The Sectoral Landscape: An Evidence Review

Industrial Strategy Council

Research Paper
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About the Industrial Strategy Council

The Industrial Strategy Council (‘the Council’) is an independent non-statutory advisory group established in November 2018. It is tasked with providing impartial and expert evaluation of the government’s progress in delivering the aims of the Industrial Strategy. Its membership is comprised of leading men and women from business, academia and civil society.

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Executive Summary

Economy-wide perspectives on productivity and economic growth miss the diversity that exists between sectors and firms. While governments mainly use horizontal policy instruments to drive economic growth, it has been recognised that selective policies are an important element of any industrial policy. To maximise the effectiveness of these more targeted interventions, it is crucial to have a clear picture of individual sectors’ characteristics. To this end, this research paper aims to establish a robust evidence base on which the UK’s selective policy interventions can be developed and assessed.

This review emphasises the heterogeneity of the UK’s sectoral landscape and the need for both focus and versatility of sectoral policies. It suggests that in order to maximise the impact on productivity sectoral interventions will have to be tailored along a number of dimensions, including:

- the degree of sector’s reliance on capital,
- the relative importance of tangible versus intangible capital (including management practices),
- the relative importance of R&D and technology adoption, depending on sector’s distance from the productivity frontier,
- the dispersion of productivity performance within a sector,
- location,
- sector’s skills requirements.

We also highlight the importance of services in sectoral policy. The traditional notion of industrial policy was rooted in a manufacturing-based economy. This report reiterates the number of ways in which services play a significant role in the modern UK economy. We show that, in the most obvious way, service industries matter and require policy attention due to their sheer scale, their often-lagging productivity and the particular difficulty in which they find themselves in the aftermath of the Covid-19 outbreak. But they are also crucial because of their increasing importance to the manufacturing industry, both as a productivity-enhancing production input, and as an output. This interrelation between manufacturing and services calls for a degree of coordination between policies aimed at manufacturing and service industries. In addition, services have a significant trade potential which the UK is well placed to tap into.

If selective policies are to target industries effectively and to succeed in supporting the emergence of new industries and technologies, they will often have to go beyond the confines of the standard industry classification and find more creative ways of defining and measuring industries.
Sectoral landscape – chapter summary

The chapter highlights the significant heterogeneity in economic performance and operating environments across industries and discusses key implications for sector-focused interventions. Key findings include:

- Over the last two decades productivity in the UK grew fastest in finance and insurance, information and telecommunication and total manufacturing. Professional services, agriculture, retail, and transport and storage have seen middling improvements. Productivity in construction, accommodation and food services and utilities has flatlined, while mining and quarrying, real estate, and arts, entertainment and recreation have all been on a downwards trend.

- There is a growing body of evidence documenting the limitations of the Standard Industry Classification as a way of measuring sectors. These range from an incomplete coverage of new digital industries to challenges in classifying well-established companies which cross the traditional boundaries dividing manufacturing and services. It is recognised that the SIC will remain the default approach to industry-level statistics given its widespread use and comparability, but alternative approaches should be considered when designing industrial policies.

- Manufacturing and service industries are more interdependent than ever before. Knowledge intensive services play a significant role for enhancing manufacturing sector’s performance. At the same time, there has also been a rapid increase in the service content of manufacturing products.

- The need for services-focused intervention will increase going forward. On the one hand, the UK has been gaining comparative advantage in trade in (mostly high-value) services since 2000s and the UK is well placed to develop this further. On the other hand, the case for support for low-value services is now undeniable. Accounting for almost one-quarter of the UK’s value added and approximately two-fifths of all hours worked, low wage sectors, such as retail, hospitality and administrative services will play a crucial role in raising the aggregate productivity of the UK and could benefit from a targeted intervention.

- Within-sector variations in productivity are as significant as those between them and the problem of a long tail of underperforming firms has a clear sectoral dimension. There are several overlapping issues which will affect optimal policy design. First, evidence suggests some sectors (e.g. professional services, ICT) have a much lower proportion of low productivity firms that others. Second, across the economy the lowest productivity firms tend to be concentrated in low-value service industries (e.g. distribution, accommodation, and restaurants). Third, regardless of sectors relative position on the productivity scale, the gap between top and bottom firms is large in all sectors.

- While evidence suggest the sectoral mix is not the central issue for levelling up, there is clearly a regional aspect to sectoral policy. Differences in the sectoral
mix do not explain the variation in regional productivity. That said, there still might be a difference in the types of occupations and functions more prevalent in different regions. Sectoral policies targeting specific branches of industry (e.g. automotive, aerospace and life sciences) will inevitably favour some areas over others.

- The Government’s commitment to reduce greenhouse gas emissions to net zero by 2050 will have a disproportionate impact on a small number of sectors as over 50% of total emissions are concentrated in only 4 industries: energy, manufacturing, transport and storage, and agriculture, forestry and fishing. Decarbonisation of manufacturing industry will be particularly challenging given the competitive pressures the sector is already under.

Drivers of sectoral productivity differences – chapter summary

The chapter highlights key differences in the determinants of productivity performance across industries. We highlight that:

- There has been a marked increase in the dispersion of productivity across sectors in the aftermath of the financial crisis.

- The UK experienced a sharp drop in productivity in the immediate aftermath of the 2008 financial crisis followed by a long period of slow growth. The productivity gap at the macro level can be mostly attributed to a drop in total-factor productivity (TFP), with capital estimated to have contributed around one third of the gap, and the labour composition having made a positive impact.

- A sharp decrease in TFP growth has been, with a few exceptions, the main driver of the drop in productivity across sectors in the aftermath of the financial crisis.

- Over the last two decades, TFP has had the greatest importance for productivity growth in high-tech industries such as information and communication, finance, professional business services and manufacturing, but these sectors also saