills. In the latest data, 80 per cent of occupations have job adverts that require new IT skills. The rate of churn in IT-related skills, and the extent of their relevance across the economy, suggests that future cohorts of workers will need their education to provide them with flexibility and resilience to change, and that current cohorts of workers will need opportunities to update their skills.

Why is there a skills gap?

Our analysis shows that, despite the UK's success in increasing the number of graduates, there are still too few graduates for the needs of the workplace, too many people with low levels of skills and qualifications, and far too few with the skills associated with tertiary-level education. This is true across the economy, but is starker within strategic sectors and those most exposed to new technologies.

What is particularly puzzling is why there are so few workers with sub-degree qualifications, given the apparent demand. This was a key question asked by the Augar Review (the Review of Post-18 Education and Funding). The main explanation given was the unequal treatment of different types of tertiary education within the student finance system, which led to the announcement of a Lifetime Loan Entitlement from 2024.

Another reason for the skills gap is the fall in workplace training, which has fallen over recent decades across all education groups. These issues are common across the whole economy, but particularly affect the strategic sectors. Given the high demand for skills, it is on the face of it surprising that employers are reducing investment in their workers. The most plausible explanations are that employers are sensitive to the risk that workers with general, transferrable skills will simply move elsewhere, meaning that an individual employer will not recoup the costs of their investment, and that training is a discretionary expenditure that is easy to cut when economic conditions are not favourable. Whatever the reasons, we need to do better.

A range of policy reforms are needed as part of a human capital strategy

Other than hiring overseas workers, there are two main routes to increasing the level of education and skills in the economy. These are improving the inflow to the workforce, and upskilling the existing workforce. The former is easier for policy to affect (because young people spend so much more of their time in education) and makes sense in the light of arguments that 'skill

begets skill' (i.e. the acquisition of skills earlier in life facilitates the acquiring of skills later on).

Here, we discuss four directions for policy – two affecting the flow, and two affecting the stock of existing workers – that have particular relevance in the light of our case studies, although they have broader application to the economy overall. These are:

- having more tertiary-educated young people;
- enabling more sub-degree qualifications;
- encouraging employers to invest more in their staff; and,
- empowering individuals to undertake lifelong learning.

A companion report for the Economy 2030 Inquiry deals with the specific challenges of providing better non-tertiary further education and apprenticeships.

Increasing the inflow of tertiary-educated entrants to the labour market should be a priority...

Having more tertiary-educated workers requires human capital investment from the earliest stage onwards. This inevitably requires more public spending on education, with an expectation that this should increase over time, given the economic and social return on investment. This would be a reversal of trends over the last 15 years, where educational investment from the state has declined not only as a share of GDP but even in real terms.

Until recently, higher education has fared well, thanks to the student finance reforms in 2012-13, but the positive impacts of this reform are gradually being unwound, leading to hard times for both institutions and students. For universities, fees are stuck in nominal terms while costs keep rising. For students, grants to cover maintenance have not increased with the cost of living. We cannot expect a massive increase in tertiary education without these two issues being addressed (a separate report for the Economy 2030 Inquiry considers in more depth how higher education could be reformed).

...as well as enabling more sub-degree qualifications and a better integrated system

As we noted above, the new Lifetime Loan Entitlement – which will allow students a loan entitlement to the equivalent of four years of post-18 education to use over their lifetime – should remove the incentive for students and institutions to systematically favour university degrees over sub-degree qualifications. This is a very welcome policy development.

But it is as yet uncertain how this reform will play out. There are two risks. First, universities may not create the type of modular provision in which ‘lifetime’ education is really that practical (there are many types of course in which a long break between modules is not appropriate). Second, four years may turn out not to be long enough, given that a university degree is three years, especially if the expectation is that people might do more than one tertiary-level qualification over their lifetime.

The Government is also creating new higher technical qualifications, in collaboration with employers, which should help to address the supply issue. But our analysis of current employer demand suggests that the creation of new sub-degree qualifications is far more important in some sectors than others. For example, there is a large pay premium in Life sciences industries (suggesting excess demand) but not within business and financial services. Within the creative and cultural sector, there is a pay premium for the first 10 years. This illustrates the importance of developing future qualifications with representative groups of employers and not assuming that the demand exists everywhere.

It is also important that students (as well as their parents and teachers) understand how sub-degree qualifications fit into the broader educational landscape, as well as to the labour market. It cannot help the demand for these qualifications that many people will not know anyone else who has undertaken them. The explanation of routes through the education system and into the labour market is not only for national government (that provides the framework) but also for local government, and for schools and

colleges. There should be a real possibility of moving between different levels of education to avoid sub-degree qualifications being seen as a glass ceiling on aspirations.

To improve training for the existing workforce, we need to incentivise employers more to invest in their workers...

As highlighted already, we expect that employers would underinvest in training their workforce if they are unable to recoup all of the benefits through worker turnover. Currently, there are very few policy levers that incentivise employers, outside the apprenticeship levy. We propose that incentives that are currently used to promote research and development also be extended to people, via 'human capital tax credits'. These are currently used in Austria and some US states. As proper implementation is so important for such policies (particularly to prevent fraud and error), a targeted and experimental approach here would be a better policy response than radical change across the whole economy, and we suggest that this mechanism be trialled initially in areas where training is in high demand, and in specific contexts (such as net zero).

...and to facilitate lifelong learning for individuals

Among the barriers faced by individuals to upskill through their lifetime are the difficulties in affording it, the availability of affordable childcare and the ability to take time off work. However, the evidence and experience does not point to a single approach that will address all of these issues.

Individual Learning Accounts are a commonly used vehicle to make it easier for individuals to afford training. The idea is that workers have a certain amount of money in these accounts to pay for training, which does not necessarily have to be funded only by public expenditure. For example, a proposal for individual learning accounts in the US suggests that these could be funded through shared investment by employers and workers, as well as government. Such accounts might offer flexibility, enabling workers to access short-term training opportunities throughout their career. Recent examples of individual learning accounts include Singapore, which recently established these for each

citizen over the age of 25 to spend on education and training programs from a list of 500 approved providers, and France, where they were established in 2015 (workers can use these to pay for 24 hours of training per year over eight years in a wide variety of programmes).

However, the UK's experience in the early 2000s shows that such policies can face formidable implementation problems, so we recommend that such a policy should be piloted and evaluated over, say, five years, before any broader implementation.

The potential prize: a double dividend of higher growth and lower inequality

This report has showed how to think about education and skills policy within the context of an overall economic strategy. We have done this by focusing on what policies are needed to generate growth in the strategic sectors, and to facilitate the successful adoption of strategic technologies. A focus on these case studies reveals high and growing demand for skilled workers, particularly at the tertiary level. In reality, this is not qualitatively different from those required in the economy at large.

The potential prize of expanding these areas of the economy is large. It may lead to a double dividend – a significant contribution both to our overall growth performance (enabling more growth of strategic sectors and higher productivity within them) and a potential reduction of inequality. The latter may be possible because these sectors provide better-paid jobs even for those with lower-level qualifications and because if we can substantially increase the level of education and skills overall, the premium at the top end (which reflects excess demand) might ultimately reduce.

Section 1

Introduction

Investing in human capital is a crucial aspect of building an economy that is both more productive and fairer, and any growth strategy must incorporate an agenda for increasing human capital and within that workforce skills. But how should we think about developing a skills strategy that complements a broader economic strategy?

We often think of skills strategies as being informed by attempts by the public sector to predict the skills that will be required by businesses; local and sector-specific skills strategies also undertake similar exercises. But thinking about skills policy in the context of a broader economic strategy means doing more than simply seeking to accommodate evolving demand. Instead, a key aim of this paper is to understand whether the UK has an appropriate skill base given our existing strengths, and to ask whether the future demand and supply of skills will need to change as the economy pivots towards these strengths. These proposals should be considered alongside reforms the Economy 2030 Inquiry has previously put forward across public investment, tax, finance and governance, planning, and business support that can raise investment, improve productivity and reduce inequality in the UK.

To do this, we build on previous Economy 2030 Inquiry analysis that has identified a range of key sectors and technologies of strategic importance for the UK, and considers what an aligned skills agenda should look like given these sectoral strengths. In particular, these ‘strategic sectors’ – Financial and business services, The creative and cultural sectors, and Life sciences industries – are areas where the UK has longstanding strength and that are projected to grow globally.¹ The ‘strategic technologies’, on the other hand, permeate across the whole economy, but are likely to lead to considerable change in what skills are required. We focus on clean technologies – where the UK must invest across sectors to meet net zero commitments, build resilience, and leverage areas of technological expertise to access growth opportunities – and artificial intelligence – a

¹ The definition of ‘strategic sectors’ comes from: J De Lyon et al., *Enduring Strengths: Analysing the UK’s current and potential economic strengths, and what they mean for its economic strategy at the start of the decisive decade*, Resolution Foundation, April 2022.

general-purpose technology that will change the nature of work across the economy, and where the UK has also contributed to innovation at the frontier. Although many of the challenges of improving education and skills are similar in strategic sectors and technologies as in the rest of the economy, considering these issues through this lens helps focus attention on how a skills agenda can reinforce wider economic strategy.

The rest of the report is organised as follows:

- Section 2 defines in more detail what we mean by ‘strategic sectors’ and ‘strategic technologies’, based on priority areas that we have identified in previous Economy 2030 Inquiry reports.
- Section 3 show that those working in strategic sectors receive a large and lasting wage premium, including for lower-skilled workers. The growth of strategic sectors is itself likely to mean the spread of ‘good jobs’.
- Section 4 analyses the task content and skill requirements of occupations in the strategic sectors, finding that the strategic sectors have higher skill requirements than the rest of the economy. Consistent with this, they also tend to employ more educated workers.
- Section 5 sets out challenges that need to be overcome. It shows that, given the occupational make-up of the UK’s strategic sectors, there is already an extremely large skill gap in the current workforce. Put simply: the UK has a massive shortage of workers educated to sub-degree level and far too many workers whose highest qualification is at A-level or equivalent or below. Moreover, the UK has been travelling in the wrong direction over recent years, with falling numbers reaching sub-degree level, at the same time as the demand for these skill levels has been growing and is very likely to continue to do so.
- Section 6 considers how the deployment and development of key strategic technologies – those relevant for net zero, and AI – suggest a greater need for higher level and technical skills in education, plus significant skill updating for existing workers.
- Section 7 we examine the factors that have led to the large skill gap and set out a range of policy directions that together would help to resolve it.
- Section 8 concludes by arguing that, as severe as this challenge is, it sets up the possibility of a potential double-dividend in the years ahead: a more ambitious and better aligned skills strategy would make both a significant contribution to raising productivity and growth in strategic sectors at the same time as it pushes against wage inequality and spreads good jobs.

This report complements other Economy 2030 reports that look specifically at the challenges of improving opportunities for those pursuing non-tertiary vocational education and higher education and an earlier report that analysed economy-wide changes in skill demand and training.²

² D Willetts, [How higher education can boost people-powered growth](#), Resolution Foundation, October 2023; R Layard, S McNally & G Ventura, [Applying the Robbins Principle to Further Education and Apprenticeships](#), Resolution Foundation, October 2023; and N Cominetti et al., [Train in vain?: Skills, tasks and training in the UK labour market](#), Resolution Foundation, December 2022.

Section 2

Identifying strategic sectors and technologies

This section describes the strategic sectors and technologies that we analyse in the report. It builds on Economy 2030 analysis that identifies sectors and technologies that should be important to the UK's economic strategy. Strategic sectors include Financial and business services, The creative and cultural sector and Life sciences industries, all areas where the UK has a longstanding competitive advantage and where global trade is set to increase. Strategic technologies include net zero and AI technologies, the deployment of which will affect sectors across the economy, and where the UK enjoys some technological advantage.

The UK has enduring strengths in growing sectors which should be exploited as part of a growth strategy

The UK is a service-exporting superpower. In value terms, UK services exports are second only to the US, and the UK stands out for having a larger share of exports in services compared to similarly-sized economies (such as Germany, France or Italy).³ The economic importance of the UK service sector is also expected to grow.⁴

The UK's specialisation in services, is broader than is sometimes presumed. The Revealed Comparative Advantage (RCA)⁵ in services extends beyond finance to business-oriented services including insurance and pensions, 'other business services' (law, accounting,

³ J De Lyon et al., [Enduring Strengths: Analysing the UK's current and potential economic strengths, and what they mean for its economic strategy at the start of the decisive decade](#), Resolution Foundation, April 2022.

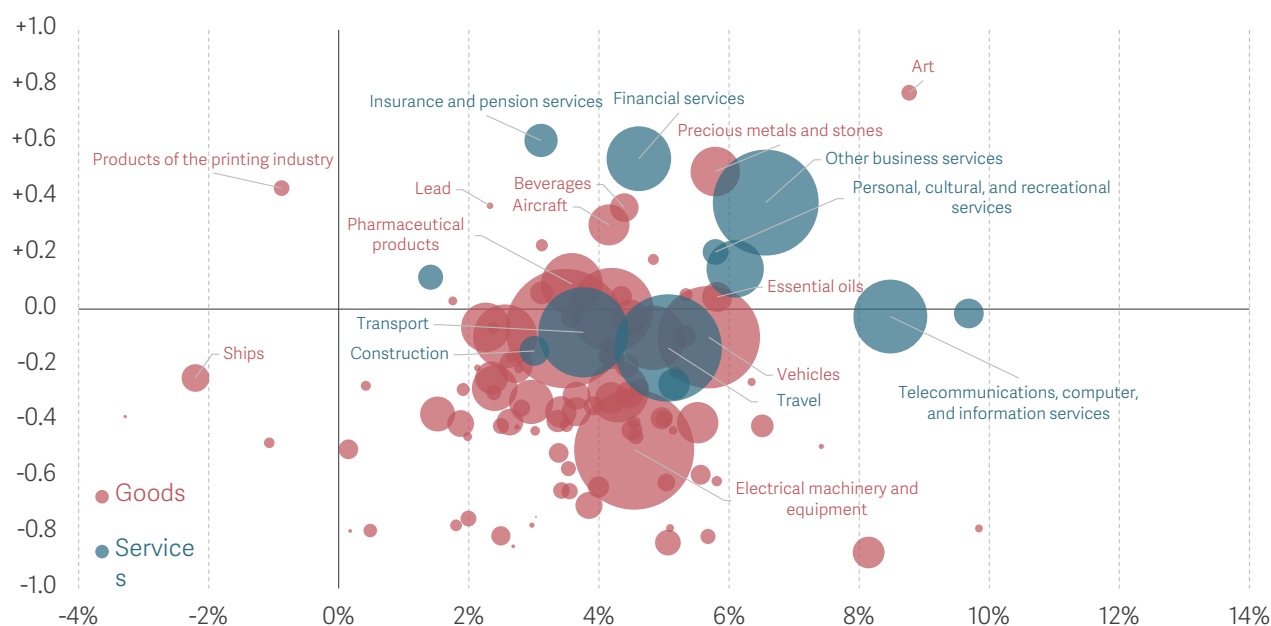
⁴ See for example, R Wilson et al., [The Skills Imperative 2035: Occupational Outlook—Long-run employment prospects for the UK](#), National Foundation of Education Research, Working Paper 2-headline report, October 2022.

⁵ The Revealed Comparative Advantage (RCA) measures how specialised a country is in exporting specific goods or services compared to a reference group. In this case we take as a benchmark the rest of the world. RCA is computed by comparing the fraction of a country's total exports accounted by a specific good or service category with the corresponding fraction of global total export. The measure is then adjusted to be between -1 and +1 with numbers larger than zero indicating that the UK exports more of that category than the rest of the world, meaning that it has a positive comparative advantage. See Box 1 in J De Lyon et al., [Enduring Strengths: Analysing the UK's current and potential economic strengths, and what they mean for its economic strategy at the start of the decisive decade](#), Resolution Foundation, April 2022.

consulting, advertising, technical and scientific services), and personal, cultural and recreational services. In Figure 1, the positive values on the vertical axis show sectors where the UK has RCA.⁶ The UK is also specialised in the manufacturing of certain goods categories, notably pharmaceutical products, where the UK accounts for 2.5 per cent of global exports. Importantly, these sectors are also those where there has been growth in worldwide trade over the past decade (as shown on the horizontal axis), and some – particularly ‘other business services’ are quite large areas of global trade (represented by the size of the bubbles). As in other countries, the UK’s comparative advantages are persistent over time. The Economy 2030 inquiry has argued that a growth strategy must build on these ‘enduring strengths’ in sectors that are growing or are set to grow globally.

FIGURE 1: The UK is specialised in a broad range of service categories with an advantage also in some goods

Revealed comparative advantage and 10-year annualised growth in global export value by product category: UK, 2019



NOTES: Bubble size is proportional to the share of total global export value. The horizontal axis measures compound annual growth rates (CAGR) of volumes between 2009 and 2019. The vertical axis shows the revealed comparative advantage in 2019. The size of the bubbles corresponds to each product’s share in world trade in 2019.

SOURCE: Analysis of Harvard Growth Lab, Atlas of Economic Complexity (HS version) and OECD-WTO, Balanced Trade in Services.

⁶ Figure 1 first appeared in: J De Lyon et al., *Enduring Strengths: Analysing the UK’s current and potential economic strengths, and what they mean for its economic strategy at the start of the decisive decade*, Resolution Foundation, April 2022.

In this report, we focus on three of these ‘strategic sectors’:⁷ Financial and business services; The creative and cultural sector and the Life sciences industries. Short definitions are provided in Box 1 (with more exact definitions in the Annex).

Table 1 sets out the types of economic activity included within the strategic sectors on which the bulk of analysis in this briefing note is based.

TABLE 1: Overview of industries in three strategic sectors

Key sub-sectors included in the strategic sectors for the purposes of our analysis

Financial and business services	The creative and cultural sector	Life sciences industries
Financial activities	Publishing	Pharmaceutical manufacturing
Insurance activities	Software and video-games	Biotechnologies
Accounting and auditing activities	Computer programming and consultancy	Manufacturing medical equipment
Legal activities	Film and TV production	
Business and management consulting	Music industry	
Technical consulting	PR activities	
R&D activities	Architecture and Design	
Market research	Advertising	
	Tertiary education	

1. Financial and business services

This includes finance, insurance and pensions and ‘other business services’, covering legal, accounting and auditing services, business and marketing

consulting activities and technical support activities such as engineering consulting. These activities accounted for nearly 30 per cent of UK exports in 2019, a much higher share than in

⁷ These are the areas selected for case studies in previous work. We take the categories available in the international trade data as the starting point, but for working at the sector level, we take standard classifications as set out in Box 1.

the US, France, or Germany. Business services other than finance and insurance represent the lion's share of these exports and are those that have experienced fastest growth, and they also made the largest contribution to the economy in this category (professional, scientific and support activities made up 12.5 per cent of GVA in 2021, compared to 8.1 per cent for finance and insurance).

2. The creative and cultural sector

This includes those creative sectors that provide tradable services in which the UK has an RCA. The sector includes ICT activities, publishing, music and audiovisual production and distribution, advertising, design and architecture as well as Tertiary education, which we consider as a tradable service (nearly 20 per cent of UK universities enrolment in 2019 were international students) and as a strategic sector, given its contribution to the UK's international standing and the role it plays in fostering research and innovation.⁸ The creative and

cultural sector accounted for nearly 7 per cent of UK exports in 2019 (second only to the US). This sector also plays an increasingly important role in the UK economy: using the government's official definition, creative industries accounted for 6 per cent of GVA in 2019 and have grown faster than the rest of the economy since 2011.⁹

3. Life sciences industries

The UK has an RCA in pharmaceutical products, which in 2019 accounted for 3 per cent of UK exports and 1 per cent of total UK gross value added. Pharmaceutical manufacturing sits at the centre of broader Life sciences industries including medical technologies and biotechnologies. These are R&D intensive sectors where the UK has technological specialisation.¹⁰ Although the UK is a leader in R&D investment in health, partly thanks to the NHS, the pharmaceutical industry's global supply chain locates most of the (more labour-intensive) production in India or China.¹¹

These sectors make an important contribution to UK exports, and together account for a large and growing share of gross value added (GVA) and employment (Figure 2). Financial and business services account for nearly 30 per cent of UK exports (2019), 20 per cent of the UK GVA (2021) and 10 per cent of employment. The creative and cultural

⁸ See discussion in Box 3 of J De Lyon et al., [Enduring Strengths: Analysing the UK's current and potential economic strengths, and what they mean for is economic strategy at the start of the decisive decade](#), Resolution Foundation, April 2022.

⁹ Department for Digital, Culture, Media and Sport, [DCMS Economic Estimates 2019: Gross Value Added](#), December 2020.

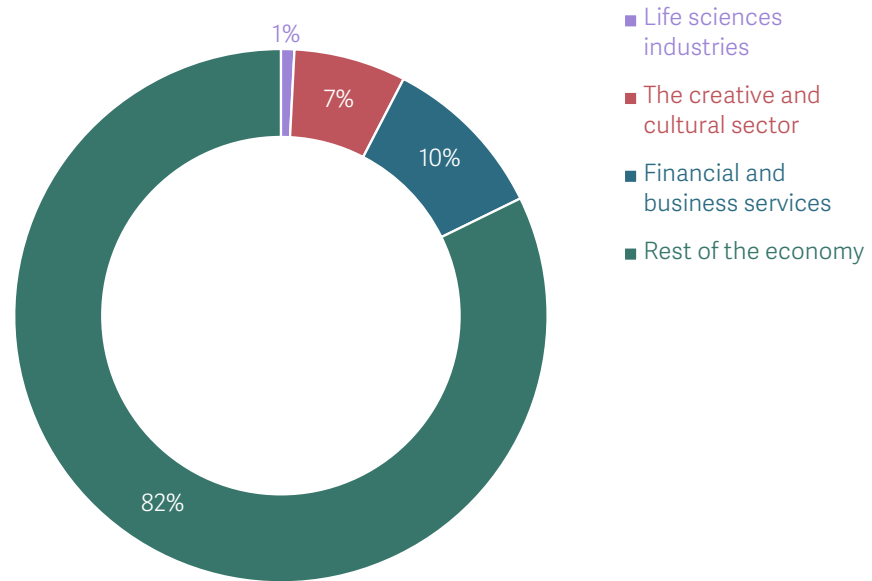
¹⁰ J De Lyon et al., [Enduring Strengths: Analysing the UK's current and potential economic strengths, and what they mean for is economic strategy at the start of the decisive decade](#), Resolution Foundation, April 2022.

¹¹ Nevertheless, UK manufacturing of pharmaceuticals alone (a subcategory in the broader Life sciences industries sector that we defined) accounted for 1 per cent of total GVA in 2019. See: J De Lyon et al., [Enduring Strengths: Analysing the UK's current and potential economic strengths, and what they mean for is economic strategy at the start of the decisive decade](#), Resolution Foundation, April 2022.

sectors account for 6 per cent of GVA (2019) and 7 per cent of employment.¹² Smaller, but innovative, Life sciences industries (i.e. pharmaceuticals) accounted for 1 per cent of GVA (2019) and 1 per cent of employment.

FIGURE 2: Strategic sectors employ 20 per cent of the UK workforce

Proportion of workforce aged 18-64 employed in the three strategic sectors and the rest of the economy: UK, 2022



SOURCE: Analysis of ONS, Labour Force Survey.

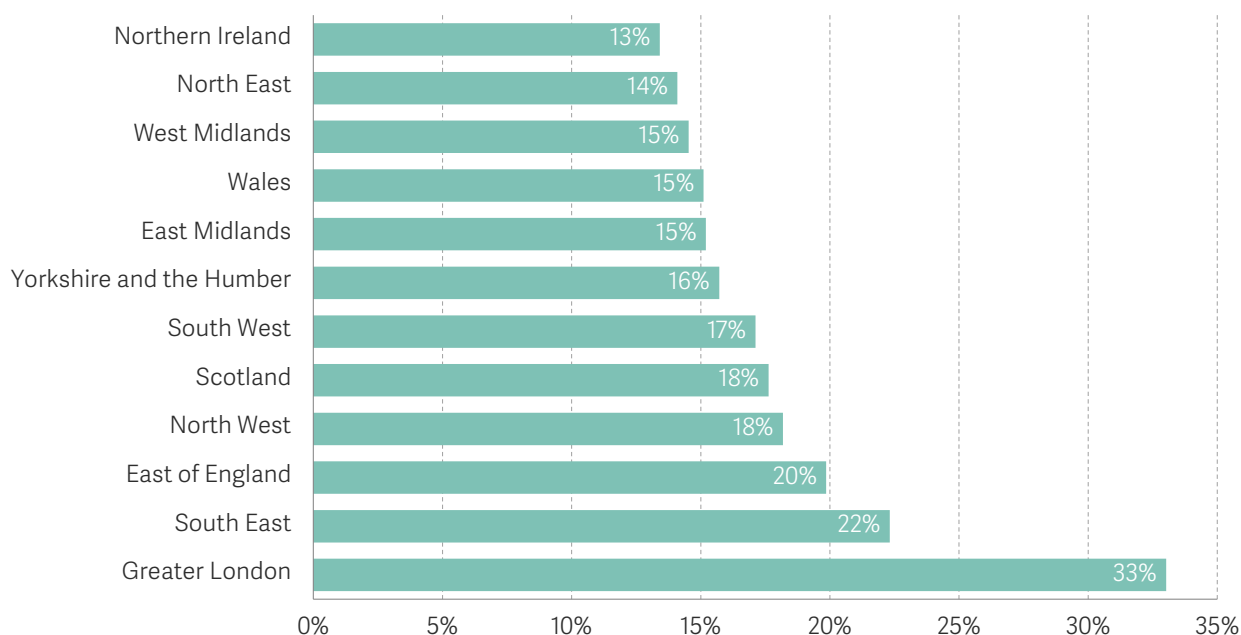
The proportion of workers in these sectors is highest in London (with one in three workers employed across the three sectors). But, as shown in Figure 3, they also generate employment across most areas of the UK (at least in the two sectors representing relatively large shares of employment: Financial and business services and The creative and cultural sectors).¹³

¹² The GVA figure for the Creative and Cultural sector refers to a related official definition employed by the government's Department for Digital, Culture, Media, and Sport. See Box 1 and the Annex for details on how our definition departs from that.

¹³ In the Annex we present differences in the geographical distribution of each of the strategic sectors. Financial and business services and the creative and cultural sector are more evenly distributed across the country than Life sciences industries, which is clustered in the South East (outside of London).

FIGURE 3: Employment in strategic sectors is currently highest in London and South East

Proportion of workforce aged 18-64 employed in the three strategic sectors, by NUTS1 regions: UK, 2022



SOURCE: Analysis of ONS, Labour Force Survey.

The UK must ensure that the right skills are in place for net zero and AI technology development and deployment

An effective growth strategy must also be forward-looking – orienting itself around key technologies where capabilities exist, or where these must be strengthened for growth and broader objectives including sustainability and security. Two key areas are clean technologies and AI, both areas where the UK has advantages,¹⁴ where technological progress and deployment are accelerating, and which will affect the whole economy.

Delivering the UK's net zero commitments requires largescale and system-wide investment and change this decade – particularly in energy, transport and buildings,¹⁵ with new technologies a key feature (84 per cent of the UK's decarbonisation to 2035 involves low carbon technologies or fuels, either alone or in combination with behavioural change).¹⁶ These changes will affect jobs.

Previous Economy 2030 analysis identified 'green' and 'brown' jobs expected to face significant change due to the net zero transition. Around 13 per cent of employment could be considered 'green': jobs most likely to involve new green tasks and skills

¹⁴ B Curran et al., *Growing Clean: Identifying and investing in sustainable growth opportunities across the UK*, Resolution Foundation, May 2022.

¹⁵ The Climate Change Committee estimated that £50 billion of additional annual investment will be required by 2030. See, Climate Change Committee, *Sixth Carbon Budget*, December 2020.

¹⁶ Figure B2.2 in Climate Change Committee, *Sixth Carbon Budget*, December 2020.

because of the net zero transition. Around 4 per cent of employment is in 'brown' jobs: occupations particularly prevalent in high emissions sectors. Looking at industrial sectors, rather than occupations, the Committee for Climate Change estimates that around 12 per cent of jobs are in sectors likely to grow, 7 per cent are in sectors that will need to redirect their products and services, and under 1 per cent are in sectors that will need to shrink (due to reduced demand for goods and services). Both analyses suggest that around a fifth of workers face meaningful change in the nature of their work, and a key role for education and skills policies will be to ensure that workers are equipped to deal with that change.

The release of ChatGPT has resulted in a further wave of anxiety about how technological change threatens jobs. Worries that jobs will be lost to automation are longstanding, but were heightened with the release of Frey and Osborne's 2013 study warning that nearly half of jobs in the US were at 'high risk' of automation.¹⁷ In fact, the period since that study has seen rising employment.¹⁸ To-date, although automation is affecting jobs, aggregate employment growth suggests automation's job-destroying impact continues to be offset by positive indirect effects. Technologies will continue to affect the labour market, but a key issue relates to the impact on the quality of jobs, which in turn depends on labour market institutions.¹⁹

Generative AI has yet to be fully adopted, and its impacts are not fully understood, but it is clear that some areas are much more vulnerable to its impacts than others. In previous waves of technical change, less-skilled workers have been the most vulnerable, but AI is expected to put downward wage and job pressure on some professionals. These changes will have implications for education and skills policies. Targeted reskilling programmes will need to help workers adapt, and education must provide future workers with the skills for resilience in a changing labour market. Given UK strengths at the innovation frontier,²⁰ a forward-looking skills strategy must also ensure that the UK continues to train, attract and retain skilled computer scientists as part of a thriving tech sector.

¹⁷ C Frey & M Osborne, [The Future of Employment: How susceptible are jobs to computerisation?](#), September 2013.

¹⁸ R Costa & Y Yu, [Adopt, adapt and improve, A brief look at the interplay between labour markets and technological change in the UK](#), Resolution Foundation, November 2022.

¹⁹ See for example: C Kapetanios & C Pissarides, [Productive robots and industrial employment: the role of national innovation systems](#), POID working paper, November 2022.

²⁰ For example, our previous analysis has showed that the UK has an overall specialisation in AI and robotics patenting: B Curran et al., [Growing Clean: Identifying and investing in sustainable growth opportunities across the UK](#), Resolution Foundation, May 2022. Analysis from Beauhurst finds that there are 1,486 AI high growth firms in the UK. Collectively, these businesses have secured £8.48b worth of equity investment, across 3,283 rounds, making artificial intelligence one of the best-funded sectors in the UK. See, www.beauhurst.com/blog/ai-startup-companies, accessed 16 October 2023

Section 3

The strategic sectors provide a route to more ‘good jobs’

One important objective for an economic strategy is to create good jobs. Do the strategic sectors discussed above create such jobs? If so, for what kind of workers and what are the implications for skills? This section begins to consider this question by looking at the wages paid in these sectors. We show wages are higher regardless of level of education and are associated with stronger growth in earnings, particularly for non-graduates.

Wages in the strategic sectors are higher across all education groups

One reason why the strategic sectors are important for the UK’s overall economic performance, and will play an important part of ensuring that growth can be shared, is that the wages are higher than the rest of the economy, and are consistently so across all education groups.

Figure 4 illustrates this, plotting average weekly wages earned by workers with different education levels.²¹ The sectoral wage gap for each education group is approximately 40 per cent, although it is slightly more modest for workers with sub-degree qualifications (Level 4-5) at 33 per cent. These gaps could partly reflect worker sorting across sectors – with more able or motivated people finding jobs in the strategic sectors – or other underlying differences, but it is plausible that working in these sectors leads to higher wages, regardless of level of education.

²¹ These estimates are obtained from augmented Mincerian regressions of weekly wages on workers’ education interacted with a cubic of potential experience. This allows us to control for differences in workers’ potential labour market experience to adjust for the fact that older workers (who have longer experience) tend to be less educated, thus confounding education wage premia.

FIGURE 4: There is a substantial wage premium at all education levels associated with the strategic sectors

Average weekly wages by workers' highest qualification, for the strategic sectors and the rest of the economy, in 2015 prices: UK, 2011-2019



NOTES: We obtain these estimates by performing augmented Mincerian regressions where the control for differences in workers' potential labour market experience and full-time employment status.

SOURCE: Analysis of ONS, Labour Force Survey.

Not only do all three strategic sectors pay higher wages across education groups but workers in these sectors experience faster wage growth throughout their careers, thanks to steeper returns to labour market experience. This is visible in Figure 5, which plots average weekly wages by education groups at different levels of labour market experience.²² Wage growth is more rapid and sustained throughout careers in the strategic sectors (even after 25 years or more of experience), compared to the rest of the economy.²³

Wage growth is higher in particular for lower-educated workers, notably for those with GCSEs or below: these workers see an average annual earnings growth in the strategic sectors of 1.9 per cent, against 1.3 per cent if employed in the rest of the economy. In other words, lower-educated workers in the strategic sectors see their average weekly earnings more than double over their careers (they become 2.1 times larger) whereas they only grow 1.7 times for those employed in the rest of the economy. The difference

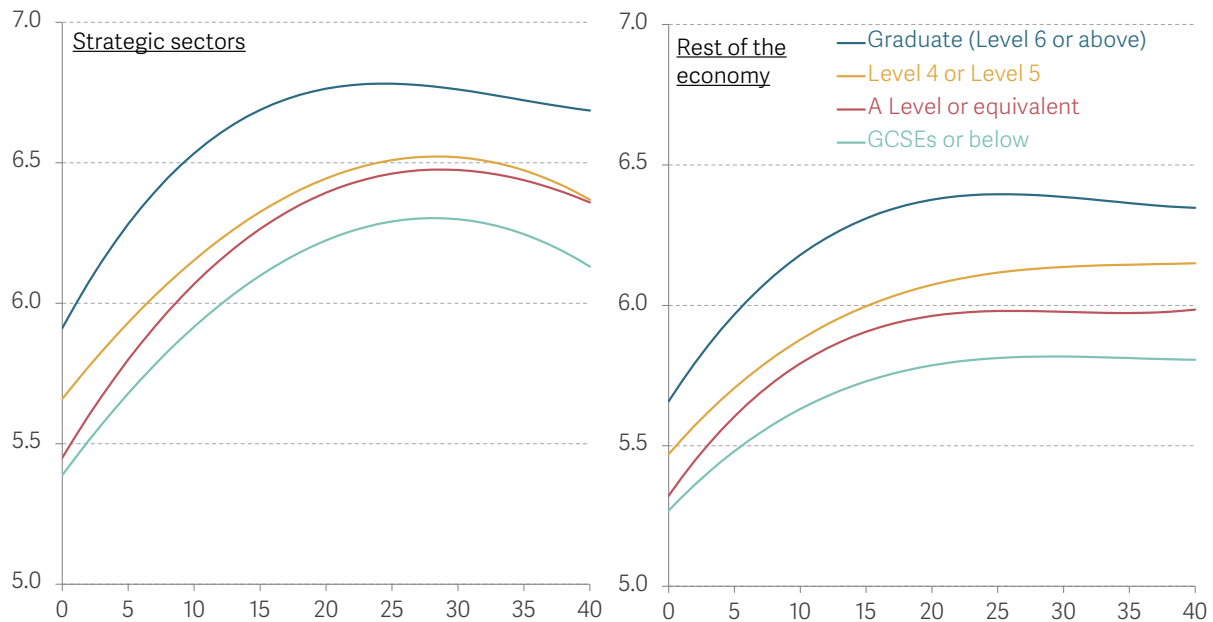
²² Like Figure 4, these estimates are obtained with an augmented Mincerian cross-sectional regression pooling together workers from different cohorts; we do not actually observe wages for the same worker at different experience points.

²³ In addition, for the strategic sectors we see that wage growth seems to fade out later in workers' career as wages actually decline. This may be an artefact of labour supply responses, as older workers retire or reduce the number of hours worked (hence affecting their weekly wages). In particular, it might be that workers in the strategic sectors have higher labour supply elasticity later in life due to prevailing income or wealth effects and retire earlier or work fewer hours.

is smaller for degree-educated workers: in the strategic sectors they see their earnings grow by 2.2 times over their careers, compared to 2 times for those employed in other sectors.

FIGURE 5: All education groups benefit from more sustained wage growth through their careers in the strategic sectors

Average weekly wages (logarithmic scale) by years of work experience: UK, 2011-2019



NOTES: These chart plot estimates of average weekly wages against workers' potential labour market experience by education group for workers employed in the strategic sectors and in the rest of the economy. These estimates are obtained pooling together all employed individuals between 2011 and 2019, while controlling for year effects and full-time employment status.
SOURCE: Analysis of ONS, Labour Force Survey.

The main findings are consistent across the three strategic sectors, but there are some differences, as set out in Box 2. In particular, workers with a sub-degree qualification (Level 4-5) in Life sciences industries earn much more than their counterparts in other sectors.

BOX 2: Differences in wages by education within sector

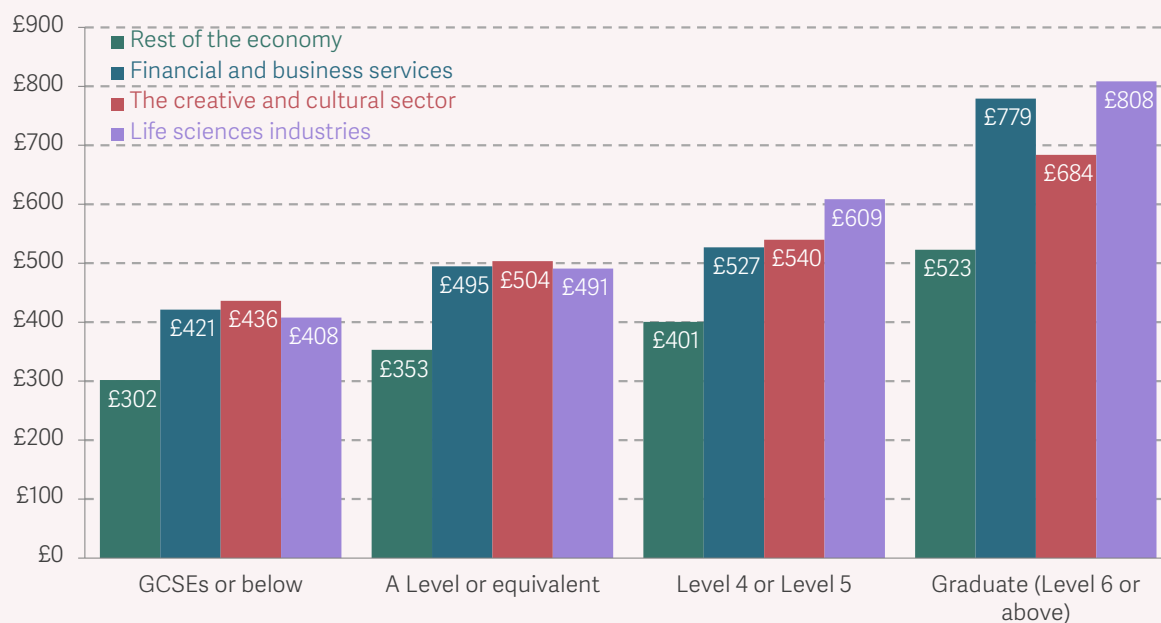
As shown in Figure 6, wages of lower educated workers (up to Level 3) are comparable across sectors. Note that workers with a sub-degree

qualification (Level 4-5) in Life sciences industries earn much more than their counterparts in other sectors and that having a degree is associated with

higher wages in Financial and business services and Life sciences industries than in the creative and cultural sector.

FIGURE 6: Wages for higher-educated workers are particularly high in Life sciences industries and Finance and business services

Average weekly wages by workers' highest qualification and sector, in 2015 prices: UK, 2011-2019



NOTES: We obtain these estimates by performing augmented Mincerian regressions where the control for differences in workers' potential labour market experience and full-time employment status.

SOURCE: Analysis of ONS, Labour Force Survey.

Figure 21 in the Annex presents wage-experience profiles separately for each of the strategic sectors. All three sectors are associated with faster wage growth than other sectors of the economy. Steeper returns to experience for lower-educated workers (GCSEs or below) are particularly visible in Financial and business services and in The creative and cultural sector, whereas higher-educated workers seem to do better in Financial and business

services and in Life sciences industries. We also see some differences in the wage premia attributed to workers with sub-degree qualifications at Level 4-5 and how they evolve over their careers. The gap with Level 3 qualifications is quite small in Financial and business services, unlike in The creative and cultural sector (at least until workers' mid-career) and in Life sciences industries, where it is remarkably high throughout workers' careers.

Taken together, the evidence shows that expanding employment in the strategic sectors will benefit both highly and less educated workers. Lower-educated workers in these sectors earn higher wages (someone with only GCSEs earns more than someone with a sub-degree qualification outside these sectors) and are employed in better jobs with higher wage trajectories over their career than in other sectors of the economy.

This is clearly good news. But to ensure these sectors can flourish, it is paramount that the education and training system support workers in developing the right skills. To better understand the implications for skills policy, the next section turns to directly consider the skills requirements of these sectors, before discussing some of the challenges they face.

Section 4

What are the skills requirements of the strategic sectors?

In this section, we use information on the importance of different types of tasks and on demand for skills from online job adverts to characterise the skills requirements of the strategic sectors. We show that these sectors employ many more Managers, Professionals and Technical experts, implying high and growing importance of analytical tasks. We also show that the demand for general and specialised technical skills is higher than in other sectors and increasing. This helps explain higher education attainment in the sector and suggests that success rests on the continued availability of workers with high levels of skills.

The key aims of this paper are to understand whether the UK has an appropriate skill base given our existing strengths, to ask how the future demand for skills is set to evolve along with the growth and diffusion of strategic sectors and technologies, and to assess whether a skills strategy is required to ensure the supply of skills keeps apace.

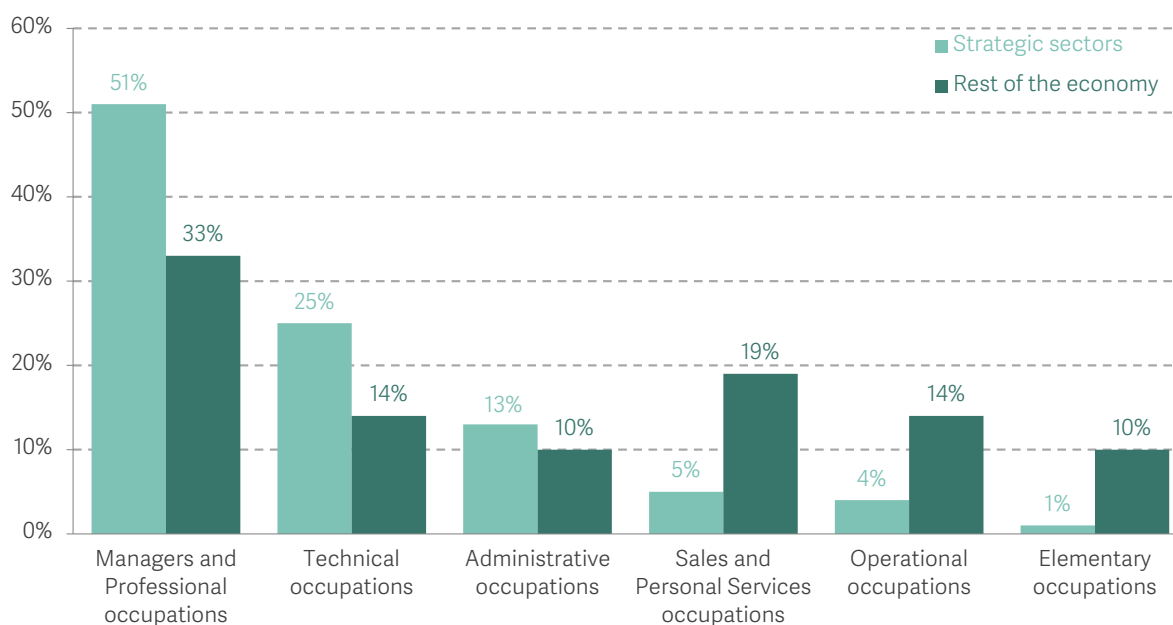
In this section, we begin to answer these questions by considering the skill requirements of occupations in the strategic sectors. We show how in these sectors, non-routine analytical tasks (such as 'data analysis and interpretation' or 'thinking creatively') and personal tasks (such as 'personal relationships' or 'coaching others') are particularly important. We also use information from online job vacancies to look at how demand for general and specific skills has changed, highlighting the growing importance of skills such as initiative and leadership, critical thinking and problem solving and social skills.

The strategic sectors are characterised by higher skill occupations, that involve more analytical work

As a first step to understanding the skills requirements for the strategic sectors, we can look at their occupational mix. Figure 7 compares the occupational profile of the strategic sectors with the rest of the economy. One in two workers in the strategic sectors are employed in managerial or professional roles, much higher than the 31 per cent in other sectors. Similarly, the proportion of workers employed in technical occupations is nearly twice as high as in the rest of the economy (25 per cent compared to 14 per cent), and administrative occupations are also better-represented than in other sectors (16 per cent). On the other hand, the more elementary roles in sales and operations only amount to 10 per cent of the employment, compared to 45 per cent in the rest of the economy. To give a better idea of the occupational composition of these sectors, Box 3 describes the most common jobs (sector-by-sector breakdowns are in the Annex).

FIGURE 7: Most workers employed in the strategic sectors have managerial, professional and technical roles

Proportion of workers aged 18-64 employed in different occupational groups, for the strategic sectors and the rest of the economy: UK, 2011-2019



NOTES: The occupational classification groups together Major Occupational Groups from the UK SOC 2010: 'Managerial and Professional occupations' = 1,2; 'Technical occupations' = 3; 'Administrative occupations' = 4; 'Sales and Personal Services' = 6,7; 'Operational occupations' = 5,9; 'Elementary occupations' = 9.

SOURCE: Analysis of ONS, Labour Force Survey.

BOX 3: The most common occupations in the strategic sectors

Table 2 lists the fifteen most common occupations (at 3-digit level under the standard occupational classification) in the strategic sectors. These occupations account for 72 per cent of total employment in these sectors. ICT professionals are the most common occupation, accounting for 13 per cent of employment across the three sectors, followed by associate professionals in Business and financial services at 9 per cent. Business, research and administrative professionals and functional managers and directors are also well represented (8 per cent) as are sales and marketing professionals (6 per cent).

As expected, next to professional and associate roles, these sectors also widely employ people in administrative and client-facing roles, such as financial administrative occupations (6 per cent), secretarial occupations and customer service occupations (both at 2 per cent). There are also more technical

roles such as engineering professionals and architects, town planners and surveyors and IT technicians.

This aggregate view masks variation across the strategic sectors. Figure 26 in the Annex shows that managerial and professional roles are particularly prevalent in The creative and cultural sector (62 per cent), and administrative occupations are particularly common in Financial and business services where they employ 21 per cent of workers (in the other strategic sectors this is slightly lower than average at 8 per cent).²⁴

Overall, these sectors are much more likely to employ workers in roles that require higher levels of skills, particularly professional and technical occupations (whereas managerial roles are likely to require a combination of skills and on-the-job experience or seniority, depending on the sector).

²⁴ Additionally, Table 5 to Table 7 in the Annex show what are the ten most popular occupations (3-digit level) in each of the strategic sectors.

TABLE 2: The most common occupations across the strategic sectors relate to professionals and managerial positions

Employment share (hours worked) in the strategic sectors for the fifteen most common occupations in those sectors: UK, 2019

Occupation (3-digit)	Proportion of workforce	Cumulative proportion of workforce
Information Technology and Telecommunications Professionals	13%	13%
Business, Finance and Related Associate Professionals	9%	22%
Business, Research and Administrative Professionals	8%	30%
Functional Managers and Directors	8%	37%
Sales, Marketing and Related Associate Professionals	6%	44%
Administrative Occupations: Finance	6%	49%
Teaching and Educational Professionals	5%	54%
Natural and Social Science Professionals	3%	57%
Other Administrative Occupations	3%	60%
Engineering Professionals	2%	62%
Customer Service Occupations	2%	64%
Information Technology Technicians	2%	66%
Secretarial and Related Occupations	2%	68%
Architects, Town Planners and Surveyors	2%	70%
Public Services and Other Associate Professionals	2%	72%

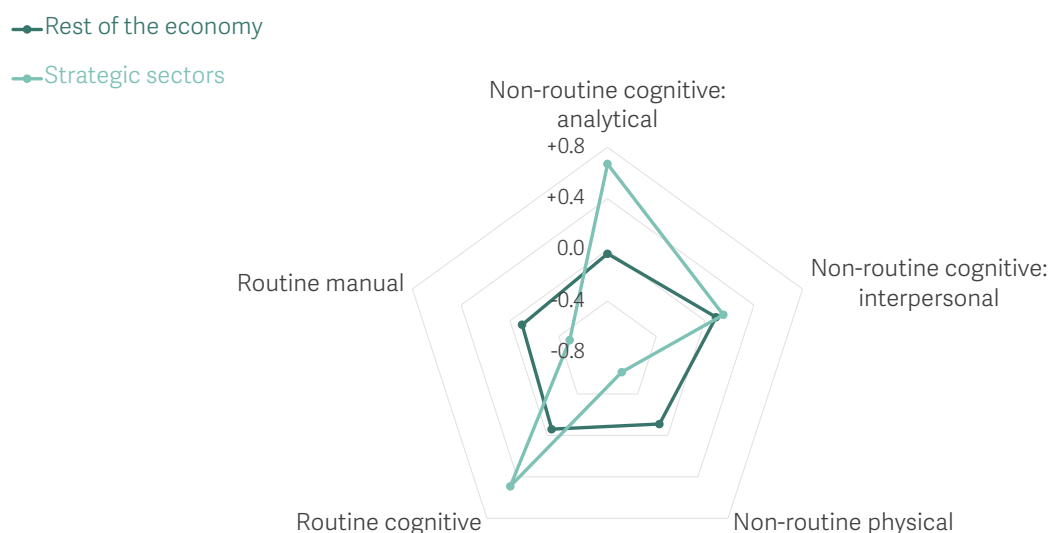
NOTES: Occupations are classified according to 3-digit Standard Occupational Classification codes.

SOURCE: Analysis of ONS, Labour Force Survey.

We now move from occupations to the specific tasks that jobs involve, as this will give us a better sense of the types of skills these jobs require. To do this, we use information on occupations in each sector and combine it with a mapping from occupations to tasks derived from the 2011 US O*NET occupational dictionary (see Box 4). This focuses on five types of tasks: analytical (non-routine), personal (non-routine), physical (non-routine), routine cognitive and routine manual.²⁵ Figure 8 compares the average importance of different types of tasks in occupations in the strategic sectors compared to those in the rest of the economy.

FIGURE 8: Occupations in the strategic sectors rely more on analytical and routine cognitive tasks

Average importance of different task types (standardised) in the strategic sectors and the rest of the economy: UK, 2011-2019



NOTES: Tasks' importance is measured at the occupation level and standardised across occupations to have mean zero and a standard deviation of one. This information is then aggregated at sector level reflecting the occupational composition within the sector.

SOURCE: Analysis of ONS, Labour Force Survey linked to O*NET (US Department of Labor).

The higher proportion of workers in managerial, professional and technical roles across the strategic sectors is reflected in a stronger emphasis on non-routine analytical tasks,

²⁵ There is currently no available classification specifically conceived for the UK, although the Department for Education's Unit for Future Skills is in the process of developing its own skills taxonomy. Many empirical analyses that aim to characterise UK occupations in terms of their skills content have therefore relied on the US-based O*NET occupational dictionary which can be translated to the UK occupational coding (UK SOC) using available crosswalks. The characterisation of occupations in terms of the importance of five types of tasks (non-routine analytical, non-routine personal, non-routine physical, routine cognitive and routine manual tasks) follows the methodology adopted by D. Acemoglu & D. Autor, *Skills, Tasks and Technologies: Implications for Employment and Earnings*, Handbook of Labor Economics, 2011. For more details, see Box 1 in N Cominetti et al., *Changing jobs? Change in the UK labour market and the role of worker mobility*, Resolution Foundation, January 2022.

whereas the higher importance of routine cognitive tasks can be explained by the higher proportion of workers in administrative roles (mostly in Financial and business services, as shown in Figure 26 in the Annex). Non-routine personal tasks are also marginally more important, whereas, unsurprisingly, routine manual and non-routine physical tasks are much less important than in the rest of the economy. The higher importance of non-routine analytical tasks helps explain the higher returns to experience for workers in these sectors (Figure 5) since these complex tasks benefit particularly from on-the-job learning.²⁶

BOX 4: Using O*NET to describe UK occupations

To compare different occupations and understand what types of skills they require, we use the US-based O*NET dictionary of occupations which rates the importance of different tasks and work activities by occupation. We follow the seminal 2011 study by Acemoglu and Autor, that used O*NET to describe occupations along two dimensions: whether tasks are performed routinely or non-routinely and whether tasks are manual or cognitive. This means tasks in each occupation are divided into the following components: non-routine cognitive analytical, non-routine cognitive personal, non-routine physical, routine cognitive and routine manual tasks.²⁷ We use the 2011 version of the O*NET dictionary mapped to the UK occupational classification (UK SOC 2010) at the 4-digit level. This approach relies on making two important assumptions. First, we have

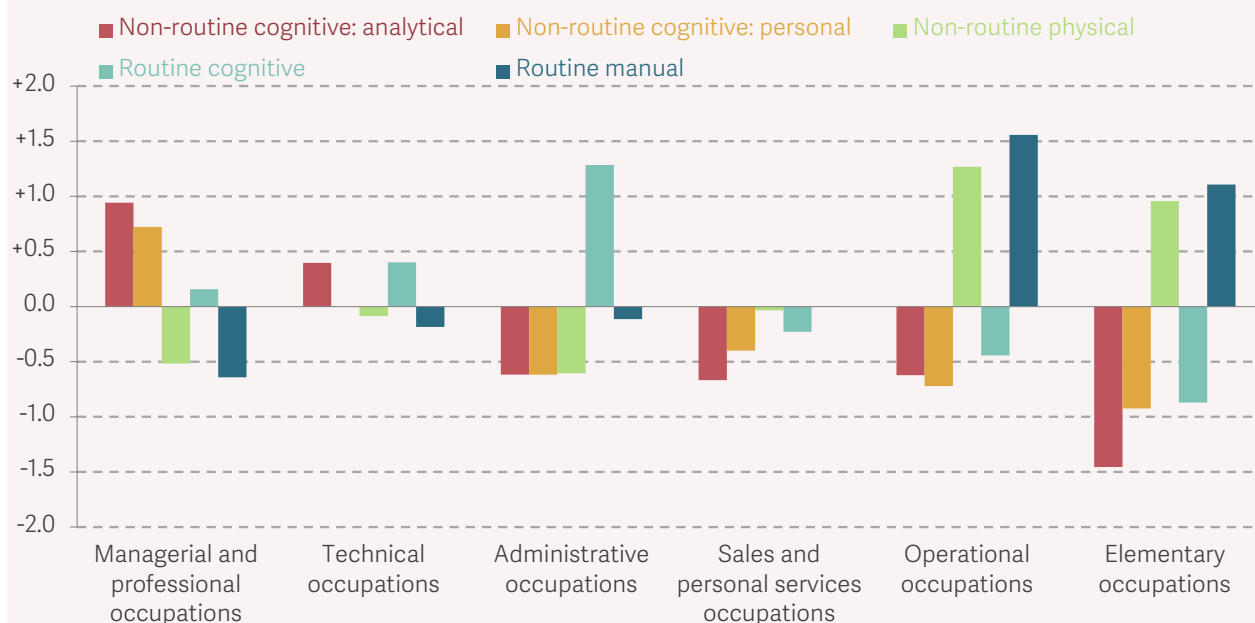
to assume that the importance of each component in any occupation is fixed across the years of analysis. Second, we have to assume that occupational requirements in the US are broadly comparable to those in the UK. Figure 9 shows that this second assumption is mostly unproblematic: applying the classification to the UK gives very intuitive results. Managerial and professional occupations are those where non-routine analytical and personal tasks are most important; administrative occupations make most intensive use of routine cognitive tasks and operational occupations extensively employ non-routine physical and routine manual tasks.

²⁶ D Deming, [Why do wages grow faster for educated workers](#), National Bureau of Economic Research Working paper No. 31373, June 2023.

²⁷ D Acemoglu & D Autor, [Skills, Tasks and Technologies: Implications for Employment and Earnings](#), Handbook of Labor Economics, 2011.

FIGURE 9: Non-routine analytical and personal tasks are most important in managerial and professional occupations

Average importance of task types (standardised) by occupational group: UK, 2011



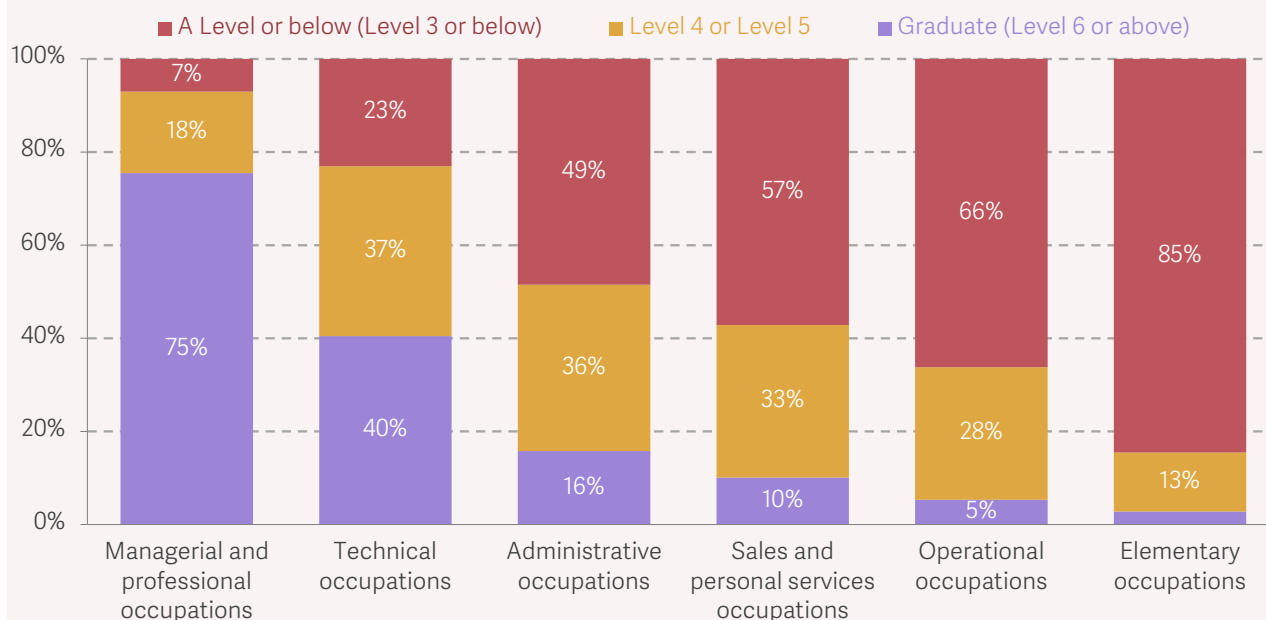
NOTES: Task importance is standardised across occupations accounting for the employment size, zero corresponds to the average with positive values indicating a given task is more important than average.
SOURCE: Analysis of ONS, Labour Force Survey linked to O*NET (US Department of Labor).

Additionally, O*NET provides information on the education requirements associated with each occupation by reporting the fraction of respondents (incumbent US workers) who consider a given level of education as the most suited for that occupation. We translate US-based educational categories to the UK by considering the requirement of having a 'high school diploma' or 'less than high school' as equivalent to having a Level 3 qualification (A-Levels and equivalent) or less; having 'some college' or 'some postsecondary technical qualification' as equivalent to having a Level 4 or

Level 5 qualification; and having a 'college degree' or more as equivalent to having at least a university degree in the UK context. This assumes that occupational education requirements are comparable between the US and UK. Figure 10 suggests this approximation is plausible. It shows that higher education requirements (Level 4 or above) characterise managerial and professional and technical occupations whereas having at most Level 3 (the equivalent of finishing high school in the UK context) becomes the norm as we move leftwards.

FIGURE 10: Professional and technical occupations have higher educational requirements

Proportion of workers expected to have a given level of education, by occupational grouping: UK, 2011



NOTES: US Respondents in O*NET are asked to state which education level is more appropriate to perform a given occupation; each bar marks the proportion of respondents saying a given level of education is the most appropriate with the US categories translated into the UK context (see Box).

SOURCE: Analysis of ONS, Labour Force Survey linked to O*NET (US Department of Labor).

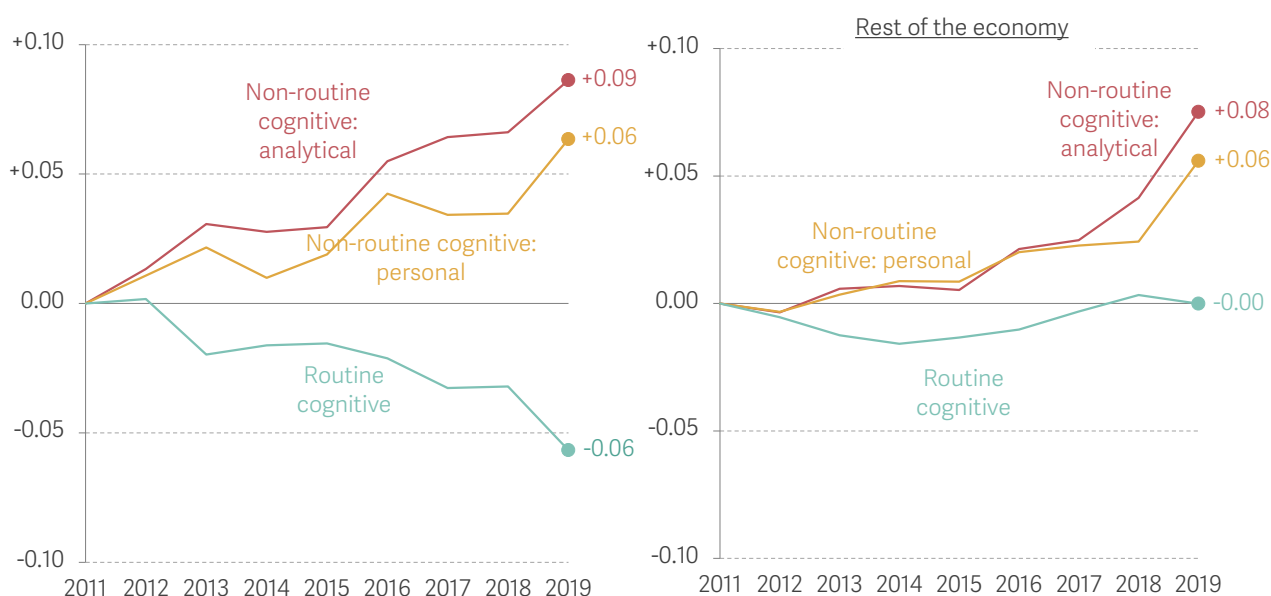
Work in the strategic sectors has become more complex over time

To anticipate which skills will be needed in these sectors over the next years, it is important to consider how task requirements are changing. Figure 11 does this by tracking changes in the importance of different tasks as the occupational mix changes within the strategic sectors and the rest of the economy over time (rather than averaging across 2011-2019, as in Figure 8). Analytical and personal tasks have become more important across all sectors, but their importance has risen more strongly in the strategic sectors. This has been accompanied by a marked reduction in the importance of routine Cognitive tasks, reflecting a shift away from administrative occupations and towards managerial and professional roles (see Figure 29 in the Annex).²⁸

²⁸ Analysis elsewhere has shown that this trend is likely to continue across the economy in the coming years. Professional and managerial occupations are expected to experience the largest increase in employment by 2035, whereas administrative roles will see a decline at economy-wide level. Consistent with our findings about the increased importance of non-routine analytical and personal skills in recent years (especially in the strategic sectors but also across the economy more broadly), six 'Essential Employment Skills' are projected to be in greatest demand in 2035. These include 'collaboration', 'communication', 'creative thinking', 'information literacy', 'organising, planning and prioritising' and 'problem solving and decision making'. See R Wilson et al., *The Skills Imperative 2035: Occupational Outlook—Long-run employment prospects for the UK*, National Foundation of Education Research, Working Paper 2-headline report, October 2022.

FIGURE 11: Analytical and personal tasks have grown in importance, particularly in the strategic sectors

Change in importance of different tasks since 2011: UK



NOTES: Tasks' importance is measured at the occupation level and standardised across occupations to have mean zero and a standard deviation of one. This information is then aggregated at sector level reflecting the occupational composition within the sector in a given year. The average importance is then measured in terms of change since 2011 (which is normalised to zero) with positive values indicating an increase in importance by the corresponding standardised value.

SOURCE: Analysis of ONS, Labour Force Survey linked to O*NET (US Department of Labor).

So far, our analysis has assumed that task requirements of occupations are fixed (based on O*NET 2011). This may raise concerns about skill requirements given that task requirements change over time. To address this, and in collaboration with the Pissarides Review, we use online vacancy data for the UK to derive an up-to-date mapping from occupations to more granular tasks.²⁹ We can use similar mappings from 2016 to 2022 to see how the mapping from occupations to tasks is changing over time (details of how we do this are in the Annex).

Figure 31 and Figure 32 in the Annex reinforce the key messages outlined above. General skills, such as analytical and personal skills, are important in the strategic sectors, and growing slightly faster there than for the economy as a whole (which has also seen significant increases). This means that changes in skill requirements within occupations reinforces the trend observed in Figure 11 driven by occupational shifts within the sector. In other words, firms in these sectors are simultaneously relying more on professional roles and increasing the skill requirements within these roles.

²⁹ Our analysis in this section draws upon work by R Costa, T Liu, C Pissarides & B Rohenkohl, Report for the Pissarides Review, forthcoming, 2023. See <https://pissaridesreview.ifow.org/> for more details.

The vacancy analysis also allows us to look at the specialised skill requirements of each strategic sector, and how these have changed over time. Unsurprisingly, the specialised skills profiles across strategic sectors and the broader economy show more variation than those of general skills, as shown in Figure 12.

Jobs in The creative and cultural sector require specialised skills in areas such as media and communications, marketing and public relations, design and science and research, all of which show shares much higher than the average job advertised. Likewise, Financial and business services jobs require strong background skills in business, finance, analysis and administration. Jobs in Life Science industries require specialised skills in science and research, manufacturing and production, and engineering, reflecting the R&D intensive and manufacturing activities in the sector. Employers also expect solid backgrounds in complementary skills such as information technology and analysis. But, crucially, the common pattern is the emphasis on skills that enable workers to perform abstract and analytical non-routine tasks.

Figure 13 looks at the changes in skills requirements, with the detailed subcategories driving these shown in Figure 34 in the Annex. Jobs in The creative and cultural sector saw strong increases in Information Technology skills, (driven by increases in skills, like computer science and software development) and increases in media and communications skills, such as language interpretation and media production. Changes to note in Life sciences industries include business skills (such as project management and strategy), and environment (with skills such as ecology, environment and resource management contributing to this). Changes in Financial and business services look similar to the rest of the economy.

FIGURE 12: There are some differences across the strategic sectors when it comes to specialised skills, but some key specific skills are important for all of them

Shares of job vacancies including specified specialised skills: UK, 2022

Specialised skills	The creative and cultural sector	Financial and business services	Life sciences industries	Rest of the economy
Business	49%	66%	58%	47%
Information Technology	46%	36%	46%	34%
Customer and Client Support	34%	53%	24%	31%
Engineering	31%	17%	42%	26%
Analysis	33%	34%	41%	23%
Marketing and Public Relations	42%	22%	20%	23%
Law, Regulation, and Compliance	16%	36%	50%	23%
Transportation, Supply Chain, and Logistics	14%	15%	29%	22%
Finance	19%	58%	19%	21%
Health Care	15%	11%	31%	21%
Sales	19%	19%	13%	19%
Maintenance, Repair, and Facility Services	9%	7%	30%	17%
Media and Communications	53%	21%	25%	16%
Manufacturing and Production	19%	9%	43%	16%
Architecture and Construction	18%	9%	10%	15%
Education and Training	18%	8%	10%	14%
Hospitality and Food Services	8%	4%	10%	14%
Design	34%	6%	10%	9%
Science and Research	19%	6%	43%	8%
Human Resources	4%	5%	6%	7%
Environment	5%	6%	15%	6%
Administration	6%	12%	6%	6%
Performing Arts, Sports, and Recreation	8%	3%	4%	5%
Public Safety and National Security	4%	2%	8%	4%
Energy and Utilities	7%	3%	8%	4%
Social and Human Services	3%	5%	2%	3%
Economics, Policy, and Social Studies	7%	5%	4%	3%
Property and Real Estate	1%	6%	1%	2%
Agriculture, Horticulture, and Landscaping	2%	1%	2%	1%
Personal Care and Services	1%	0%	1%	0%

NOTES: Strategic sectors include occupations that are particularly prevalent in these sectors as compared to the rest of the economy, as set out in the Annex.

SOURCE: Analysis of data provided by [Adzuna Intelligence](#).

FIGURE 13: The demand for key sets of specialised skills have been growing faster in the strategic sectors than the rest of the economy

Change in shares of vacancies including specified specialised skills: UK, 2016-2022

Specialised skills	The creative and cultural sector	Financial and business services	Life sciences industries	Rest of the economy
Analysis	11%	8%	8%	7%
Business	9%	8%	9%	6%
Law, Regulation, and Compliance	3%	6%	5%	5%
Education and Training	7%	4%	5%	5%
Engineering	6%	5%	5%	4%
Information Technology	9%	0%	9%	4%
Marketing and Public Relations	7%	2%	7%	4%
Media and Communications	8%	5%	6%	3%
Manufacturing and Production	7%	1%	0%	3%
Finance	5%	6%	3%	2%
Transportation, Supply Chain, and Logistics	4%	2%	6%	2%
Customer and Client Support	4%	7%	6%	2%
Environment	3%	3%	6%	2%
Maintenance, Repair, and Facility Services	1%	1%	5%	2%
Hospitality and Food Services	3%	2%	1%	2%
Health Care	2%	2%	0%	2%
Design	4%	2%	1%	2%
Human Resources	1%	1%	0%	2%
Architecture and Construction	4%	3%	1%	2%
Science and Research	4%	2%	1%	1%
Public Safety and National Security	2%	1%	4%	1%
Economics, Policy, and Social Studies	0%	2%	2%	1%
Performing Arts, Sports, and Recreation	3%	1%	2%	1%
Energy and Utilities	3%	1%	2%	1%
Social and Human Services	-2%	1%	1%	1%
Property and Real Estate	0%	0%	1%	0%
Agriculture, Horticulture, and Landscaping	1%	1%	0%	0%
Personal Care and Services	0%	0%	0%	0%
Administration	2%	-1%	0%	0%
Sales	3%	0%	1%	0%

NOTES: Strategic sectors include occupations that are particularly prevalent in these sectors as compared to the rest of the economy, as set out in Box 3.

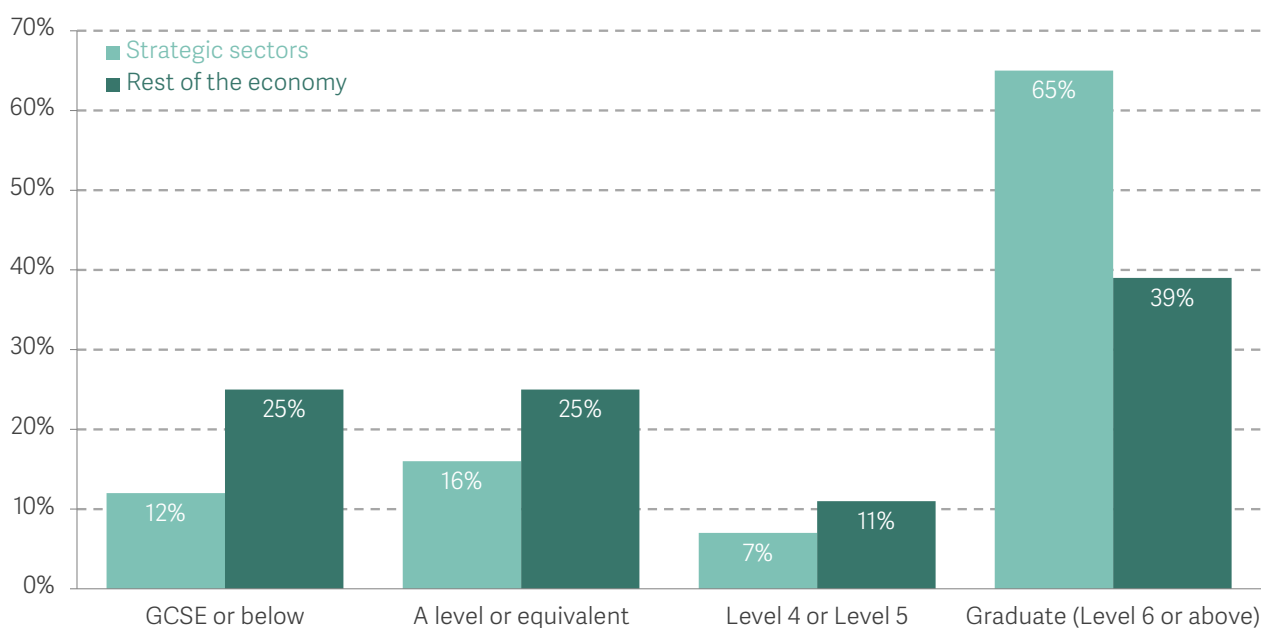
SOURCE: Analysis of data provided by [Adzuna Intelligence](#).

The importance of analytical skills and technical knowledge explains the much higher share of graduates in the strategic sectors

Our analysis of task importance and demand for skills in online job adverts points to the growing importance of analytical and social skills, as well as other technical skills that are specific to sectors. But how do people typically acquire these skills? Clearly, some may be learnt on the job (an issue we return to below) but analytical skills, and technical knowledge especially, are normally associated with formal education. This is consistent with the much higher education attainment among workers employed in the strategic sectors. As shown in Figure 14, the proportion of workers in such sectors holding at least a university degree (65 per cent) is almost twice as high as in the rest of the economy. In contrast, a much smaller proportion of workers hold lower-level qualifications (equivalent to having a GCSE or less), intermediate level qualifications at Level 3 (such as A-Levels or BTECs), or even sub-degree qualifications at Level 4 (such as Higher National Certificate) and Level 5 (such as Higher National Diploma). Figure 30 in the Annex shows that education attainment within the sectors has increased between 2011 and 2019, but no more rapidly than in the rest of the economy.

FIGURE 14: Workers in the strategic sectors are, on average, more educated than the rest of the economy

Proportion of workers aged 18-64 by their highest qualification, for the strategic sectors and the rest of the economy: UK, 2011-2019



SOURCE: Analysis of ONS, Labour Force Survey.

Overall, then, this section has shown that the strategic sectors have higher skill requirements and employ higher-educated people than the rest of the UK economy.

The expansion of these sectors brings the promise of more 'good jobs' for workers educated at all levels – as we can see from the fact that there are wage premia in these sectors at all education levels – but for these opportunities to materialise it is crucial that employers in these sectors can rely on workers with the right mix of skills. And whether our current skills policy is up to that challenge is the topic of the next Section.

Section 5

Challenges in meeting the skills requirements of the strategic sectors

The high wage premiums for educated workers in the strategic sectors – as outlined in Section 3 – indicate that demand for skills already exceeds supply. But another way to look at shortages is to compare the current educational attainment of workers in these sectors with the educational requirements of the jobs they are doing. This exercise suggests that the UK has too many people with no more than upper-secondary education, and too few with sub-degree qualifications. These problems are compounded by the fact that employers in the strategic sectors have reduced training among all types of workers.

The previous sections have shown that three strategic sectors create good jobs across the skills distribution, but that they require access to workers with a mix of general and specific skills. Growth in these sectors will, therefore, require additional workers to develop these skills. Unfortunately, as we document in this section, the UK already faces a number of challenges in meeting these skills needs.

The current system fails to supply enough upper-intermediate skills obtained with sub-degree qualifications

One might think that market incentives should ensure that workers and labour-market entrants respond to increases in the demand for skills by acquiring additional skills. Certainly the growth of these sectors (and the rising importance of analytical skills) has been accompanied by an expansion in the number of graduates. However, the high

graduate premium in these sectors illustrates that there is still excess demand for such workers.³⁰

The best way to look at whether labour markets are good at sorting out skills imbalances would be to check whether the current workforce possesses the skills required in these sectors. This is impractical, since measuring worker skills is notoriously difficult.³¹ A feasible alternative to measure skill imbalances is to approximate worker skills with their level of education and contrast this with the education requirements within the sector. To do so, we rely on information on occupational education requirements from US O*NET. For each occupation, we relate the share of workers that are expected to have a given level of education to the share of workers who have that level of education.³² Aggregating across occupations within a sector, and assuming that educational requirements in the US and UK are similar, the resulting 'gap' gives a rough indication of whether workers have the expected level of education and skills.

Figure 15 reports the analysis pooling together the three strategic sectors. Looking first at the darker bars on the left, shows the excess of workers educated only up to Level 3 or below (having at most A-Levels, or equivalent, but often less): their share in these sectors is more than 10 percentage points higher than expected given the underlying educational requirements at occupation-level. This excess of lower-educated workers is matched by a 15 percentage points undersupply of workers with what in the UK would be considered as sub-degree qualifications (Level 4 or Level 5). In short, the current share of workers qualified at Level 4-5 (7 per cent) should be almost three times higher (assuming that US and UK education levels produce – or could produce – roughly the same skills at this level) meaning that the strategic sectors are missing around 660,000 workers educated at sub-degree level.³³ In contrast, there is only a small excess of workers with a degree

³⁰ The national college wage premium has been extraordinarily flat at a national level between 1993 and 2015 despite a tripling of university degrees over the same period. This must mean that demand for university graduates has increased in the meantime. One explanation is that technological change has changed the nature of work (towards firm organisation that is more decentralised and flexible) which requires more educated workers. See: R Blundell, D Green & W Jin, [The UK as a technological follower: higher education expansion and the college wage premium](#), *The Review of Economic Studies* 89(1), January 2022. Other work suggests a different pattern across regions, with the premia falling in regions outside London. Nonetheless, even outside London, the graduate wage premium was still 30 per cent in 2019. Thus, this observation does not change the substantive point that graduates are in high demand across the country. See: A Stansbury, D Turner & E Balls, [Tackling the UK's regional economic inequality](#), Mossavar-Rahmani Center for Business and Government Working Paper, March 2023.

³¹ A Felstead, D Gallie & F Green, [Measuring Skills Stock, Job Skills and Skills Mismatch](#), *Oxford Handbook of Skills and Training*, February 2017.

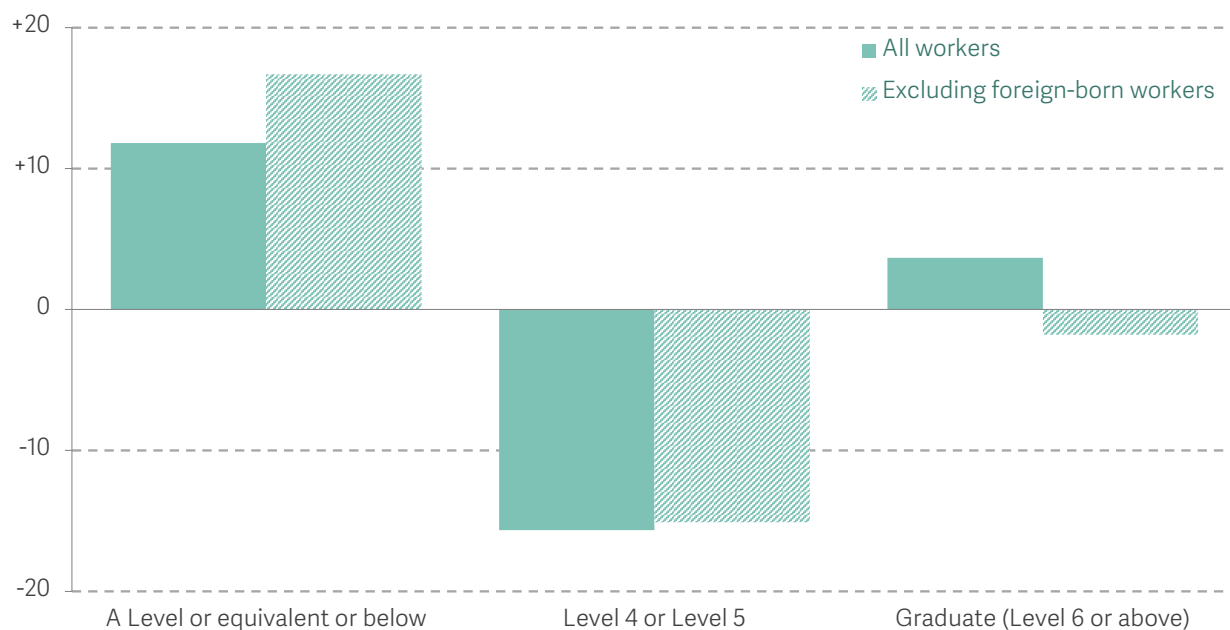
³² The O*NET dataset classifies occupations based on their typical education requirements. For each occupation (under the US occupational coding) we have information on the fraction of respondents (incumbent workers) who report that a given level of education is the most adequate. We translate US-based educational categories to the UK context by considering the requirement of having a 'high school diploma' or 'less than high school' as equivalent to having a Level 3 qualification (A-Levels and equivalent) or less; having 'some college' or 'some postsecondary technical qualification' is considered as equivalent to having a Level 4 or Level 5 qualification; and having a 'college degree' or more as equivalent to having at least a university degree in the UK context. One crucial assumption is that education requirements for each occupation are comparable between the US and UK. It is also important to remember that in this exercise (as in the rest of the O*NET-based inspired analysis) we refer to O*NET measurements from 2011.

³³ This is based on the average size of the annual workforce employed in the strategic sectors between 2011 and 2019 as recorded in the Labour Force Survey.

(4 percentage points). In other words, and subject to the important caveats discussed above, this analysis suggests that the main problem faced by these sectors today is a lack of workers at the upper range of intermediate skills

FIGURE 15: There are too many low-educated workers in the strategic sectors

Gap between expected and actual level of education in the strategic sectors, with and without foreign-born workers: UK, 2011-2019



NOTES: Expected level of education estimated given the underlying occupational composition and the US-based O*NET data. Positive values indicate an excess of workers qualified at that level. The lighter bars indicate what the difference would look like if we excluded foreign-born workers from the computation of workers' actual qualifications.

SOURCE: UK Labour Force Survey linked to O*NET (US Department of Labor).

Figure 36 to Figure 38 in the Annex list, for each of the three strategic sectors, the groups of occupations (3-digit) where a lack of sub-degree qualifications is more evident: a common trend is that there are too many people with Level 3 qualifications (or lower) employed in Professional and Associate Professional roles.

The lighter bars on the right in Figure 15 show what the gap would look like excluding foreign-born workers. The excess of low-educated workers is even more pronounced: instead of a small excess of graduates, there is a small deficit of around 75,000 graduates. This follows from the fact that 85 per cent of foreign-born workers in these sectors have at least a university degree, compared to 56 per cent of workers born in the UK.³⁴

³⁴ Analysis available on request shows that the situation is similar across the three sectors, with an excess of workers only educated at Level 3 or below and a visible lack of workers with sub-degree qualifications.

Similar skills gaps are found across the economy

Shortages in sub-degree qualifications are not confined to the strategic sectors but are widespread across the economy (see Figure 35 in the Annex), suggesting this has less to do with skill misallocation across sectors than with structural issues in the way upper-intermediate skills are delivered.

As argued by the Augar Review, it is likely that inequities in how the student finance system treats university degrees versus other types of higher education provision (at Levels 4 and 5), distort the decisions of students and providers.³⁵ The level and nature of investment in further education colleges (which makes it difficult to start new courses with high overheads) also play a role.

The result is a low percentage of students with a sub-degree qualification in the UK: only 9 per cent of 25-64 year-olds in 2022 held one as their highest level. This is lower than in other European countries with a similar economic profile: in France, 15 per cent of workers in the same age group hold sub-degree qualifications, growing to 18 per cent in Sweden and to 25 per cent in Ireland. It is also higher in other Anglo-Saxon countries with similar economic institutions: in Australia, 18 per cent of 25-64 year-olds have a sub-degree qualification, and in Canada this as high as 36 per cent.³⁶ The situation among younger cohorts is even worse where only 4 per cent of the UK's 25 year olds hold a Level 4 or 5 qualification. This compares with Germany where qualifications at these Levels make up to 20 per cent of all higher education.³⁷

However, one should not see provision at Levels 4/5 and 6 as alternatives to each other. Even within the current system, a significant minority of students progress within tertiary education to different levels (for example, from Levels 4 or 5 to Level 6). Even if they choose not to, the option to progress between levels of study is valuable and may influence decisions. In countries like Switzerland, which emphasises vocational education at the tertiary level, permeability between levels is seen as an essential part of the infrastructure.³⁸ This increases the attractiveness of a more vocationally orientated education from an early age, thereby generating incentives for students to start on that track. There isn't much point talking about 'parity of esteem' for routes that offer radically different trajectories, as is often the case in England.

³⁵ Department for Education, [Independent panel report: post-18 review of education and funding](#), May 2019.

³⁶ These statistics are based on OECD data, summing together the proportion of 25-64 year-olds with 'post-secondary non-tertiary education' and with 'short-cycle tertiary education' as their highest education attainment. OECD, [Educational attainment of 25-64 year-olds \(2022\): Percentage of adults with a given level of education as the highest level attained](#), Education at a Glance 2023, OECD Indicators, September 2023.

³⁷ Department for Education, [Independent panel report: post-18 review of education and funding](#), May 2019.

³⁸ U Backes-Gellner & P Lehnert, [The contribution of vocational education and training to innovation and growth](#), University of Zurich (IBW) Economics of Education Working Paper Series No. 177, February 2021

In the UK, there is a shortage of people with a sub-degree qualification despite evidence of an earnings premium, even after accounting for many other student characteristics in younger cohorts (up to age 30).³⁹ After this age, however, trajectories do change. We previously saw (in Figure 4) that in the strategic sectors, weekly wages for individual qualified at Level 4-5 are around 7 per cent higher than for individuals qualified at Level 3 (and 26 per cent higher than for people with Level 2 qualifications), and additionally that Level 4-5 wage premia are particularly high at the beginning of workers' careers (Figure 5). To summarise, we already see education gaps within the strategic sectors, with the analysis using O*NET highlighting a lack of workers with certified upper-end intermediate skills (at Levels 4-5). This is likely to be related to structural issues with the UK education system which need to be addressed as discussed further below.

There has been a general failure to provide training to existing workers

Another reason we might be concerned about skill acquisition is that participation in workplace training has fallen over recent decades. We have already shown that, although job complexity has grown over time, training participation among the UK workforce has slowly declined since its peak in 2002.⁴⁰ This pattern can be seen across all education groups (including lower-educated workers) and among prime-age workers, so does not automatically reflect an increase in workers' pre-market skills on account of higher levels of education. Workplace-based training enables workers to develop the skills required to perform more complex tasks and to keep up with the introduction of new technologies in the workplace, so this decline is worrying.

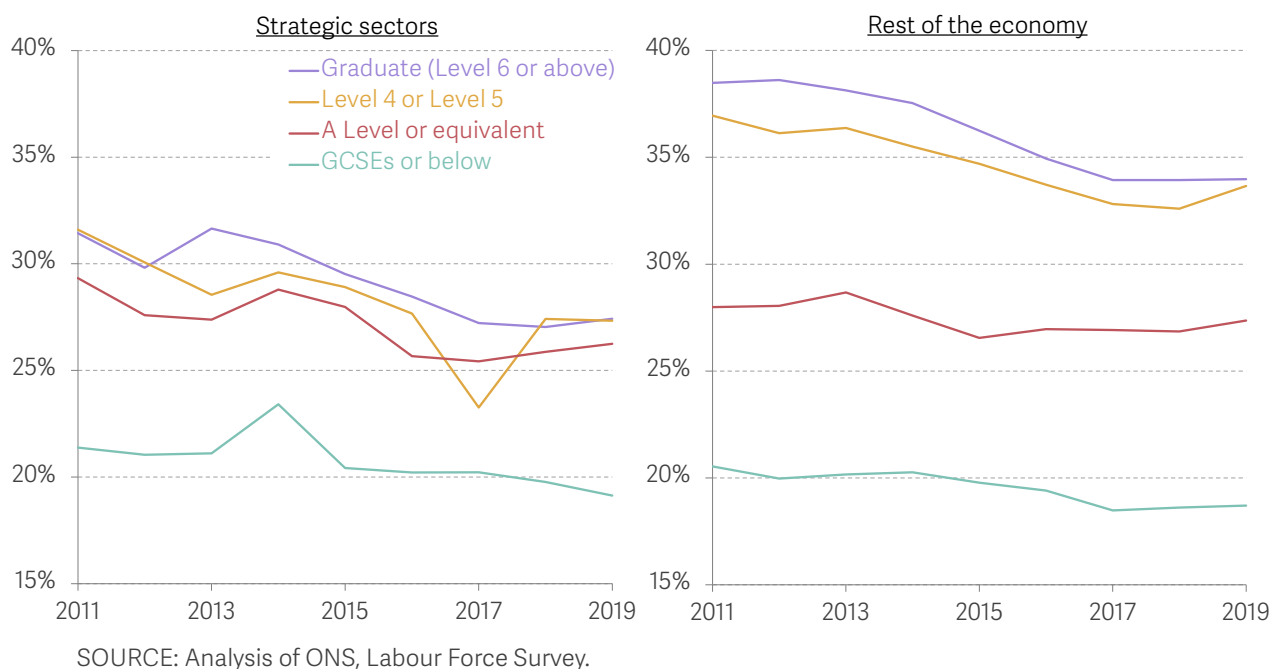
In practice, it is lower-educated workers that are least likely to receive training in the workplace or to participate in training activities to develop new skills or advance in their careers (as opposed to simply receiving training at their job-induction or for health and safety reasons). These issues are common across the economy and particularly affect the strategic sectors. The left panel of Figure 16 shows that training participation fell between 2011 and 2019 for all education groups in the strategic sectors. This is comparable to what we observe for the rest of the economy (right panel) In both cases, even if training participation has fallen most for higher educated workers, it remains lowest for workers educated only up to GCSE level.

³⁹ Espinoza et al., [Post-18 education: Who is taking the different routes and how much they earn?](#) Centre for Vocational Education Research Briefing Note No. 13, September 2020.

⁴⁰ N Cominetti et al., [Train in vain?: Skills, tasks and training in the UK labour market](#), Resolution Foundation, December 2022.

FIGURE 16: Workplace training participation has fallen across the board in the strategic sectors and in the rest of the economy

Proportion of workers participating in workplace training in the last three months by highest qualification level, in the strategic sectors (left), and in the rest of the economy (right): UK, 2011-2019



There are a number of potential reasons for the decline in training, and we discuss them further below.⁴¹ But this analysis suggests that lower investment in skills has become an ingrained feature of the economy, including in higher-paid, export-oriented sectors.

⁴¹ See also: J Li et al, [Trends in job-related training and policies for building future skills into the recovery](#), Centre for Vocational Education Research Discussion Paper No. 33, December 2020.

Section 6

Strategic technologies require high skill levels as well as adaptability

Beyond the strategic sectors, broader trends and transitions, such as the decarbonisation of the economy in line with net zero commitments, and ongoing digitalisation in light of the latest wave of generative AI, have implications for skills demand. Our analysis of 'green jobs' suggests that they tend to require a disproportionate share of analytical tasks and personal tasks, which are in turn associated with occupations requiring higher levels of education. Our results, as well as broader literature, suggest that meeting skills needs through the education system and by training the existing workforce will be key for a smooth and inclusive transition to net zero.

We examine the potential impacts of AI by analysing IT-related requirements in job adverts, where AI skills are one of the largest categories of new skills. We find that there is a particularly high rate of churn in IT-related skills, and that such skills have relevance for most occupations across the economy. These facts suggest that future cohorts of workers will need their education to build flexibility and resilience to change, and that current cohorts of workers are given the opportunity to update their skills.

So far, we have shown that there is high demand for highly skilled and educated workers in several established strategic sectors. But broader trends and transitions, such as the decarbonisation of the economy in line with net zero commitments, and ongoing digitalisation in light of the latest wave of generative AI, have implications for skills demand. In both cases, there are implications for the UK as a developer of relevant technologies in certain areas, and for enabling the successful deployment or diffusion of

these technologies across the economy. This section draws upon previous work in the Economy 2030 Inquiry and broader research to set out what these transitions imply for a human capital strategy in the UK.

Existing 'green' jobs are relatively high skilled

A key challenge in understanding the labour market impacts of the net zero transition is that, as yet, there is no commonly agreed definition of a 'green job'.⁴²

Occupational approaches tend to define green jobs as those involving new green tasks and skills arising from the net zero transition. Such analyses, including a recent UK based analysis mapping O*NET green job classifications to labour force survey data, suggest that green jobs tend to be highly skilled, and more likely to be held by graduates than non-green jobs, even within industrial sectors.⁴³ A previous report for the Economy 2030 Inquiry builds on this occupational approach, identifying a set of 'core' green jobs and 'brown' jobs (particularly prevalent in high emissions sectors).⁴⁴ This analysis estimates that around 13 per cent of employment in 2019 was in green jobs (examples include manufacturing production managers, construction trades, plumbing and heating managers or environmental professions), and 4 per cent was in brown jobs (such as LGV drivers, welders, mining managers, and jobs like engineering professionals or pilots). The vast majority of these brown jobs are not expected to disappear during the transition to net zero, but instead will need to change with new tasks and skills which might already be being adopted in many cases.⁴⁵

A detailed comparison of workers in these two types of jobs finds that green jobs are particularly prominent amongst graduates (16 per cent of graduates work in these jobs), but brown jobs are most common for workers with 'other' qualifications (like trade apprenticeships, where 9 per cent work in brown jobs) or no qualifications (see Figure 17).⁴⁶

⁴² For a review of relevant literature, and the pros and cons of different approaches, see: A Valero et al., [Are 'green' jobs good jobs?](#), Centre for Economic Performance Discussion Paper No. CEPSP39, October 2021.

⁴³ See: A Valero et al., [Are 'green' jobs good jobs?](#), Centre for Economic Performance Discussion Paper No. CEPSP39, October 2021; and M Broome et al., [Net Zero Jobs: The impact of the transition to net zero on the UK labour market](#), Resolution Foundation, June 2022.

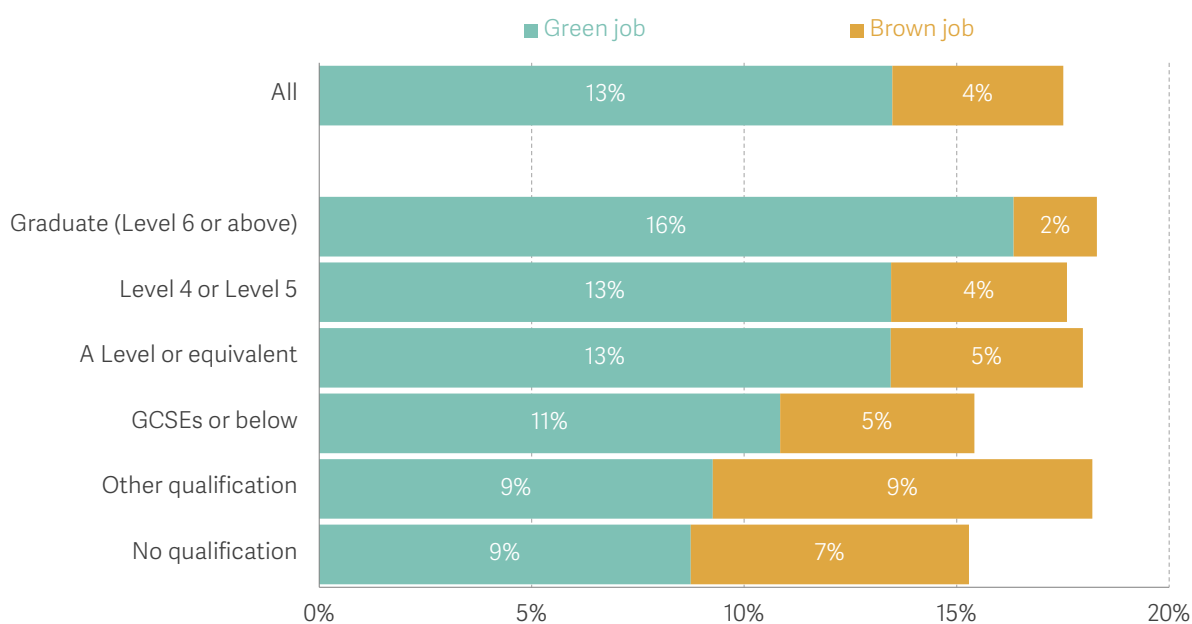
⁴⁴ As set out in our previous work, our 'brown' job category included some occupations that are already involving new green tasks and skills, but because such occupations are particularly prevalent in high emissions sectors, we categorised them as 'brown' – jobs that require significant change to tasks and technologies employed as part of the transition to net zero. See: M Broome et al., [Net zero jobs: The impact of the transition to net zero on the UK labour market](#), Resolution Foundation, June 2022.

⁴⁵ For example, coal mining operatives – a job that is inconsistent with a net zero economy – account for just 0.01 per cent of employment in 2019.

⁴⁶ This originally appeared in: M Broome et al., [Net Zero Jobs: The impact of the transition to net zero on the UK labour market](#), Resolution Foundation, June 2022.

FIGURE 17: Workers in green jobs tend to be more educated

Proportion of workers aged 16-69 in green or brown jobs, by highest qualification level: UK, 2019



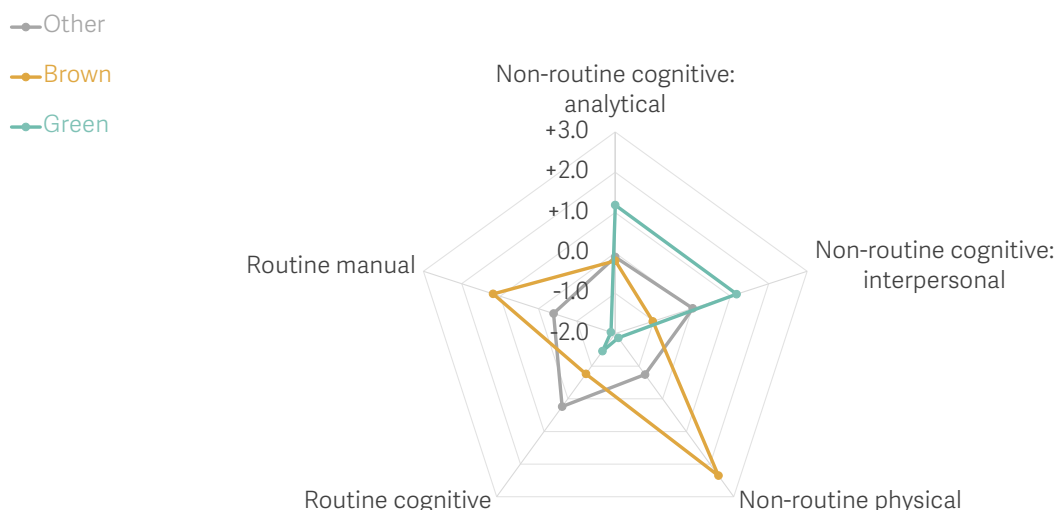
SOURCE: Analysis of ONS, Labour Force Survey.

Figure 18 compares task requirements of green and brown jobs using the approach detailed in Section 4. In green jobs, non-routine analytical and personal tasks are the most important tasks. In contrast, routine and physical tasks are more relevant in brown jobs. Job-to-job transitions rarely occur between jobs with such different overall task profiles.⁴⁷

⁴⁷ This is taken from: M Broome et al., *Net Zero Jobs: The impact of the transition to net zero on the UK labour market*, Resolution Foundation, June 2022.

FIGURE 18: Green and brown jobs look very different based on the type of tasks workers perform

Relative intensity of different types of tasks across green, brown and other occupations: UK, 2019



NOTES: The measures of task intensity are standardised across all SOC 2010 4-digit level occupations.
SOURCE: Analysis of O*NET and ONS, Labour Force Survey.

Figure 19 applies the same occupational classification of green and brown jobs to the online job vacancies data used in Section 4. Here, green jobs (regardless of sector) are compared to brown occupations, and to all other jobs. In common with the strategic sectors, a higher share of green jobs than 'other' jobs require specialised skills, including in science and research, the environment, and energy and utilities. For brown jobs, engineering, manufacturing and construction skills stand out. Skills related to the environment have a similar importance for brown and green jobs (reflecting the fact that many of these jobs are already changing and adapting to sustainability imperatives).⁴⁸ Additional analysis looking at changes in the importance of specialised skills, and also of the more general categories of skills across green, brown and other jobs is set out in the Annex.

⁴⁸ The rich text available in job adverts allows for a more granular classification of green jobs than is possible using standard UK occupation codes. Recent research has built classifications of more specific (and narrowly defined) green jobs based on a set of keywords selected from existing definitions of green tasks and products, estimating that around 1.5 per cent of job adverts could be considered green in 2021. Again, on this definition, it is found that a core set of green jobs is more likely to require cognitive, IT, management, social, and technical skills compared to non-green jobs. See: M Sato et al., *Skills and wage gaps in the low carbon transition: comparing job vacancy data from the US and UK*, Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy, January 2023.

FIGURE 19: Green and brown jobs place more emphasis on certain specialised skills than other jobs

Shares of vacancies including specified specialised skills: UK, 2022

Specialised skills	Green jobs	Brown jobs	Other
Business	66%	37%	44%
Information Technology	36%	37%	34%
Customer and Client Support	39%	20%	31%
Analysis	27%	24%	24%
Finance	28%	10%	23%
Engineering	34%	62%	23%
Health Care	11%	10%	22%
Law, Regulation, and Compliance	31%	33%	22%
Marketing and Public Relations	33%	9%	22%
Transportation, Supply Chain, and Logistics	29%	34%	19%
Sales	31%	11%	17%
Maintenance, Repair, and Facility Services	20%	29%	16%
Media and Communications	21%	18%	16%
Education and Training	8%	5%	15%
Hospitality and Food Services	8%	14%	14%
Manufacturing and Production	20%	45%	13%
Architecture and Construction	22%	38%	12%
Design	9%	11%	9%
Science and Research	11%	15%	8%
Human Resources	6%	5%	7%
Other	8%	7%	7%
Administration	4%	3%	7%
Performing Arts, Sports, and Recreation	3%	3%	5%
Environment	10%	10%	5%

Public Safety and National Security	4%	5%	4%
Social and Human Services	4%	1%	3%
Energy and Utilities	7%	10%	3%
Economics, Policy, and Social Studies	5%	2%	3%
Property and Real Estate	3%	1%	2%
Agriculture, Horticulture, and Landscaping	1%	2%	1%
Personal Care and Services	0%	0%	0%

NOTES: Green and brown occupations defined in Tables 1 and 2 of M Broome et al., *Net zero jobs: The impact of the transition to net zero on the UK labour market*, The Resolution Foundation, June 2022.

SOURCE: Analysis of data provided by [Adzuna Intelligence](#).

Skills are likely to be a key enabler of the next phase of the transition to net zero

The different analyses discussed so far point to green jobs having high skill requirements. But the next stage of the transition will involve accelerated action to decarbonise all areas of the economy, and structural change which will further impact on jobs and the demand for skills. An assessment by the CCC concluded that the net zero transition is likely to create between 135,000 to 725,000 additional jobs by 2030 in low-carbon sectors, such as building retrofit, renewable energy generation and the manufacture of electric vehicles.⁴⁹ But, given international competition, such jobs growth is not guaranteed, and it would require active reskilling and upskilling of the workforce.

In terms of more specific skills needs, in 2021, the Government's Green Jobs Taskforce considered three groups of sectors: those that are well-established and will experience significant growth (e.g. offshore wind or buildings retrofit); those predicted to grow ahead of the transition (e.g. carbon capture, usage and storage); and those that are experiencing significant transformation and perhaps decline in some areas (e.g. automotive, heating and cooling, or oil and gas).⁵⁰ While noting specific, technical skills requirements, the Taskforce also highlighted the importance of general skills, including the ability to work between and across disciplines. It also emphasised other key areas, such as general STEM skills, together with digital, project and change management, and leadership skills.

Ensuring that skills needs are met – via both education and retraining – will be key to delivering net zero, ensuring that transitions (particularly for those exiting 'brown' jobs)

⁴⁹ Climate Change Committee, *A Net Zero Workforce*, May 2023.

⁵⁰ Department for Energy, Business and Industrial Strategy, *The Green Jobs Taskforce report*, July 2021.

are managed well, and realising new opportunities for firms producing innovative net zero goods and services to meet growing global demand.⁵¹

The diffusion of AI is accelerating, creating a need for workers to refresh their skills

As the birthplace of the First Industrial Revolution, the UK is no stranger to technological innovation and how it can significantly change the nature of work. The latest wave of technological change – the so-called Fourth Industrial Revolution – involves a combination of new technologies that lie across physical, digital, and biological spheres. Artificial Intelligence (AI) is likely the most prominent of such technologies, and it is currently seen as a threat to a wide range of occupations which, so far, were thought to be immune to job losses due to technological adoption. For the purposes of this report, it is important understand how the spread of new AI-related technologies is shaping in the UK labour market and the demand for skills.

We start by revisiting the vacancy analysis in order to track the emergence of new skills directly and indirectly related to AI. To do so, we focus on the IT category as an encompassing group of skills with close degree of linkage to AI. We find that this is a dynamic area, with new IT-related specialised skills representing one in every four new skills that appeared in job adverts between 2016 and 2022 - by far the largest share of any other grouping (see Table 3).⁵² Within new IT skills, the skill “AI” is one of the most frequently mentioned. It is also the case that nearly half of all specialised skills which have disappeared or significantly decreased in importance (measured by change in the number of mentions in job vacancies) also lie within the IT category. Combined, these findings point to a high level of churn in specialised IT skills – a significant amount of skills turn obsolete but a high number of new skills emerge and take their place.

⁵¹ B Curran et al., [Growing Clean: Identifying and investing in sustainable growth opportunities across the UK](#), Resolution Foundation, May 2022.

⁵² “New skills” are those that either appear for the first time or are seeing a particularly rapid rise in demand. “Old skills” are those that disappear or that are phased out at a fast rate. For details on the definition of new and old skills please see: R Costa et al, Report for the Pissarides Review, forthcoming, 2023.

TABLE 3: IT-related skills represent the highest shares of emerging and disappearing skills in the recent period

Specialised skill categories, by share of new skills and old skills appearing in job adverts: UK, 2016-2022

Specialised skill category	Share of new skills	Share of old skills
Information Technology	24%	47%
Health Care	8%	15%
Engineering	6%	3%
Environment	6%	0%
Science and Research	5%	1%
Law, Regulation, and Compliance	5%	2%
Other	4%	3%
Analysis	4%	3%
Business	4%	2%
Energy and Utilities	4%	1%
Finance	4%	1%
Education and Training	4%	1%
Human Resources	3%	2%
Design	3%	2%
Performing Arts, Sports, and Recreation	2%	1%
Maintenance, Repair, and Facility Services	2%	1%
Media and Communications	2%	2%
Transportation, Supply Chain, and Logistics	2%	1%
Agriculture, Horticulture, and Landscaping	1%	0%
Marketing and Public Relations	1%	4%
Customer and Client Support	1%	0%
Economics, Policy, and Social Studies	1%	0%
Public Safety and National Security	1%	0%
Administration	1%	1%
Manufacturing and Production	1%	1%
Sales	1%	3%
Architecture and Construction	0%	1%
Hospitality and Food Services	0%	1%
Social and Human Services	0%	0%
Property and Real Estate	0%	0%
Personal Care and Services	0%	1%

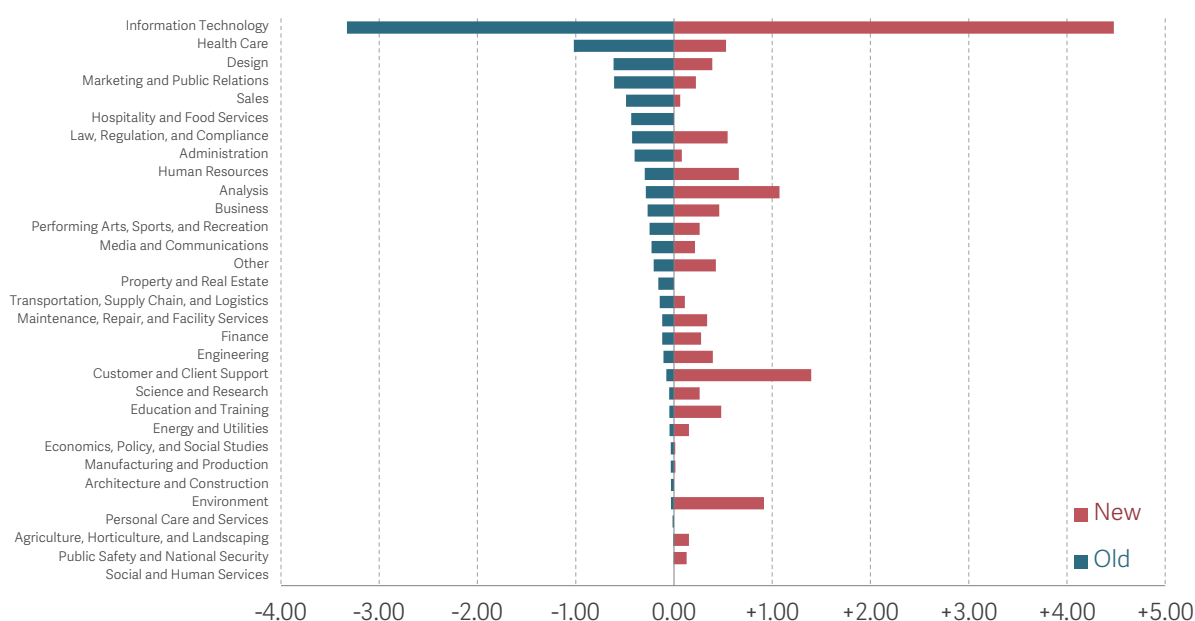
NOTES: Skill categories are defined according to Lightcast specialised taxonomy.

SOURCE: Analysis of data provided by [Adzuna Intelligence](#).

Figure 20 further reinforces the previous point by showing that among IT vacancies, the changes in shares of mentions per vacancy of “new” or “old” skills are larger than in any other specialised skill field. This statistic gives a sense of the speed of change in turnover of skills.

FIGURE 20: The turnover of new and old skills is largest in IT-related specialised skills

Changes in shares of skill mentions per vacancy: UK, 2016-2022



SOURCE: Analysis of data provided by [Adzuna Intelligence](#).

It is difficult to predict which specific jobs and sectors will be most affected by displacement, productivity and reinstatement effects of the next wave of technological change.⁵³ But we are able to identify that certain high-skilled occupations linked to IT (such as IT managers and directors, programmers and software developers, and database administrators) already require, and will continue to require, a robust and continuous level of (re-)training in order for workers to keep their skills from becoming obsolete.

Approximately 8 per cent of job adverts in 2022 included at least one new IT skill in their job description. But new IT skills are relevant across the majority of occupations, with 80 per cent of 396 occupations having at least one job ad requiring a new IT skill.⁵⁴ The need for new skills ranges in intensity across occupations, with 92 per cent of all cyber security job adverts requiring a new IT skill, and journalists and reporters and marketing associates seeing 6.6 per cent and 5.7 per cent of their jobs adverts requiring new IT

⁵³ For explanation of these effects, see: R Costa & Y Yu, *Adopt, adapt and improve: A brief look at the interplay between labour markets and technological change in the UK*, Resolution Foundation, November 2022.

⁵⁴ These occupations are defined using the SOC 2020 4-digit classification.

skills respectively. There is therefore a wide reach of these new technologies across the occupational spectrum.

Overall, the speed of change and reach of AI-relevant IT skills implies that workers at different skill levels will need to adapt. Preparing the future workforce with flexible skill sets and investing in updating the skills of current workers will be needed to mitigate potential displacement effects and take full advantage of potential gains of this new technological wave.

Section 7

Policy proposals for building human capital for strategic sectors and technologies

This report has stressed the need for the UK to have a more skilled workforce to help meet the needs of the economy at large as well as allow strategic sectors to flourish, and to deploy strategic technologies effectively. In this section, we discuss the main policy avenues to support investment in human capital.

For young people, the financing of higher education needs to be safeguarded and financial support for further education put on a level playing field. There needs to be a concerted effort to improve and integrate the sub-degree offer, signposting progression pathways from Level 3 to Level 4 and 5 through university to better exploit the synergies between FE and HE. For the existing workforce, tax policy needs to provide the right incentives for firms and individuals to take up training, and regional and sectoral co-ordination can help overcome market failures.

The analysis so far in this report has shown that the demand for highly-skilled and educated workers is high in the economy in general and even more pronounced for strategic sectors and technologies.

At present, the demand for skilled workers is being partly met by hiring educated workers from overseas. There is nothing wrong with relying on migrant workers, and the overall economic contribution of migrants over recent decades has been positive.⁵⁵ As argued elsewhere in the Economy 2030 Inquiry, attracting top international talent and skilled

⁵⁵ Among other things, historically migration of skilled workers has helped reining in pay inequality. See: M Manacorda, A Manning & J Wadsworth, [The Impact of Immigration on the Structure of Wages: Theory and Evidence from Britain](#), Journal of the European Economic Association 10(1), February 2012.

labour needs to be an important part of the overall strategy to improve skills.⁵⁶ But we also need to improve the supply of skilled workers from within the UK.

Meeting the high and growing demand for skills can be done in two ways: increasing the inflow of labour market entrants with tertiary education and upskilling the existing workforce. The former is easier to do at scale, because young people spend most or all of their time within the education system whereas older people have more competing demands. Furthermore, the acquisition of skills earlier in life facilitates the acquiring of skills later on. In what follows, we tackle each route in turn, with a focus on economy-wide policy levers, but we will also briefly discuss policies that are focused more on specific regions or sectors. Even in a best-case scenario with many well-resourced policies to increase education and skills, the reality is that it takes time to do this at scale.

Education policies should seek to increase the inflow of labour market entrants with tertiary education, addressing inequalities in access and improving routes to a sub-degree qualification

Much like investing in physical capital to build up productive capital stock, it takes investment in human capital to improve the quality of the workforce. The influential work by James Heckman and others shows this needs to start at an early age, and it also suggests the importance of continued investment as a person progresses through the education system.⁵⁷ As a result, the quantity and quality of investment in young people's education from childhood onwards is of fundamental importance for influencing how many of them will ultimately enter the labour market as highly skilled and qualified young adults. In addition, when it comes to socio-economic gaps in access to higher education in England, research suggests that most of this can be explained by the fact that poorer students have lower levels of attainment at GCSE and Key Stage 5.⁵⁸

One of the more obvious levers available to the Government is educational spending, which has been shown to cause changes in student achievement.⁵⁹ But this has been in decline by any measure. Education spending has declined as a share of GDP (from over 5 per cent of GDP in the late 2000s to 4.6 per cent today), as a share of government spending (to 10 per cent of all spending in 2020-21 – a historical low point) at the same time as the proportion of the population in full-time education has been rising, and in absolute terms (especially between 2010-11 and 2019-20, when there was a real terms cut

⁵⁶ S Bhalotia et al., [Trading Up: The role of post-Brexit trade approach in the UK's economic strategy](#), Resolution Foundation, June 2023.

⁵⁷ See, for example: F Cunha & J Heckman, [The technology of skill formation](#), *American Economic Review* 97(2), May 2007.

⁵⁸ H Chowdry et al., [Widening participation in higher education: Analysis using linked administrative data](#), *Journal of the Royal Statistical Society* 176, February 2013.

⁵⁹ S Gibbons, S McNally & M Viarengo, [Does Additional Spending Help Urban Schools? An Evaluation Using Boundary Discontinuities](#), *Journal of the European Economic Association* 16(5), October 2018; R Johnson & C Jackson, [Reducing Inequality through Dynamic Complementarity: Evidence from Head Start and Public School Spending](#), *American Economic Journal: Economic Policy* 11(4), November 2019.

of 8 per cent).⁶⁰ Such spending reductions have consequences for how much students learn in education and this does not bode well for growth.

Within education spending, higher education has fared relatively well because of student finance reforms which introduced student fees, and then massively increased them from 2012-13. But neither the capped fees nor maintenance loans are keeping pace with inflation, meaning lower real-terms income for universities and less financial support for students. These issues of the level of financing need to be addressed to support an expansion of tertiary education.⁶¹

Inequities within higher education need to be addressed, with qualifications at sub-degree level properly integrated

Within higher education, there are also inequities that may have distorted the decisions of students and providers; these were discussed in detail in the Augar Review, which we summarise in Box 5.⁶² In brief, the student finance system has historically given students an incentive to enrol in three-year degree courses, and providers an incentive to offer these courses, because of complicated rules that limit flexibility in access to loans and how they may be used. In addition, many Level 4 and 5 qualifications have not been eligible for income-contingent loans.

BOX 5: The Augar Review

The Independent Review of Post-18 Education and Funding, known as the Augar Review, was published in May 2019. It extensively reviewed and critiqued provision within tertiary education, including on the level and structure of finance, drawing attention to the inequitable way that tertiary level education is financed between Levels 4 and 5 and Level 6. The review also highlighted that the UK also compares

poorly internationally to other countries in providing education at Levels 4 and 5.

In addition to the (distorting) incentives, the review argued that the severe funding cuts experienced by further education colleges have left them with no surpluses available for high-cost technical provision. In particular, in 2009/10, there were approximately 510,000 learners enrolled on a sub-bachelor (Level 4-5) course; by 2014/15

⁶⁰ E Drayton et al., [Annual report on education spending in England: 2022](#), Institute for Fiscal Studies, December 2022.

⁶¹ In a recent blog, Nicholas Barr argues for some restoration of the teaching grant, not increasing fees and reforms to parameters of the loan system (interest rates, time for repayment, and changing the income thresholds for repayment of loans). See: N Barr, [A fairer way to finance tertiary education](#), LSE Politics and Policy, June 2023. A companion paper to this argues for a quinquennial review of fees and loan terms; see: D Willetts, [How higher education can boost people-powered growth](#), Resolution Foundation, October 2023.

⁶² Department for Education, [Independent panel report: post-18 review of education and funding](#), May 2019.

this had reduced to 240,000 and by 2016/17 to 190,000. The review argues that these declines are accounted for in large part by the way in which post-18 funding is currently organised.

Some of its core recommendations have been acted upon in the Skills and Post-16 Education Act 2022, including more equitable treatment of different forms of tertiary education within the Lifetime Loan Entitlement.

Our analysis of the strategic sectors strongly concurs with the diagnosis that there is a gap in provision of sub-degree (Level 4 and 5) qualifications, and that this lack of supply is potentially limiting for employment growth in these sectors. But the huge earnings premium associated with a degree in the 'strategic sectors', as well as in the economy more generally, suggests there is also a continued need to increase the number of students with degree-level qualifications.

Although the HE participation rate in the UK is comparable to other similarly sized developed economies, progression has slowed over the last few years. But demographic trends suggest that the number of 18-year-olds will increase to well over 850,000 young people in 2030 (up from 700,000 in 2020).⁶³ Given that younger generations are much more likely to go to university, this may result in a net increase in the supply of university graduates, which would support the expansion of the strategic sectors. On the other hand, recent generations will still suffer from the scarring effects of Covid-19 which has been shown to have large effects on knowledge and skills, particularly for disadvantaged students.⁶⁴

To increase the supply of students with all forms of higher education, the most obvious policy recommendation is to increase investment. The FE and HE sectors cannot do more with less and less income.⁶⁵

The Government has committed to putting all tertiary education on a level playing field when it comes to the student finance system. The Lifetime Loan Entitlement will be implemented from 2025 and allow students an entitlement to borrow up to the equivalent in value of four years of post-18 education to use over their lifetime. In principle, this should remove one of the incentives for students and institutions to systematically favour university degrees over sub-degree qualifications. Reforms will also bring in student loans for separate modules, and there will be changes to the rules governing student loan eligibility for learners who already hold a qualification at the same or higher level.⁶⁶

⁶³ ONS estimates included in: UCAS, *What is the Journey to a million?*, accessed 16 October 2023.

⁶⁴ H Patrinos, E Vegas & R Carter-Rau, *An Analysis of COVID-19 Student Learning Loss*, Policy Research Working Paper 10033, World Bank Group, May 2022.

⁶⁵ Level 4 and 5 provision is mostly split between universities (about 45 per cent) and further education colleges (53 per cent).

⁶⁶ L Sibieta, I Tahir & B Waltmann, *Adult Education: the past, present and future*, Institute for Fiscal Studies, June 2022.

Although these reforms move things in the right direction, it is not yet clear whether providers will offer qualifications in a modular form, as there are many contexts in which it would not be practical to have large time intervals between modules. In addition, some groups of students may be disadvantaged by a four-year loan allowance (relative to the current system) and given that a standard university degree takes three years, this does not allow much scope for combining different levels of qualification.⁶⁷ These issues do not have a simple solution.

The creation of new sub-degree qualifications is to be welcomed, but they are needed in some areas far more than others

Another government policy in this area is the creation of new higher technical qualifications.⁶⁸ These are approved by the Institute for Apprenticeships and Technical Education against employer-led occupational standards.

Our analysis supports the creation of new national qualifications at this level, though we caution against their blanket adoption across the economy as a whole. Current Level 4 and 5 qualifications are in demand within the Life sciences industries (where there is a large pay premium) but not in Financial and business services. Within The creative and cultural sector, there is a pay premium for the first 10 years (relative to Level 3). Therefore, it is important to develop such qualifications with representative bodies within these sectors and then to ensure that employers more broadly understand how the courses equip people for work in the sector.

Students, parents and teachers need to understand where sub-degrees fit into the educational landscape and what they mean for careers

It is also important that students (as well as their parents and teachers) understand how Level 4 and 5 qualifications link with earlier qualifications and what opportunities they open up in the future, both in terms of employment and higher levels of education (should they wish to pursue it). In addition to an improved level and structure of funding, it is important that students and employers understand pathways from Level 3 to Levels 4-5 and to Level 6, including on how apprenticeships link into all of this.

The complexity of post-16 pathways in vocational education in particular has been well documented.⁶⁹ It also doesn't help that Level 4 and 5 qualifications are in such scarce supply that many people may not have even heard of them. Although qualifications need to be set in a national framework, an improvement in signposting and careers advice and

⁶⁷ For example, those who have completed four years of post-18 study would no longer be eligible for any funding at Levels 4-6 under the lifetime loan guarantee (whereas currently they would be eligible to take out an Advanced Learner Loan).

⁶⁸ See information about Higher Technical Qualifications on: find-employer-schemes.education.gov.uk/schemes/higher-technical-qualifications, accessed 16 October 2023.

⁶⁹ See, for example: C Hupkau et al., Post-Compulsory Education in England: Choices and Implications, National Institute Economic Review 240, May 2017.

information could be pursued at a regional or local level, especially as regional priorities for employment and growth may be different.⁷⁰

Corporate tax reforms can strengthen incentives for firms to invest in their workforce

The need to acquire and develop human capital continues throughout a person's working life. As we have discussed, the net zero transition and ongoing diffusion of AI across the economy both require existing workers to up- or re-skill to adapt to new technologies and tasks. Research on training in Switzerland has shown that those in more technical fields have greater need of updating their skills to avoid their employment prospects deteriorating.⁷¹

Given that employers benefit from more highly skilled workers, there is already an incentive for them to invest in the training of their workforce. But this may not happen at anything like the right level because of the strong possibility that workers may leave the firm after their training, once their productivity has been enhanced by their newly-acquired human capital. When the worker's skills are of general value and transferrable (as are so many of the skills identified as important in our analysis for strategic sectors), then this becomes even more likely. Employee turnover, therefore, can drastically reduce employers' return on their investment in training.⁷² Although market imperfections mean that firms do have some incentive to invest in general training, it still remains the case that firms will underinvest if they cannot recoup the returns because some newly-trained workers will move to other firms.⁷³

Previous work in the Economy 2030 Inquiry has documented the decline in training over recent decades, showing that the proportion of workers who report that they have received work-related training in the past three months has fallen from 29 per cent in 2002 to 24 per cent in 2020.⁷⁴ Earlier in this report, we showed that this decline in training has been just as bad in the strategic sectors. There are a number of potential reasons for this decline, but among the most plausible are the facts that training is a discretionary

⁷⁰ The importance of exposure and information is well-illustrated in the context of work on who becomes an inventor in America which shows that young people growing up with exposure to innovation are more likely to become inventors. See: A Bell et al., *Who Becomes an Inventor in America? The Importance of Exposure to Innovation*, *Quarterly Journal of Economics* 134(2), November 2018.

⁷¹ T Schultheiss & U Backes-Gellner, *Different degrees of skill obsolescence across hard and soft skills and the role of lifelong learning for labor market outcomes*, *Industrial Relations* 62(3), January 2023.

⁷² This argument is behind Becker's theory that firms in competitive markets will not invest in general training at all and all costs would need to be borne by workers. See: G Becker, *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*, University of Chicago Press, Chicago, 1964.

⁷³ For a discussion of training in imperfect markets, see: D Acemoglu & J S Pischke, *The Structure of Wages and Investment in General Training*, *Journal of Political Economy* 107(3), June 1999.

⁷⁴ N Cominetti et al., *Train in Vain? Skills, tasks and training in the UK labour market*, Resolution Foundation, December 2022.

expenditure (and therefore easy to cut during times of financial pressure) and that transferrable skills have increased in importance over time (therefore increasing the risk that workers, once trained, will move firms).⁷⁵

In this environment, there is a strong case for government intervention to incentivise firms to train their workers. If training is subsidised, firms will worry less about poaching (i.e. they have lower costs to recoup if the worker subsequently moves). Furthermore, subsidising training would help redress inequities in the tax system which favour physical capital over human capital through incentives like R&D tax credits. The UK is, of course, in need of increased capital investment and would benefit from permanent, enhanced investment allowances.⁷⁶ But in the current tax code, capital is subsidised more favourably than labour,⁷⁷ giving firms an incentive to replace workers with machinery where possible.⁷⁸

The mechanism through which firms could be subsidised to invest in training could be a 'human capital tax credits' system.⁷⁹ These would work just like R&D tax credits and mean that firms investing in certain types of training would be subsidised through the tax system. Such systems are in place in Austria and in several US states.⁸⁰ We are not aware of evaluations of these incentives when directed towards human capital, although there is evidence of their effectiveness in the more common R&D context.⁸¹ As proper implementation is so important for such policies (particularly to prevent fraud and error), a targeted and experimental approach here would be a better policy response than radical change across the whole economy, so we propose that this mechanism should be trialled in areas where training is in high demand. Some of this could be in the contexts described in this report such as training the net zero workforce.⁸²

Of course, in the UK, there is already the apprenticeship levy, where the design is such that large employers (levy payers) are incentivised to enter their employees into apprenticeships. Although there is much to be said for this system, it is not working well

⁷⁵ J Li, A Valero & G Ventura, [Trends in job-related training and policies for building future skills into the recovery](#), Centre for Vocational Education Research Discussion Paper No. 33, December 2020.

⁷⁶ P Brandily et al., [Beyond Boosterism: Realigning the policy ecosystem to unleash private investment for sustainable growth](#), Resolution Foundation, June 2023.

⁷⁷ D Rodrik, V Doshi & H Spencer, [Creating a Good-Jobs Economy in the UK](#), Resolution Foundation, July 2023.

⁷⁸ This has been documented as an important issue in the US. See: D Autor, D Mindell & E Reynolds, [The Work of the Future: Building Better Jobs in an Age of Intelligent Machines](#), MIT Work of the Future Report, November 2020.

⁷⁹ These were proposed by the LSE Growth Commission. See: P Aghion et al., [UK Growth: A New Chapter](#), Centre for Economic Performance, LSE, February 2017. See also: R Costa et al., [Investing in People: the case for human capital tax credits](#), Centre for Vocational Education Research, LSE, March 2018.

⁸⁰ For discussion, see: A Fitzpayne & E Pollack, [Working Training Tax Credit: Promoting Employer Investments in the Workforce](#), Aspen Institute Future of Work Initiative, August 2018.

⁸¹ See, for example: A Dechezleprêtre et al., [Do Tax Incentives for Research Increase Firm Innovation? An RD Design for R&D, Patents and Spillovers](#), Centre for Economic Performance, LSE, 2016 (forthcoming in *American Economic Journal: Economic Policy*). For a more general review of the evidence, see: N Bloom, J Van Reenen & H Williams, [A Toolkit of Policies to Promote Innovation](#), *Journal of Economic Perspectives* 33(3), Summer 2019.

⁸² Another way of strengthening incentives for investment in training through the corporate tax system, which could be explored in the UK, is through something like the enhanced investment subsidies in the US Inflation Reduction Act; these are available conditional on investments involving a certain percentage of labour hours performed by qualified apprentices

for SMEs (as discussed in another report for the Economy 2030 Inquiry).⁸³ And of course, apprenticeships are a very specific type of training. We need mechanisms to support other types of training as well.

Stronger incentives for individuals to invest in their education and skills are also required – potentially through Individual Learner Accounts or personal tax incentives

Employer-based incentive systems will not be suited to individuals who are out of the labour market, those who are self-employed, or who are on contracts where employers have little incentive to invest in training (for example, short-term contracts).

So governments should think about how best to ensure that individuals are incentivised and resourced to undertake training themselves. The two key reasons why individuals may not invest enough in skills from the point of view of society overall are credit constraints, because individuals can't borrow against the hoped-for higher future earnings, and that individuals may not take fully account of the benefits of education and training to wider society. However, the constraints to individuals from investing in education and training may arise for reasons other than direct costs alone; they may arise because of family commitments (including access to affordable childcare), or the ability to take time off work. Because of these other constraints, it isn't clear whether subsidising the direct costs of education or training will be sufficient on its own.⁸⁴

There is also much less evidence about the returns to investing in education as an adult compared to these investments for young people, although there is a large body of evidence about the effects of training in the context of active labour market policies.⁸⁵ There is good evidence on the effects of adult education from some northern European countries, and studies find evidence for positive returns, though impacts vary, being more beneficial for those with only compulsory and secondary education in Finland⁸⁶ and for women in Norway.⁸⁷ Research from the UK has found that training can have a role for

⁸³ R Layard, S McNally & G Ventura, [Applying the Robbins Principle to Further Education and Apprenticeships](#), Resolution Foundation, October 2023.

⁸⁴ One recent government initiative to support workers with lower-level education is the 'Lifetime Skills Guarantee', which allows adults to undertake a Level 3 qualification for free if they don't already have one. In practice, this may be quite restrictive as there needs to be a suitable course available in the local area. As funding for Further Education Colleges is not demand-led, this cannot be taken for granted. See, R Layard, S McNally & G Ventura, [Applying the Robbins Principle to Further Education and Apprenticeships](#), Resolution Foundation, October 2023;

⁸⁵ See, for example: D Card, J Kluve & A Weber, [What Works? A Meta Analysis of Recent Active Labor Market Program Evaluations](#), Journal of the European Economic Association 16(3), June 2018.

⁸⁶ A. Kauhanen & H. Virtanen, [Heterogeneity in Labor Market Returns to Adult Education](#), ETLA Working Papers No. 91, September 2021.

⁸⁷ P Bennett, R Blundell & K Salvanes, [A Second Chance? Labor Market Returns to Adult Education Using School Reforms](#), IZA Discussion Paper, August 2020.

women in reducing the wage gap that arises from part-time work after having children, and that this is especially important for those women who completed high school level education but did not go on to university.⁸⁸

Individual Learning Accounts are a commonly used vehicle to provide individual incentives for training: they have been implemented in other countries, and also in the UK in the early 2000s. The idea is that workers have a certain amount of money in these accounts to pay for training, which does not necessarily have to be funded only by public expenditure. For example, a proposal for individual learning accounts in the US suggests that they should be funded through shared investment by employers and workers, as well as government.⁸⁹ Such accounts might offer flexibility, enabling workers to access short-term training opportunities throughout their career.

Recent examples of individual learning accounts include Singapore, which recently established these for each citizen over the age of 25 to spend on education and training programs from a list of 500 approved providers; and France, where they were established in 2015 (workers can use their accounts to pay for 24 hours of training per year over eight years in a wide variety of programmes). But these programmes are not new, and have been robustly evaluated in the past.⁹⁰ Evidence from The Netherlands shows that this mechanism does increase training participation, although there was a high deadweight cost (it is estimated that over half of the training would have otherwise been financed by private parties).⁹¹ Similar findings have also been reported for Switzerland.⁹²

However, the experience of Individual Learning Accounts in England in the early 2000s is not considered to be a good one. The Augar review concluded that this was the result of poor design and hasty implementation; in particular, large numbers of providers were involved without proper controls and were incentivised to recruit learners at speed for low-level courses.⁹³ The crucial issue is that providers meet quality standards and that low-paid workers have sufficient funds to access training. Given the UK's experience in the early 2000s, we recommend that such a policy should be piloted (through a randomised control trial, ideally) and evaluated over, say, five years, before any broader implementation.

⁸⁸ R Blundell, et al., *Wages, Experience, and Training of Women over the Life Cycle*, *Journal of Labor Economics* 39(51), January 2021.

⁸⁹ A Fitzpayne & E Pollack, *Working Training Tax Credit: Promoting Employer Investments in the Workforce*, Aspen Initiative Future of Work Initiative, August 2018.

⁹⁰ A review included individual learning accounts as one of the potential funding mechanisms to support lifelong learning. See: T Falch & H Oosterbeek, *Financing lifelong learning: funding mechanisms in education and training*, European Expert Network on Economics of Education, EENEE Analytical Report No. 10, September 2011.

⁹¹ D Hidalgo, H Oosterbeek, & D. Webbink, *The impact of training vouchers on low-skilled workers*, *Labour Economics* 31(C), December 2014.

⁹² D Messer & S Wolter, *Money matters: evidence from a large-scale randomized field experiment with vouchers for adult training*, Technical report. IZA Discussion Paper 4017, February 2009.

⁹³ Department for Education, *Independent panel report: post-18 review of education and funding*, May 2019. An alternative view is in: D Autor, D Mindell & E Reynolds, *The Work of the Future: Building Better Jobs in an Age of Intelligent Machines*, MIT Work of the Future Report, November 2020.

Finally, tax incentives for individuals can also be used to subsidise investment in training.⁹⁴ For example, various countries allow individuals to deduct direct training expenditure from their taxable income (and this used to be the case in the UK). The sort of incentive has been evaluated rigorously in The Netherlands, and found to be an effective instrument.⁹⁵ At a marginal tax rate of 0.4, every euro invested by the government in the form of a tax deduction leads to €0.75 to €1.50 of private expenditure on training investment, although, it should be noted that the individuals who are affected by the policy reform (which facilitates the evaluation) are those who experience a substantial change in the marginal tax rate, and are not typically in the disadvantaged group to which training policies are often targeted.

Regional and sector specific initiatives may also be needed, but will depend on context

Many of the policies above are about changing national policy, although there is scope for targeting towards particular sectors or technologies (e.g. human capital tax credits), piloting policies before adopting them nationally, and offering skills programmes at a regional or sectoral level (including the provision of information about pathways), albeit within a national regulatory environment (such as the qualification framework etc.).

As we have argued, taxes and subsidies have a role to play in providing the right incentives to firms and individuals, so as to overcome externalities. But, as set out in a provocation for the Economy 2030 Inquiry by Dani Rodrik and co-authors, effective industrial policy (of which skills policies form a part) is not simply focused on tax incentives, but should also provide a broader suite of customisable public services.⁹⁶ The authors discuss the scope for such policies within local economic areas and involving partnerships between the private and public sectors. Sectoral training programmes are highlighted as a good example where there is a strong evidence base in the US. These programmes address skill gaps identified in specific industries (as well as long-term employment for those taking part) by providing a suite of complementary services such as extensive wrap-around support or credentialed qualifications. Core to the success of such policies is a re-imagination of the relationship between business, government and training providers and the targeting of specific industries, occupations and skills.

Skills Bootcamps are a recent example of this type of approach in the UK. These are free courses of 12 to 16 weeks for adults aged 19 or over who are either in work or recently unemployed, giving them the opportunity to build up sector-specific skills and get a

⁹⁴ For a summary of evidence, see: T Falch & H Oosterbeek, [Financing lifelong learning: funding mechanisms in education and training](#), European Expert Network on Economics of Education, EENEE Analytical Report No. 10, September 2011.

⁹⁵ E Leuven & H Oosterbeek, [Evaluating the effect of tax deductions on training](#), *Journal of Labor Economics*, 22(2), April 2004.

⁹⁶ D Rodrik, V Doshi & H Spencer, [Creating a Good-Jobs Economy in the UK](#), Resolution Foundation, July 2023.

fast-track interview with a local employer. Bootcamps are developed in partnership with employers, colleges, training providers, and local authorities. In principle, they seem like a good idea (with the pilot giving some encouraging results), although there still needs to be a proper impact evaluation (which is in process).⁹⁷

As highlighted in a report for the Economy 2030 Inquiry on empowering workers, some programmes focused on sectoral skills in the UK – for example, those operated by the Construction Industry Training Board (CITB), the Engineering and Construction Industry Training Board (ECITB) and the film industry’s Screen Skills (formerly known as Creative Skillset) – have focused explicitly on non-wage aspects of work.⁹⁸ These organisations all operate statutory training levies which are redistributed in the form of grants to subsidise training costs. They design and develop occupational standards, and provide careers information and support professional development in various ways. The same report also describes how sectoral standards can be driven up by licensing requirements – as has been the case in the security industry – and argues for exploring new labour market institutions with the remit and agility to target the most acute problems. The report proposes sectoral Good Work Agreements to tackle problems in particular sectors, where training is one of the core issues for them to cover.

This is the context in which specific policies targeting, for example, strategic sectors, or green jobs ought to be considered. For example, our analysis suggests that relative to the US, Level 4/5 qualifications are ‘undersupplied’ in Financial and business services. Yet, the existing wage premia to Level 4/5 qualifications in this sector is not very high, whereas the graduate wage premium is enormous (suggesting strong demand for a highly skilled workforce). Whether there is a more efficacious way to increase the supply of highly skilled workers in that sector (beyond increasing the number of graduates and incentivising training for existing employees) requires the input of those with deep knowledge of the sector’s requirements and trade-offs.

⁹⁷ The pilot is discussed in: D Rodrik, V Doshi & H Spencer, [Creating a Good-Jobs Economy in the UK](#), Resolution Foundation, July 2023. Early results from the process evaluation have been published: CFE Research, [Evaluation of Skills Bootcamps: wave 2 Implementation report](#), Department for Education, March 2023.

⁹⁸ C McCurdy, H Slaughter & G Kelly, [Putting good work on the table: reforming labour market conditions to improve pay and conditions](#), Resolution Foundation, September 2023.

Section 8

Conclusion

This report has shown how to think about education and skills policy within the context of an overall economic strategy. We have done this by focusing on what policies are needed to generate growth in strategic sectors, and to facilitate the successful adoption of strategic technologies. It complements other reports that look specifically at the challenges faced by improving opportunities for those pursuing non-tertiary vocational education and higher education, and an earlier report that analysed economy-wide changes in skill demand and training.

Our analysis shows that the strategic sectors and technologies have high and growing demand for skilled workers. In practice, the needs of these sectors and technologies are not so different to those in the rest of the economy. But they show an even greater need for a more highly educated and skilled workforce. Meeting these skills needs, and those of the rest of the economy, is not going to happen without increased and sustained investment in education, especially for those coming into the labour market now and in the years to come.

We have highlighted the need for more university graduates and for a more integrated tertiary education sector, where sub-degrees play a much bigger role than they do today. Also, to encourage adult training, policy needs to expand its range of incentives to firms and individuals beyond current policy measures. We suggest that there is scope to trial new instruments and properly evaluate them – including human capital tax credits (for firms) and individual learning accounts (for individuals) – especially as implementation issues can be challenging.

The potential prize of expanding these areas of the economy is large. It may lead to a double dividend – a significant contribution both to our overall growth performance (enabling more growth of strategic sectors and higher productivity within them) and a potential reduction of inequality. The latter may be possible because these sectors provide better-paid jobs even for those with lower-level qualifications and because, if we can substantially increase the level of education and skills overall, the premium at the top end (which reflects excess demand) might ultimately reduce.

Annex

More details on definitions of the strategic sectors

The starting point to systematically define strategic sectors for the UK economy is to observe which are the activities the UK has an international comparative advantage in. The analysis in our earlier Economy 2030 report highlighted the sectors where the UK enjoys a positive revealed comparative advantage (RCA) and where there has been sustained growth in global export value.⁹⁹ The most significant ones in terms of overall world trade value are mostly traded services which include (in decreasing order of RCA for the UK):

- Insurance and pension services
- Financial services
- Other business services
- Personal, cultural and recreational services
- Charges for the use of intellectual property
- Telecommunication, computer and information services

The UK is also highly specialised in the production of niche luxury goods (e.g. Art, Precious metals and stones) as well as beverages and aircrafts, but these are products that tend to have a relatively small share in international trade (so individually, they are unlikely to contribute much additional growth).

One manufacturing category where the UK plays a leading role and with a large share of trade is pharmaceutical products. This activity is also linked to the broader Life sciences industry where the UK has historically enjoyed a technological advantage. Overall, this motivates our choice to focus, in line with the previous report, on Financial and business services, The creative and cultural sector, and Life sciences industries as three large strategic sectors that can drive growth in the UK.

The remainder of this section of the Annex focuses on how we cross-mapped the trade categories mentioned above to the Standard Industrial Classification (SIC) in order to identify these sectors in the Labour Force Survey (LFS) workers' data. We also discuss the extent to which our categorization differs from other official definitions available.

⁹⁹ See Figure 6 J De Lyon et al., [Enduring Strengths: Analysing the UK's current and potential economic strengths, and what they mean for its economic strategy at the start of the decisive decade](#), Resolution Foundation, April 2022.

Mapping trade activities to industrial sectors

Trade in services statistics underpinning the analysis of the UK's RCA rely on the Extended Balance of Payments Services Classification (EBOPS), which can be cross-mapped to the Statistical classification of products by activity (CPA). This in turn is nested within the broader classification of economic activities (NACE) that the UK's SIC system follows. This allowed to us link each trade category to a detailed list of industrial activities. Table 4 reports the complete list of SIC codes (4-digit level) that we adopted for our categorisation.

Definition of The creative and cultural sector

Our definition of The creative and cultural sector is based on the following trade services categories: personal, cultural and recreational services; telecommunication, computer and information services; and charges for the use of intellectual property.

We exclude from personal, cultural and recreational services the 'Heritage and Recreational activities' subcategory, which include the operation of museums, archives and libraries, as well as other recreational facilities. Some of these activities could normally be considered as an integral part of the creative industries, but they count as mostly non-tradable services and are less likely to drive to productivity growth. We also exclude other non-tradable services that, while formally fall within the personal services category, are in any case not directly associated to the creative sector, such as healthcare and education, with the exception of tertiary education. We include tertiary education in our definition as we consider it as both a tradable service (nearly 20 per cent of UK universities' enrolment in 2019 was accounted for by international students), and in recognition of its important contribution to the UK's international standing and the strategic role it plays in fostering research and innovation¹⁰⁰.

How does our definition of The creative and cultural sector compare with the Government's official definition of the Creative Industries? The UK government's official definition of includes sectors such as advertising and marketing; architecture; crafts; fashion and design; film, TV, video and photography; IT, software and computer services; publishing; museums, galleries and libraries; and music, performing and visual arts.¹⁰¹ As it is clear by looking at the list in Table 3, our definition covers most of the activities that are designated as creative industries by the government and there is a large overlap between the two: 89 per cent of the workforce employed in sectors falling under the

¹⁰⁰ See, J De Lyon et al., *Enduring Strengths: Analysing the UK's current and potential economic strengths, and what they mean for is economic strategy at the start of the decisive decade*, Resolution Foundation, April 2022.

¹⁰¹ Department for Digital, Culture, Media and Sport, *The UK Creative Industries Economic Estimates*, March 2022.

'official' Creative Industries definition are also covered by our definition and 66 per cent of the workers employed in what we classify as The creative and cultural sector also fall within the official definition.

Definition of Life sciences industries

For our definition of Life sciences industries, we follow the official definition adopted by the Office for Life Sciences, which includes the following manufacturing activities: basic pharmaceuticals; pharmaceutical preparations; irradiation, electromedical and electrotherapeutic equipment; medical and dental equipment and supplies; as well as research and experimental development on biotechnologies.¹⁰²

TABLE 4: Complete list of economic activities in each strategic sector

List of economic activities in each of the three strategic sectors, by SIC class

Financial and business services	SIC class
Central banking	6411
Other monetary intermediation	6419
Activities of holding companies	6420
Trusts, funds and similar financial entities	6430
Financial leasing	6491
Other credit granting	6492
Other financial service activities, except insurance and pension funding	6499
Life insurance	6511
Non-life insurance	6512
Reinsurance	6520
Pension funding	6530
Administration of financial markets	6611
Security and commodity contracts brokerage	6612
Other activities auxiliary to financial services, except insurance and pension funding	6619

¹⁰² Office for Life Sciences, *Bioscience and health technology sector statistics 2019*, August 2020. That report seeks to quantify the economic magnitude of Life sciences industries using survey data. It found that the above-mentioned definition based on the standard industrial classifications (SIC) only manages to account for around 25 per cent of businesses in Life sciences industries.

Activities of insurance agents and brokers	6622
Other activities auxiliary to insurance and pension funding	6629
Fund management activities	6630
Legal activities	6910
Accounting, bookkeeping and auditing activities; tax consultancy	6920
Business and other management consultancy activities	7022
Engineering activities and related technical consultancy	7112
Technical testing and analysis	7120
Other research and experimental development on natural sciences and engineering	7219
Research and experimental development on social sciences and humanities	7220
Market research and public opinion polling	7320
Other professional, scientific and technical activities	7490
Landscape service activities	8130
Organisation of conventions and trade shows	8230
The creative and cultural sector	SIC class
Book publishing	5811
Publishing of directories and mailing lists	5812
Publishing of newspapers	5813
Publishing of journals and periodicals	5814
Other publishing activities	5819
Publishing of computer games	5821
Other software publishing	5829
Motion picture, video and television programme production activities	5911
Motion picture, video and television programme post-production activities	5912
Motion picture, video and television programme distribution activities	5913
Motion picture projection activities	5914

Sound recording and music publishing activities	5920
Public relations and communication activities	7021
Architectural activities	7111
Advertising agencies	7311
Media representation	7312
Specialised design activities	7410
Photographic activities	7420
Translation and interpretation activities	7430
Radio broadcasting	6010
Television programming and broadcasting activities	6020
Computer programming activities	6201
Computer consultancy activities	6202
Tertiary education	8542
Life sciences industries	SIC class
Manufacture of basic pharmaceutical products	2110
Manufacture of pharmaceutical preparations	2120
Manufacture of irradiation, electromedical and electrotherapeutic equipment	2660
Manufacture of medical and dental instruments and supplies	3250
Research and experimental development on biotechnology	7211

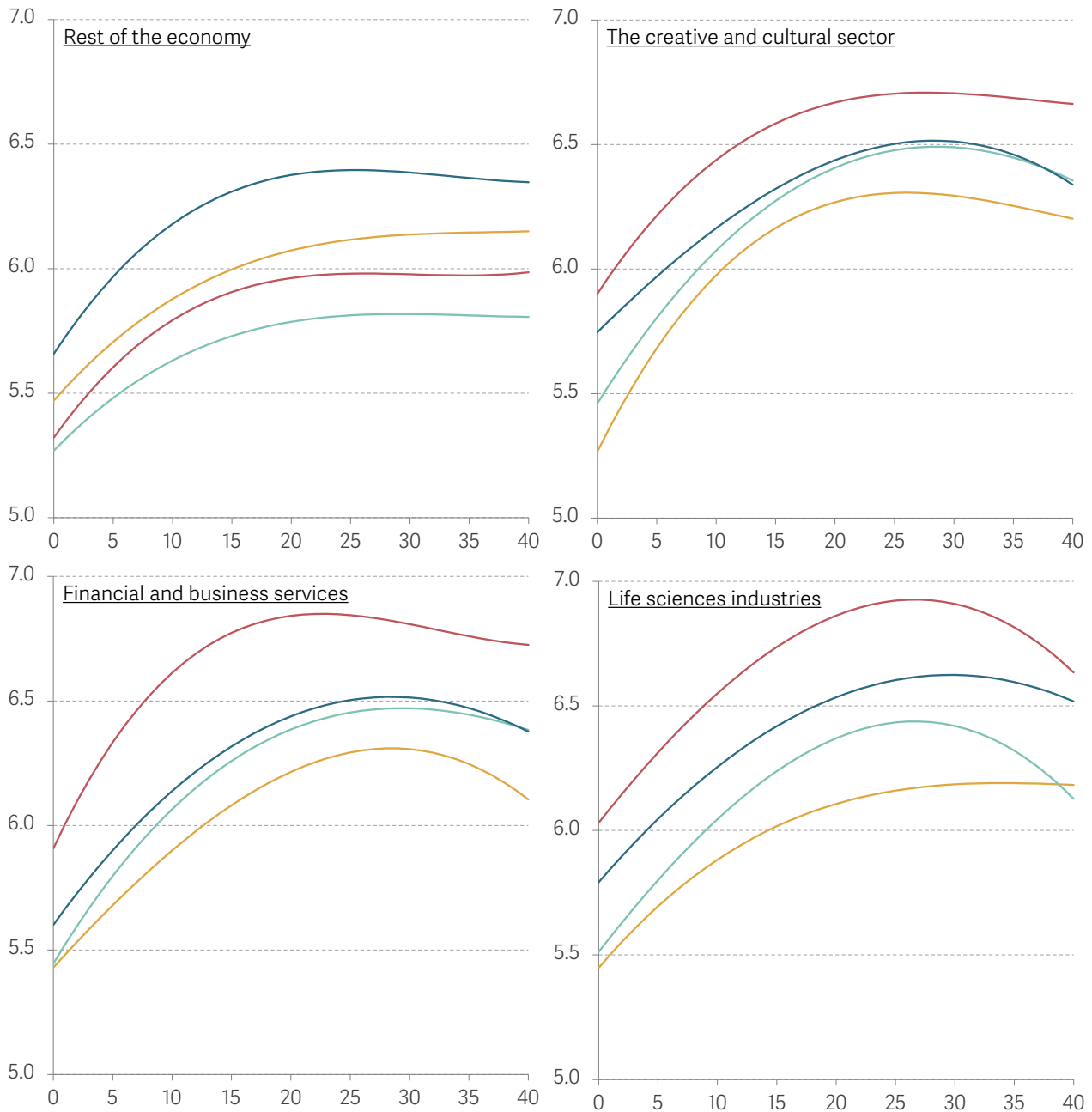
Wages-experience profiles within the strategic sectors

This subsection briefly considers the wage-experience profiles of differently educated workers separately for each strategic sector. As noted in Section 3, what is striking about these sectors is that all workers, regardless of their education background, enjoy more sustained wage growth during their careers than if they were employed outside of these sectors (see Figure 21). This is particularly visible in Finance and business services and, to a greater extent, in The creative and cultural sector. Workers qualified to GCSE level or below enjoy particularly strong wage growth in The creative and cultural sector, as do those holding A-Levels or equivalent qualifications. Conversely, wage growth for degree-holders is more modest in this sector than in Financial and business services and Life sciences industries, where, in general, university graduates enjoy higher wages (see

Figure 21). Finally, it is worth highlighting how workers qualified at Level 4-5 enjoy a much higher wage premium (throughout their careers) in Life sciences industries, whereas this is more modest, and tends to disappear in the strategic sectors.

FIGURE 21: Intermediate qualifications are associated with higher wage growth in Life sciences industries

Average weekly wages by years of work experience, by sector and highest qualification level, in 2015 prices: UK, 2011-2019



NOTES: These estimates are obtained pooling together all employed individuals between 2011 and 2019, while controlling for year effects and full-time employment status.

SOURCE: Analysis of ONS, Labour Force Survey.

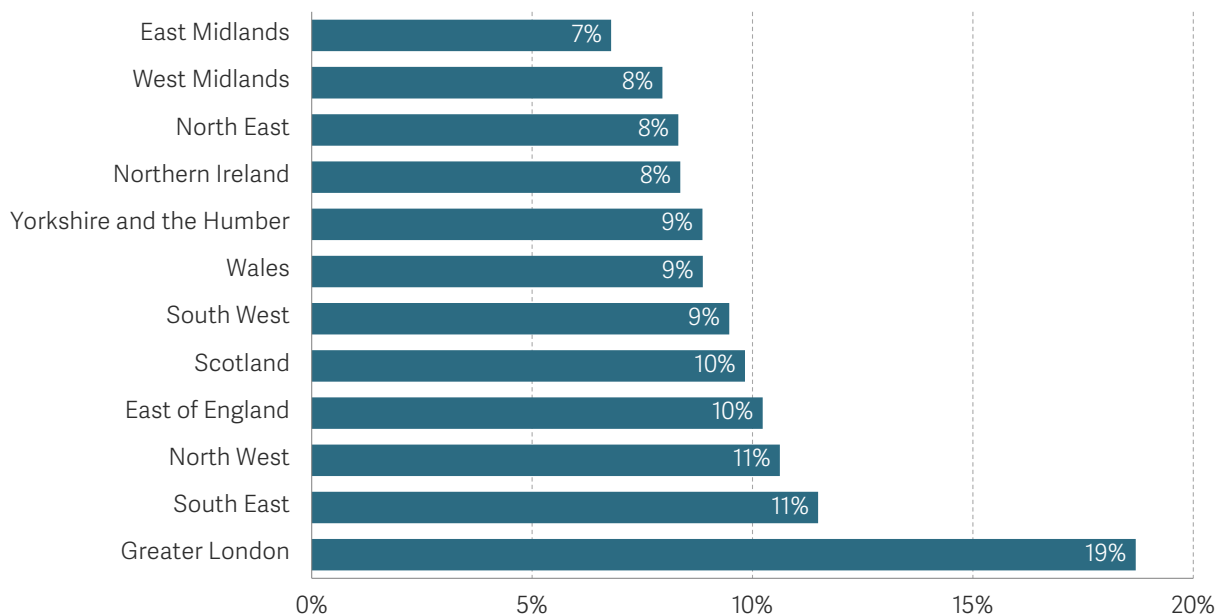
Geographic distribution of the strategic sectors

A closer look at the geographic distribution of the strategic sectors reveals some differences in where each sector is concentrated. Figure 22 and Figure 23 show that patterns are quite similar across Finance and business services, and The creative and cultural sector: areas with a higher share of workers employed in Finance and business services also tend to have a higher share of employment in the creative and the cultural sector (except for the East Midlands, where the latter is much more prominent).

The picture looks quite different for Life sciences industries which is clustered in specific areas of the country. For example, the share of people employed in this sector in the East of England (2 per cent) is twice as high as the national level, and it is also much higher in the South East, but quite low in London (Figure 24).

FIGURE 22: Except for London, Financial and business services are spread fairly evenly across the UK

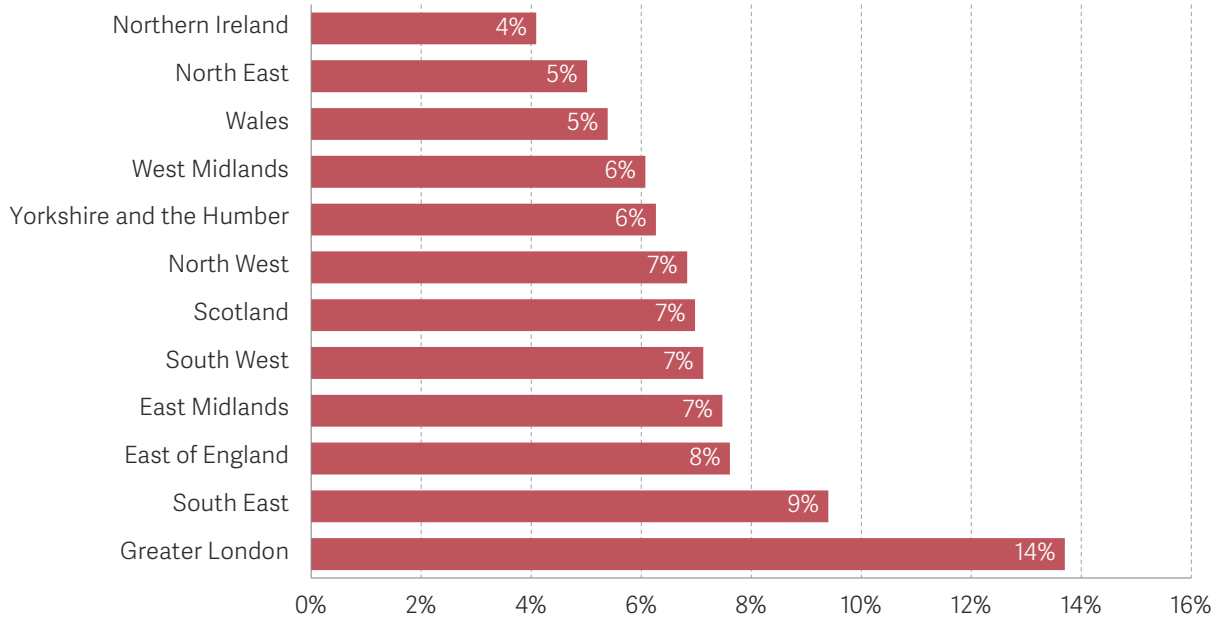
Proportion of workforce employed in Financial and business services, by NUTS1 regions: UK, 2022



SOURCE: Analysis of ONS, Labour Force Survey.

FIGURE 23: Employment in the creative and cultural sector is higher in London, the South and the East

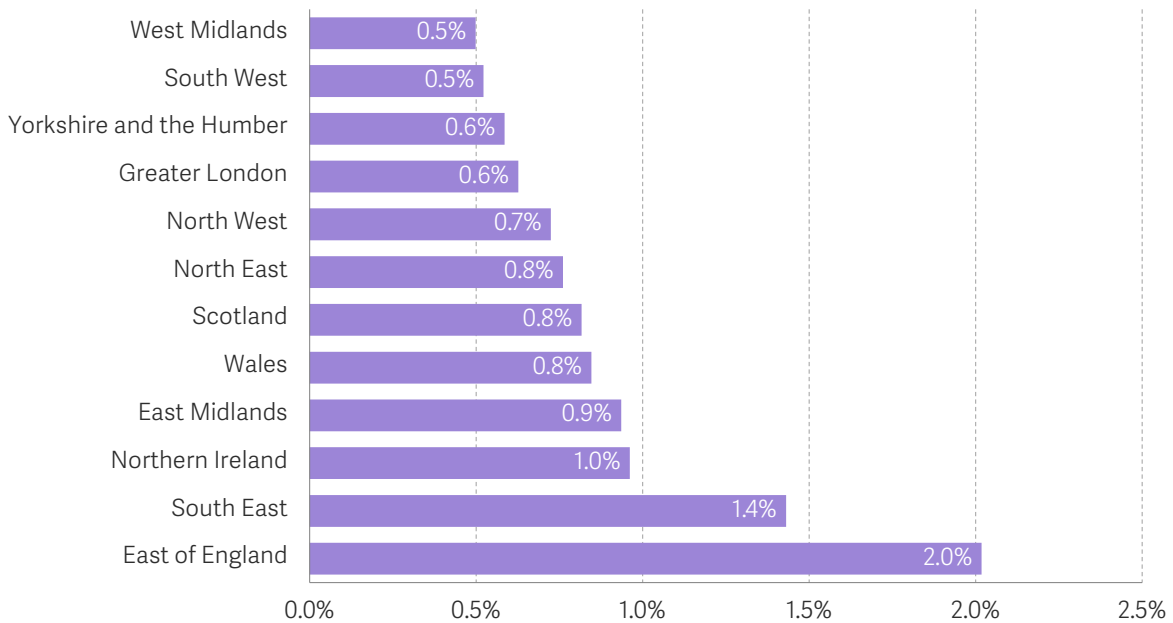
Proportion of workforce employed in The creative and cultural sector, by NUTS1 regions: UK, 2022



SOURCE: Analysis of ONS, Labour Force Survey.

FIGURE 24: Life sciences industries are concentrated in the East and South East of England

Proportion of workforce employed in Life sciences industries, by NUTS1 regions: UK, 2022



SOURCE Analysis of ONS, Labour Force Survey.

Differences in skills profile and task-content between the strategic sectors

This subsection briefly explores differences in the occupational and skill profiles of the three strategic sectors.

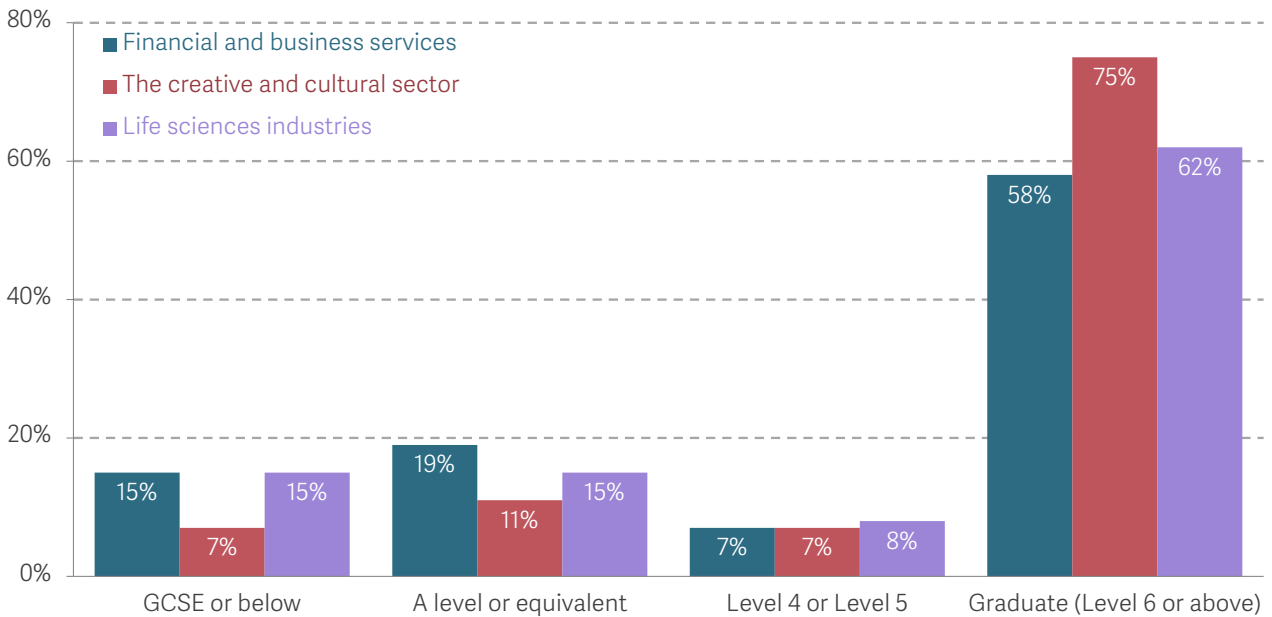
Figure 25 looks at the highest qualification held by workers across the three sectors. We can see that The creative and cultural sector's workforce is particularly well-educated, with over 70 per cent holding at least a university degree and half as many workers having only GCSEs or below. As shown in Figure 26, this is related to the fact that this sector employs many more workers in managerial and professional roles (over 60 per cent compared to just below 45 per cent in both Finance and business services and Life sciences industries). It is also worth noticing that Finance and business services employ many more workers in administrative roles, whereas we can find more workers employed in technical or operational roles in Life sciences industries (which is to be expected, since it involves manufacturing activities).

In turn, these differences translate into different task-content profiles across sectors. As it can be seen in Figure 27, in The creative and cultural sector, non-routine analytical and personal tasks associated with creative thinking, data analysis and leadership are much more important. Routine cognitive tasks are more prevalent in Finance and business services, whereas in Life sciences industries, routine manual and non-routine physical tasks are more important than in the other strategic sectors (although still less important than in the economy as a whole).

Finally, to give a more precise idea of which occupations are more prevalent in each of the strategic sectors Table 4 to Table 6 list the ten most common occupations (3-digit level).

FIGURE 25: The share of workers with a university degree is particularly high in The creative and cultural sector

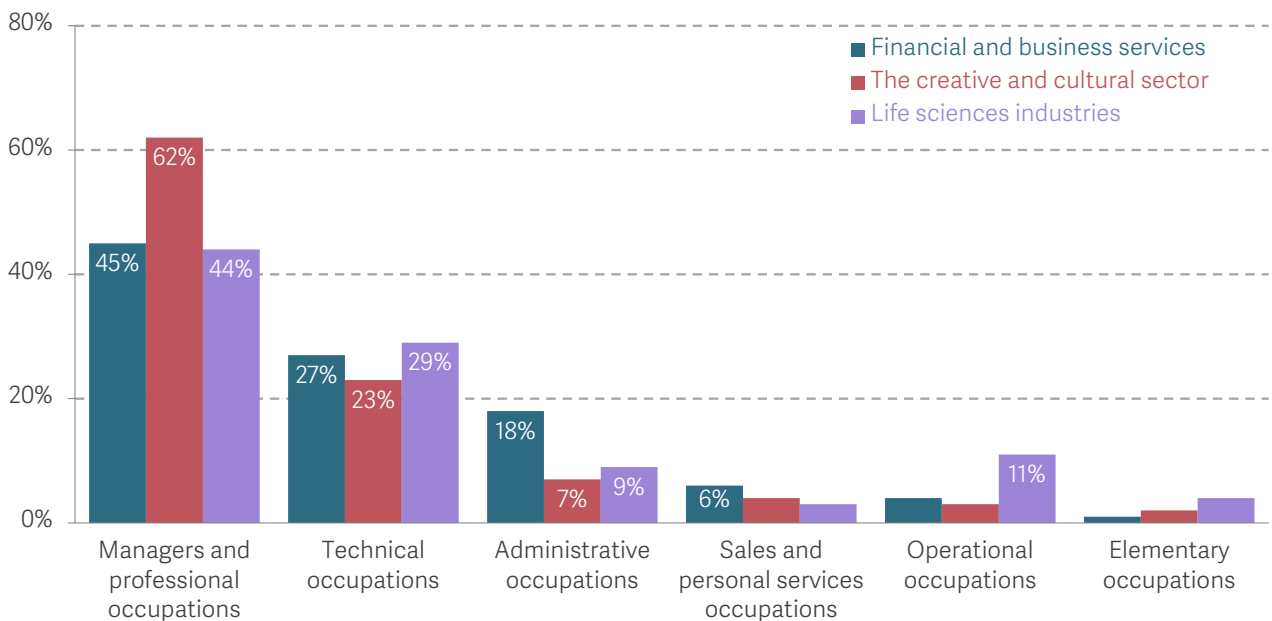
Proportion of workers by their highest qualification, by strategic sector: UK, 2011-2019



SOURCE: Analysis of ONS, Labour Force Survey.

FIGURE 26: Managerial and professional occupations are particularly important in The creative and cultural sector

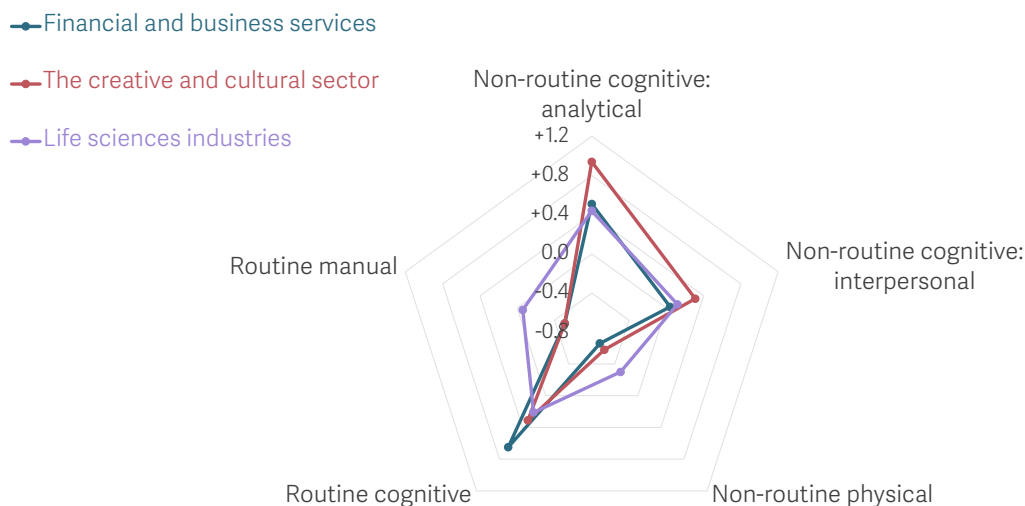
Proportion of workers employed in different occupational groups, by strategic sector: UK, 2011-2019



SOURCE: Analysis of ONS, Labour Force Survey.

FIGURE 27: Analytical and personal tasks are particularly important in The creative and cultural sector

Average importance of different task types (standardised), by strategic sector: UK, 2011-2019



NOTES: Tasks’ importance is measured at the occupation level and standardised across occupations to have mean zero and a standard deviation of one. This information is then aggregated at sector level reflecting the occupational composition within the sector (2011-2019).
 SOURCE: Analysis of ONS, Labour Force Survey linked to O*NET (US Department of Labor).

TABLE 5: Most common occupations in Financial and business services

Employment share (hours worked) for the ten most common occupations in Financial and business services: UK, 2019

Occupation (3-digit)	Proportion of workforce	Cumulative proportion of workforce
Business, Finance and Related Associate Professionals	15%	15%
Business, Research and Administrative Professionals	11%	26%
Administrative Occupations: Finance	9%	35%
Functional Managers and Directors	8%	42%
Information Technology and Telecommunications Professionals	6%	49%
Sales, Marketing and Related Associate Professionals	5%	53%
Engineering Professionals	3%	56%
Legal Professionals	3%	60%
Other Administrative Occupations	3%	63%
Customer Service Occupations	3%	65%

SOURCE: Analysis of ONS, Labour Force Survey.

TABLE 6: Most common occupations in The creative and cultural sector

Employment share (hours worked) for the ten most common occupations in The creative and cultural sector: UK, 2019

Occupation (3-digit)	Proportion of workforce	Cumulative proportion of workforce
Information Technology and Telecommunications Professionals	23%	23%
Teaching and Educational Professionals	11%	34%
Functional Managers and Directors	8%	43%
Sales, Marketing and Related Associate Professionals	8%	51%
Business, Research and Administrative Professionals	4%	55%
Media Professionals	4%	59%
Natural and Social Science Professionals	3%	62%
Artistic, Literary and Media Occupations	3%	65%
Information Technology Technicians	3%	68%
Design Occupations	3%	71%

SOURCE: Analysis of ONS, Labour Force Survey.

TABLE 7: Most common occupations in Life sciences industries

Employment share (hours worked) for the ten most common occupations in Life sciences industries: UK, 2019

Occupation (3-digit)	Proportion of workforce	Cumulative proportion of workforce
Sales, Marketing and Related Associate Professionals	12%	12%
Natural and Social Science Professionals	10%	22%
Functional Managers and Directors	6%	28%
Science, Engineering and Production Technicians	6%	34%
Engineering Professionals	5%	39%
Quality and Regulatory Professionals	5%	43%
Health Associate Professionals	4%	48%
Business, Research and Administrative Professionals	4%	52%
Process Operatives	4%	55%
Research and Development Managers	3%	59%

SOURCE: Analysis of ONS, Labour Force Survey.

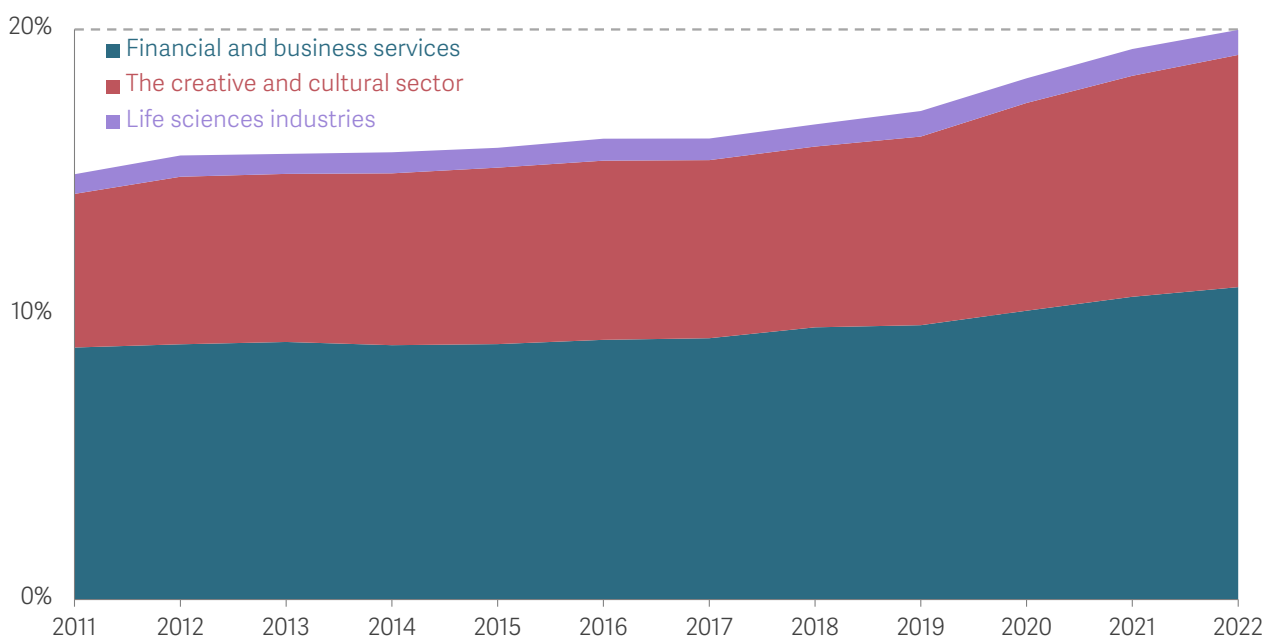
Additional time series

In this subsection we present some additional findings on the evolution of the strategic sectors between 2011 and 2019.

Figure 28 shows that employment in the strategic sectors has increased substantially over the 2010s: in 2011, the sectors accounted for around 15 per cent of employment, growing up to 20 per cent in nine years, with the increase being stronger in The creative and cultural sector.

FIGURE 28: Employment in the strategic sectors has increased over the last decade

Proportion of workforce employed in strategic sectors, by year: UK

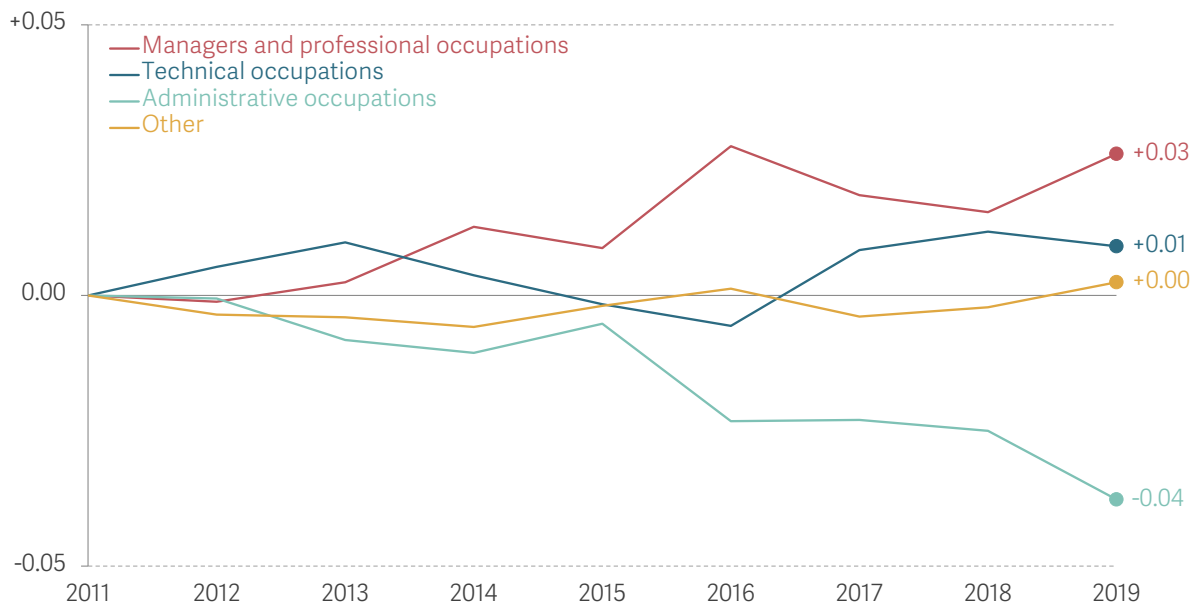


SOURCE: Analysis of ONS, Labour Force Survey.

Next, Figure 29 shows the change in the occupational composition of the strategic sectors over the period. We can see that there was an increase in the share of workers in managerial and professional occupations (+3 percentage points) and technical occupations, but also a marked decline in the share of people employed in administrative roles (-4 percentage points). The change in the underlying composition helps explain the increased importance of analytical tasks documented in Figure 11 of the main text.

FIGURE 29: Managers, professionals and technical occupations have become more prevalent in the strategic sectors at the expense of administrative roles

Share of employment in broad occupational groups over time (indexed to level back in 2011): UK, 2011-2019

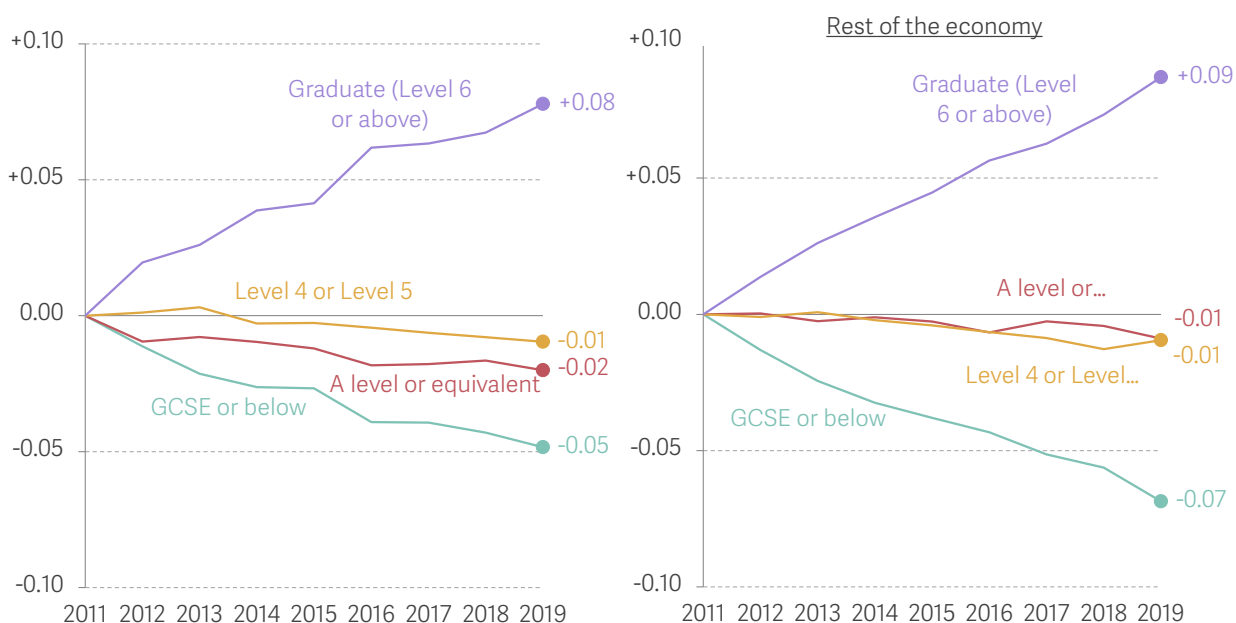


SOURCE: Analysis of ONS, Labour Force Survey.

Finally, Figure 30 plots the change in the proportion of workers with different levels of highest qualification: it is impressive to see that over less than a decade, the proportion of workers holding at least a university degree rose by more than 7 percentage points, with an associated fall in the proportion of workers with at most GCSEs and A-Levels or equivalent. As the chart makes clear, this improvement in workers' education attainment was not confined to the strategic sectors but was common across the whole economy.

FIGURE 30: Strategic sectors have become more high-skilled over time, but no more than the whole economy

Change in share of workers with a given level of highest education since 2011: UK



SOURCE: Analysis of ONS, Labour Force Survey.

Analysis of job vacancy data – description of the data and methodology

As discussed in Section 4, we make use of online job vacancy data to move beyond the analysis of job skills requirements as inferred by the importance of different types of task. In this respect, online vacancy data is considered a good indicator for the skills directly required by employers, and researchers are increasingly using such data to examine demand dynamics for skills within and between jobs.

In collaboration with the Pissarides Review, we have analysed administrative vacancy data from Adzuna, one of UK's most popular online job advert platforms, to study changes in job requirements and skill demand at the occupational level.¹⁰³ In particular, we make use of detailed UK-specific job requirements that are extracted from job descriptions using natural language processing and semantic analysis. The use of online vacancies data has well-documented advantages and limitations, but, importantly, it tends to do well in terms of representativeness of job postings in medium and high-skilled occupations, which are the types of jobs more commonly found in the strategic sectors.¹⁰⁴

¹⁰³ Our analysis in this section draws upon: R Costa et al, Report for the Pissarides Review, forthcoming, 2023.

¹⁰⁴ ONS, *Using Adzuna data to derive an indicator of weekly vacancies: Experimental Statistics*, June 2021.

Unfortunately, due to proprietary information protection, we are not able to identify the employer, and hence the sector, for a given job posting. To circumvent this limitation, we focus on sets of occupations that are relatively prevalent in the strategic sectors. To do this, we rely on the Labour Force Survey to identify the occupations (at the 4-digit SOC level) whose share of employment within a given strategic sector is highest compared to the share of employment among the overall workforce. Using this approach, we focus on the top 10 most prevalent occupations for each sector, which we list in Table 8 alongside the proportion of workers holding a degree within these occupations.

The results are intuitive: for example, occupations such as journalists, newspaper and periodical editors and graphic designers are among the top 10 in The creative and cultural sector, whereas brokers and management and business consultants are specific to the Financial and business sector. Similarly, Life sciences industries feature specialised occupations found in research labs and pharmaceutical production lines, such as chemical and biological scientists, R&D managers or laboratory, medical and pharmaceutical technicians. Except for a few occupations specific to Financial and business services (where administrative roles, as discussed above, are quite common) and some operative roles in Life sciences industries, Table 3 also confirms that occupations that are particularly prevalent in the strategic sectors are high-skilled, with a markedly high proportion of workers holding a degree.

TABLE 8: High-skill occupations are particularly prevalent in the strategic sectors

Proportion of workers with a degree in the ten occupations that are most concentrated in each strategic sector: UK, 2011-2019.

Financial and business services		The creative and cultural sector		Life sciences industries	
Insurance underwriters	35%	Higher education teaching professionals	98%	Chemical scientists	88%
Brokers	53%	Journalists, newspaper and periodical editors	83%	Chemical and related process operatives	13%
Pensions and insurance clerks and assistants	26%	Arts officers, producers and directors	79%	Medical and dental technicians	29%
Bank and post office clerks	20%	Architects	94%	Biological scientists and biochemists	92%
Finance and investment analysts and advisers	57%	Natural and social science professionals	98%	Quality assurance technicians	53%
Legal secretaries	14%	Advertising accounts managers and creative directors	66%	Planning, process and production technicians	37%
Solicitors	99%	Graphic designers	63%	Laboratory technicians	56%
Collector salespersons and credit agents	25%	Photographers, audio-visual and broadcasting equipment operators	56%	Research and development managers	84%
Management consultants and business analysts	72%	Authors, writers and translators	89%	Quality assurance and regulatory professionals	86%
Market research interviewers	50%	Advertising and public relations directors	83%	Pharmaceutical technicians	58%

NOTES: In order to identify the occupations that are more concentrated in a given sector than in the rest of the economy we measure the ratio between the share of workers in a sector that are employed in a given occupation (4-digit level) and the share of the total workforce employed in that occupation.

SOURCE: Analysis of ONS, Labour Force Survey.

With a focus on these key occupations, we want to understand the skills most commonly requested in job adverts, how this has evolved in recent times, and how it compares to the rest of the economy. To do this, we rely on a mapping of Adzuna's skills taxonomy

to the Lightcast taxonomy.¹⁰⁵ This identifies approximately 4,100 unique skills which are further grouped into three types:

- Common skills: these encompass both inherent personal traits and acquired expertise – such as “Communication” or “Microsoft Excel” – and can find application across a wide array of industries and professions. These encompass a spectrum of attributes like soft skills, human skills, and overall proficiencies.
- Specialised skills: these have a narrower focus, and are predominantly essential within certain occupational niches or tailored to execute particular tasks (such as “C++” or “Hotel Management”). These are occasionally referred to as technical skills or hard skills.
- Certifications: these are discernible benchmarks established by industry or educational accrediting bodies (such as “Certified Nursing Assistant” or “Certified Quality Engineer”).

Within each of these types, there are further categories and subcategories, often clustering skills according to field of knowledge in the case of specialised skills for example. In our analysis, we focus on common and specialised skills (certifications are not often referred in job adverts, and are quite specific to certain occupations, where they help ensure minimum standards and act as a form of occupational licensing).

For each occupation, we measure the importance of a skill by the share of vacancies which mention unique skills belonging to a given type-category pair – for example, a value of 30 for the common skill “Business” means that 30 per cent of the vacancies for an occupation mentioning unique skills in that type and category. Aggregate shares displayed by strategic sector are calculated by weighting each occupation by its number of vacancies hence resulting in a weighted average share. The use of vacancy descriptions to arrive at these skill shares and their changes over time allows us to interpret them, albeit cautiously, as a proxy for demand for a given skill set.¹⁰⁶

Additional analysis of job vacancy data

Figure 31 summarises the importance of different sets of common skills for the strategic sectors and the whole economy. It is clear from this chart that skills that are important across the economy are also particularly important in the strategic sectors, in particular ‘physical and inherent abilities’, ‘media and communications’, ‘business’ and ‘law, regulation and compliance’. ‘Education and training’ is particularly high in The creative

¹⁰⁵ Lightcast (formerly, Burning Glass) is another popular online vacancy platform, and its skills taxonomy offers more suitable structure for the analysis and comparability with other studies. For more detailed explanation of the mapping procedure, see: R Costa et al, Report for the Pissarides Review, forthcoming, 2023.

¹⁰⁶ For detailed explanation of adjustments made to the rate of change in skills to account for the changing nature and length of job ad descriptions, see: R Costa et al, Report for the Pissarides Review, forthcoming, 2023.

and cultural sector (19 per cent versus 6 per cent), reflecting the fact that we have included tertiary education in this strategic sector. As we might expect, “Science and Research” is important in Life sciences industries (14 per cent compared to 5 per cent in the whole economy), but also in The creative and cultural sector (18 per cent) which again is likely to reflect the fact that tertiary education is included in this category.

FIGURE 31: Common skills that are important in the whole economy are particularly important in the strategic sectors

Shares of vacancies including specified common skills: UK, 2022

Common skills	The creative and cultural sector	Financial and business services	Life sciences industries	Rest of the economy
Physical and Inherent Abilities	68%	64%	63%	61%
Media and Communications	53%	48%	43%	41%
Business	34%	44%	49%	38%
Sales	17%	24%	12%	25%
Customer and Client Support	6%	16%	11%	19%
Administration	15%	25%	22%	15%
Finance	10%	7%	4%	8%
Information Technology	7%	8%	9%	7%
Education and Training	19%	1%	2%	6%
Science and Research	18%	8%	14%	5%
Analysis	1%	5%	1%	3%
Law, Regulation, and Compliance	4%	2%	20%	3%
Marketing and Public Relations	11%	1%	1%	3%
Health Care	0%	0%	1%	1%
Property and Real Estate	0%	4%	1%	1%
Public Safety and National Security	0%	0%	1%	1%
Performing Arts, Sports, and Recreation	0%	0%	0%	0%
Transportation, Supply Chain, and Logistics	0%	0%	0%	0%
Design	2%	0%	0%	0%
Human Resources	0%	0%	0%	0%

NOTES: Strategic sectors include occupations that are particularly prevalent in these sectors as compared to the rest of the economy.

SOURCE: Analysis of data provided by [Adzuna Intelligence](#).

Figure 32 shows that some of the key sets of common skills for these sectors – in particular ‘physical and inherent abilities’ – have also been growing in importance in recent years, at a rate that slightly exceeds the whole economy.

FIGURE 32: The most important common skills have also seen a rise in demand

Change in the share of vacancies including specified common skills: UK, 2016-2022

Common skills	The creative and cultural sector	Financial and business services	Life sciences industries	Rest of the economy
Physical and Inherent Abilities	15%	13%	13%	11%
Media and Communications	9%	6%	7%	6%
Business	7%	8%	8%	4%
Administration	1%	7%	5%	3%
Science and Research	4%	2%	3%	1%
Customer and Client Support	-2%	2%	1%	1%
Finance	2%	2%	0%	1%
Marketing and Public Relations	4%	0%	0%	1%
Sales	3%	2%	1%	1%
Analysis	0%	1%	0%	1%
Education and Training	0%	0%	1%	1%
Property and Real Estate	0%	2%	1%	0%
Law, Regulation, and Compliance	1%	1%	0%	0%
Design	0%	0%	0%	0%
Public Safety and National Security	0%	0%	1%	0%
Performing Arts, Sports, and Recreation	0%	0%	0%	0%
Health Care	0%	0%	0%	0%
Human Resources	0%	0%	0%	0%
Transportation, Supply Chain, and Logistics	0%	0%	0%	0%
Information Technology	-1%	-1%	0%	0%

NOTES: Strategic sectors include occupations that are particularly prevalent in these sectors as compared to the rest of the economy.

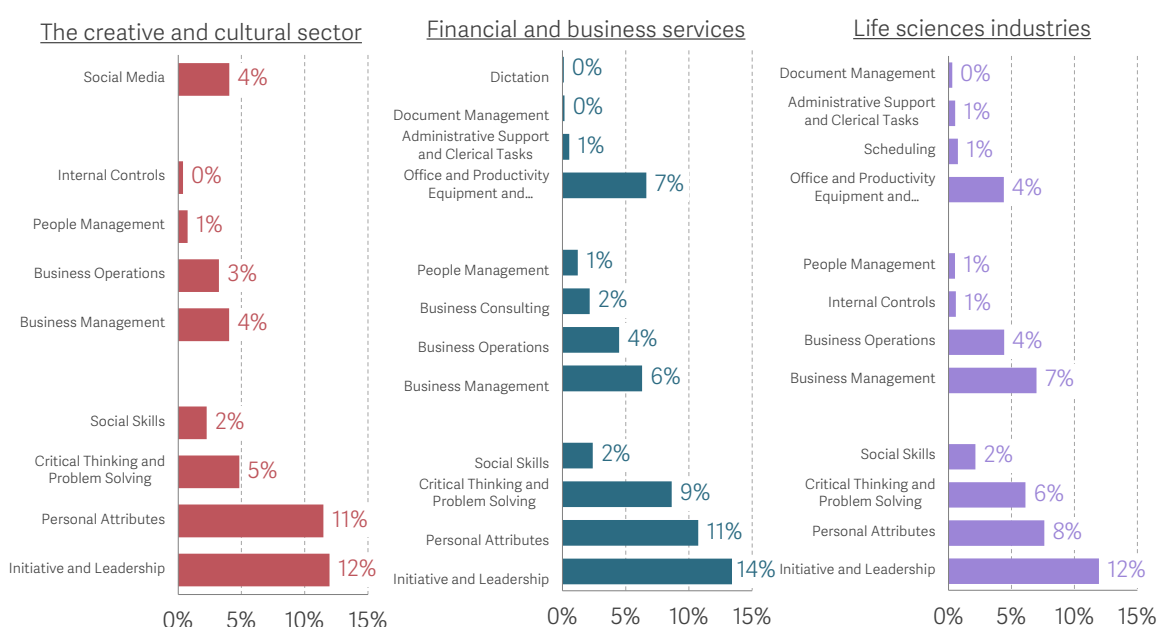
SOURCE: Analysis of data provided by [Adzuna Intelligence](#).

The label of the ‘physical and inherent abilities’ category is quite vague, but looking at the types of detailed skills within this category we find ‘initiative and leadership’, ‘critical thinking and problem solving’ and ‘social skills’ among those for which demand

has increased the most.¹⁰⁷ ‘Business’ is another category of common skills observing higher-than-average increases across the strategic sectors. Among the most expanding common skills of this category are ‘business management and operations’ and in particular, ‘people management’. The subcategories of common skills that have risen the most across the strategic sectors are shown in Figure 33 for each of the strategic sectors separately. Demand for ‘critical thinking and problem solving’ has increased more markedly in Financial and business services and so has ‘initiative and leadership’.

FIGURE 33: Analytical and personal common skills have grown in importance across all sectors

Change in the share of vacancies including specified common skills, for the three strategic sectors: UK, 2016-2022



NOTES: Strategic sectors include occupations that are particularly prevalent in these sectors compared to the rest of the economy. Top four subcategories in common skills groupings, in terms of the increase in the share of adverts mentioning skills, are shown for each strategic sector.

SOURCE: Analysis of data provided by [Adzuna Intelligence](https://www.adzuna.com).

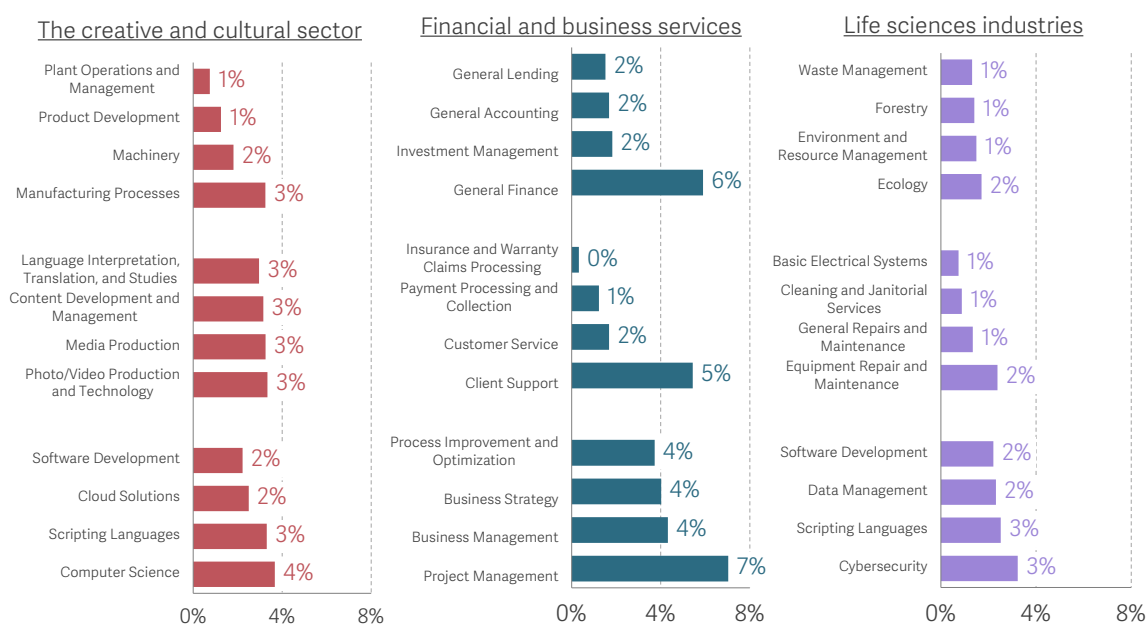
The subcategories of specialised skills that have risen the most across the strategic sectors are shown in Figure 34 for each of the strategic sectors separately. In the Financial and business services sector, specialised managerial skills such as ‘project management’, ‘business management’ and ‘business strategy’ have grown in importance alongside more people-oriented skills such as ‘client support’. In The creative and cultural

¹⁰⁷ The category ‘physical and inherent abilities’ is subdivided into five subcategories: ‘initiative and leadership’, ‘personal attributes’, ‘physical abilities’, ‘critical thinking and problem solving’ and ‘social skills’.

sector, photo and video production skills have grown the most in importance, whereas in Life sciences industries demand for ‘client support’ skills has expanded followed by skills in ‘environment and resource management’.

FIGURE 34: The specific skills growing in importance vary more across sectors

Change in the share of vacancies including specialised skills, for the three strategic sectors: UK, 2016-2022



NOTES: Strategic sectors include occupations that are particularly prevalent in these sectors compared to the rest of the economy. Top four subcategories in specialised skills groupings, in terms of the increase in the share of adverts mentioning skills, are shown for each strategic sector.

SOURCE: Analysis of data provided by [Adzuna Intelligence](https://www.adzuna.com).

Additional analysis of gaps between expected and actual education levels

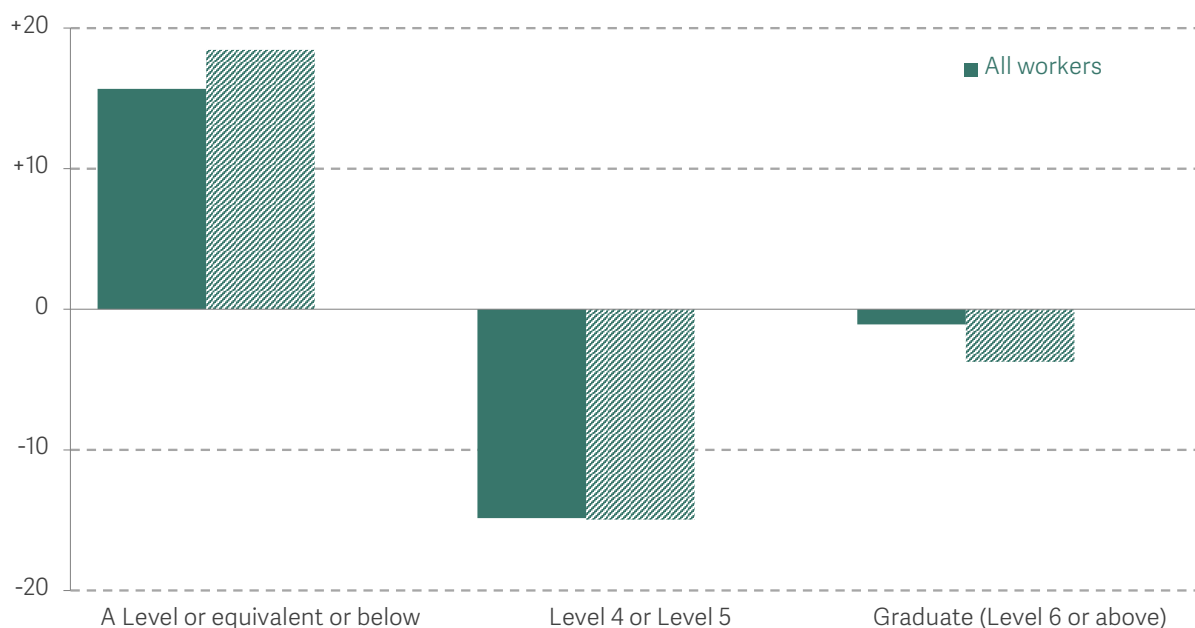
Section 5 remarked on how, based on a crude assumption that US-based occupational requirements are translatable to the UK, the strategic sectors have a surplus of workers educated up to Level 3 (equivalent to A-levels), but miss around 660,000 workers with upper-intermediate skills that could be delivered by sub-degree qualifications (Level 4/5). This is worrying in the context of a strategy of boosting employment in the strategic sectors, but it is an issue that is by no means confined to these sectors, and is widespread across the economy.

To see this, Figure 35 plots the gap between the expected and actual share of workers with a given qualification outside of the strategic sectors, showing that the gaps are even larger. Outside of the strategic sectors, the share of workers with at most a Level

3 qualification is over 15 percentage points higher than what we would expect based on the underlying occupational requirements, this is mirrored by an equivalent deficit of workers educated at Level 4/5. There is also a very small deficit in the number of university graduates which becomes more accentuated once we consider only native workers' skill supply (in the dark green bars). On the one hand, this additional analysis shows that, even allowing for the discrepancies between the US and UK education systems, the UK clearly faces a structural problem in terms of neglecting a range of upper-intermediate skills that in other countries are provided by post-secondary education. It also shows that the UK currently relies on international talent to fulfil its graduate roles. The fact that this is a common feature across sectors suggests that there is no overall misallocation across sectors: reshuffling the current workers' stock across sectors, as hard as that would be, would not represent a definite solution to the overall lack of skills in the economy.

FIGURE 35: Shortages of intermediate and advanced skills are widespread in the UK economy

Gap between expected and actual level of education in the rest of the economy, all workers and excluding foreign-born workers: UK, 2011-2019



NOTES: Expected share calculated given the underlying occupational composition (according to the US-based O*NET data). Positive gaps indicate an excess of workers with that level of education. The light green bars indicate what the difference would look like if we excluded foreign-born workers from the computation of workers' actual qualifications.

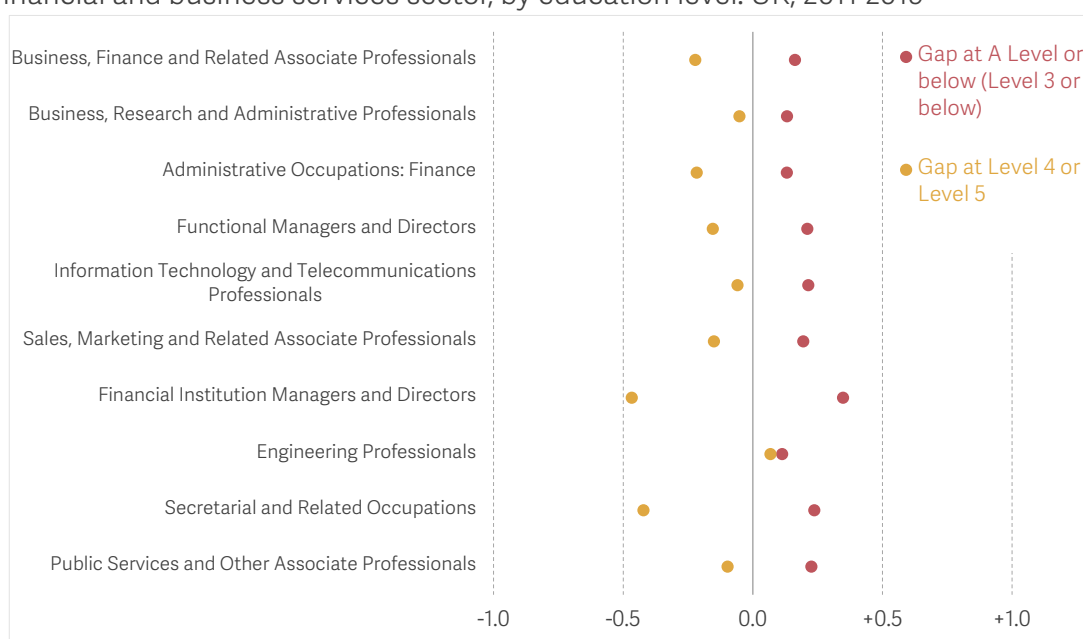
SOURCE: Analysis of ONS, Labour Force Survey linked to O*NET (US Department of Labor).

In the remainder of this annex, we present detailed evidence on which occupations in each sector have the largest education imbalances based on the analysis of O*NET education requirements translated to the UK. This can give a richer idea of which roles

are more likely to need additional upper-intermediate skills. Starting from the Financial and business services sector, Figure 36 plots the 10 occupations with the largest excess of workers educated at Level 3 (in absolute terms, based on the employment size of the occupation). We can see that many workers employed in both associate professional and professional roles in business, finance and administration lack a qualification at Level 4 or 5. They also fall short in managerial and directorial roles and in ICT professional roles.

FIGURE 36: There is a lack of intermediate skills in business-related professional and associate professional roles

Gap between expected and actual level of education for the top 10 occupations in the Financial and business services sector, by education level: UK, 2011-2019



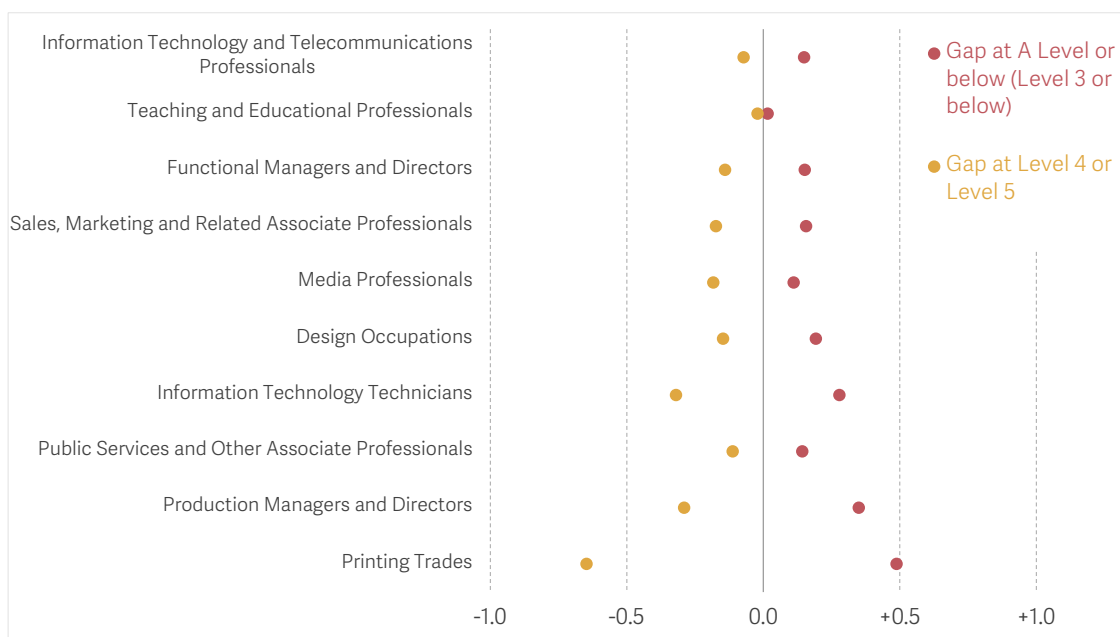
NOTES: Expected share calculated given the underlying occupational composition (according to the US-based O*NET data). Positive gaps indicate an excess of workers with that level of education. The results are shown for the ten occupations with the largest excess of workers qualified at Level 3 in absolute numbers (in descending order).

SOURCE: Analysis of ONS, Labour Force Survey linked to O*NET (US Department of Labor).

In The creative and cultural sector (Figure 37), we also find large gaps among ICT professionals, functional managers and directors, as well as sales and marketing associate professionals. We also see gaps in more technical or artistic roles including media professionals, designers, ICT technicians and production managers.

FIGURE 37: In The creative and cultural sector there is a lack of intermediate skills in professional and technical roles in ICT, sales and media

Gap between expected and actual level of education for the top 10 occupations in The creative and cultural sector, by education level: UK, 2011-2019



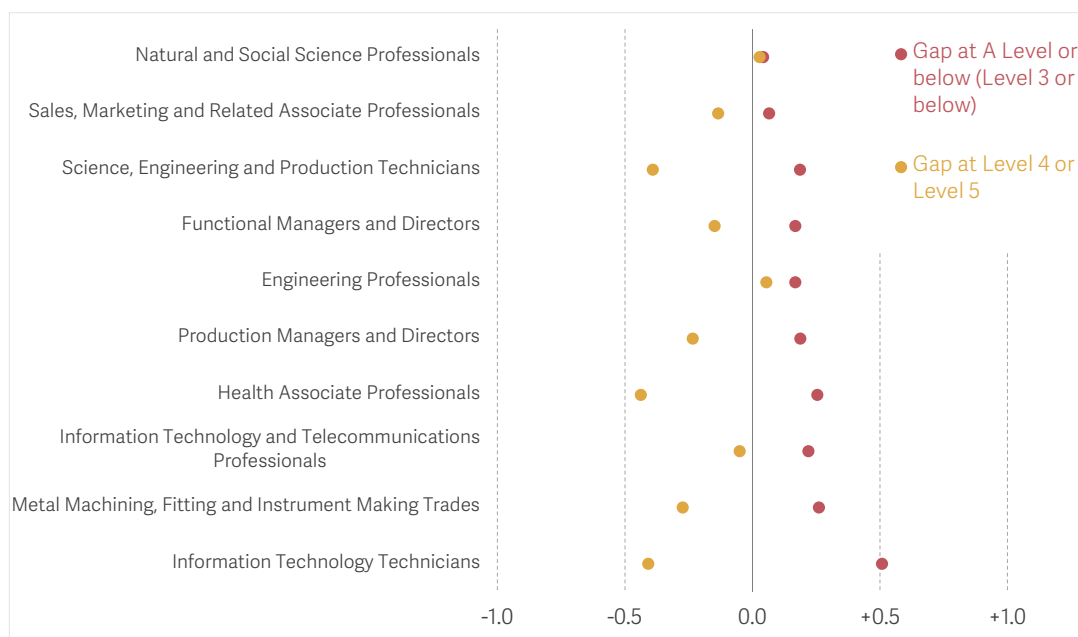
NOTES: Expected share calculated given the underlying occupational composition (according to the US-based O*NET data). Positive gaps indicate an excess of workers with that level of education. The results are shown for the ten occupations with the largest excess of workers qualified at Level 3 in absolute numbers (in descending order).

SOURCE: Analysis of ONS, Labour Force Survey linked to O*NET (US Department of Labor).

Finally, education gaps in sales and marketing roles, functional or production managers and directors and ICT professionals are also found in Life sciences industries (Figure 38). However, in this sector we also find noticeable gaps in more technical roles related to science and health: science, engineering and production technicians have lower qualifications than we would expect and so do health associate professionals. Engineering professionals are also less educated, but in this case it is the share of workers with a degree that is supposed to be higher (and not just sub-degrees).

FIGURE 38: In Life sciences industries we see lack on skills in scientific, health-related and technical roles

Gap between expected and actual level of education for the top 10 occupations in Life sciences industries, by education level: UK, 2011-2019



NOTES: Expected share calculated given the underlying occupational composition (according to the US-based O*NET data). Positive gaps indicate an excess of workers with that level of education. The results are shown for the ten occupations with the largest excess of workers qualified at Level 3 in absolute numbers (in descending order).

SOURCE: Analysis of ONS, Labour Force Survey linked to O*NET (US Department of Labor).

Additional analysis of job vacancy data, comparing green, brown and other jobs

In Section 6, we showed how, in common with the strategic sectors, a higher share of green jobs require specialised skills (including in science and research, the environment and energy and utilities) versus “other” jobs. Figure 39 shows that, in general, the rise in specialised skills has been faster in general in green jobs than either brown or other jobs. This is particularly the case in the skills categories ‘analysis’, ‘law, regional and compliance’, ‘economics, policy and social sciences’ and ‘environment’.

FIGURE 39: Green jobs have seen a faster increase in demand in some specialised skills compared to brown and other jobs

Change in the shares of vacancies including specialised skills: UK, 2016-2022

Specialised skills	Green jobs	Brown jobs	Other
Analysis	11%	6%	7%
Business	6%	4%	6%
Education and Training	4%	3%	5%
Engineering	4%	3%	5%
Law, Regulation, and Compliance	7%	6%	5%
Marketing and Public Relations	2%	0%	4%
Information Technology	6%	5%	3%
Manufacturing and Production	3%	1%	3%
Media and Communications	5%	4%	3%
Customer and Client Support	5%	0%	2%
Finance	5%	0%	2%
Hospitality and Food Services	0%	5%	2%
Environment	3%	2%	2%
Transportation, Supply Chain, and Logistics	4%	3%	2%
Design	1%	2%	2%
Maintenance, Repair, and Facility Services	2%	1%	2%
Health Care	2%	1%	2%
Human Resources	1%	2%	2%
Public Safety and National Security	1%	1%	1%
Other	2%	2%	1%
Architecture and Construction	3%	4%	1%
Science and Research	3%	1%	1%
Economics, Policy, and Social Studies	2%	0%	1%
Performing Arts, Sports, and Recreation	1%	1%	1%
Social and Human Services	1%	0%	1%
Energy and Utilities	1%	2%	1%
Property and Real Estate	0%	0%	0%
Agriculture, Horticulture, and Landscaping	0%	1%	0%
Personal Care and Services	0%	0%	0%
Administration	-1%	0%	0%
Sales	0%	1%	0%

NOTES: Green and brown occupations defined in Tables 1 and 2 of M Broome et al., Net zero jobs: The impact of the transition to net zero on the UK labour market, The Resolution Foundation, June 2022.

SOURCE: Analysis of data provided by [Adzuna Intelligence](#).

We also look at the broader categories of “common” skills and find that the category of “physical and inherent abilities”¹⁰⁸ appears to be more important in green jobs than brown or other jobs, as well as ‘business’ and ‘finance’ (see Figure 40). And, although ‘physical and inherent abilities’ have been growing in importance across the economy (as we saw in our previous analysis), they appear to have grown more in green jobs than brown or other jobs (Figure 41).

FIGURE 40: Green jobs have a higher share of adverts asking for key common skills that are important more widely in the economy

Share of vacancies including specified common skills: UK, 2022

Common skills	Green jobs	Brown jobs	Other
Physical and Inherent Abilities	66%	49%	61%
Media and Communications	43%	32%	42%
Business	51%	30%	36%
Sales	33%	13%	23%
Customer and Client Support	16%	18%	19%
Administration	18%	11%	16%
Information Technology	6%	6%	8%
Education and Training	1%	1%	7%
Finance	15%	6%	7%
Science and Research	6%	5%	5%
Analysis	4%	1%	3%
Marketing and Public Relations	4%	0%	3%
Law, Regulation, and Compliance	5%	10%	2%
Property and Real Estate	2%	0%	1%
Health Care	3%	0%	1%
Public Safety and National Security	0%	0%	1%
Performing Arts, Sports, and Recreation	0%	0%	1%
Transportation, Supply Chain, and Logistics	0%	1%	0%
Design	0%	0%	0%
Human Resources	0%	0%	0%
Other	0%	0%	0%

NOTES: Green and brown occupations defined in Tables 1 and 2 of M Broome et al., Net zero jobs: The impact of the transition to net zero on the UK labour market, The Resolution Foundation, June 2022.

SOURCE: Analysis of data provided by [Adzuna Intelligence](#).

¹⁰⁸ As discussed previously, the category ‘physical and inherent abilities’ is subdivided into five subcategories: ‘initiative and leadership’, ‘personal attributes’, ‘physical abilities’, ‘critical thinking’ and ‘problem solving and social skills’.

FIGURE 41: Physical and inherent abilities have grown in importance more in green jobs than brown or other jobs

Change in the share of vacancies including specified common skills: UK: 2016-2022

Common skills	Green jobs	Brown jobs	Other
Physical and Inherent Abilities	12%	10%	11%
Media and Communications	7%	6%	6%
Business	6%	5%	4%
Administration	6%	2%	3%
Science and Research	2%	1%	1%
Customer and Client Support	2%	2%	1%
Sales	-1%	3%	1%
Finance	2%	1%	1%
Marketing and Public Relations	1%	0%	1%
Education and Training	0%	0%	1%
Property and Real Estate	1%	0%	0%
Analysis	1%	1%	0%
Design	0%	0%	0%
Public Safety and National Security	0%	0%	0%
Performing Arts, Sports, and Recreation	0%	0%	0%
Law, Regulation, and Compliance	1%	1%	0%
Health Care	0%	0%	0%
Human Resources	0%	0%	0%
Transportation, Supply Chain, and Logistics	0%	0%	0%
Other	0%	0%	0%
Information Technology	0%	0%	-1%

NOTES: Green and brown occupations defined in Tables 1 and 2 of M Broome et al., Net zero jobs: The impact of the transition to net zero on the UK labour market, The Resolution Foundation, June 2022.

SOURCE: Analysis of data provided by [Adzuna Intelligence](#).

The Pissarides Review into the Future of Work and Wellbeing

Automation technologies are transforming work, society and the economy in the UK in ways comparable to the Industrial Revolution. The adoption of these technologies accelerated through the COVID-19 pandemic, with impacts unevenly distributed. The Pissarides Review into the Future of Work and Wellbeing will research the impacts of automation on work and wellbeing and analyse how these are differently distributed between socio-demographic groups and geographical communities in the UK. It is a collaboration between the Institute for the Future of Work (IFOW), Imperial College London and Warwick Business School, and supported financially by the Nuffield Foundation.

The Economy 2030 Inquiry

The UK is on the brink of a decade of huge economic change – from the Covid-19 recovery, to exiting the EU and transitioning towards a Net Zero future. The Economy 2030 Inquiry will examine this decisive decade for Britain, and set out a plan for how we can successfully navigate it.

The Inquiry is a collaboration between the Resolution Foundation and the Centre for Economic Performance at the London School of Economics. It is funded by the Nuffield Foundation.

For more information on this report, contact:

Louise Murphy

Economist

louise.murphy@resolutionfoundation.org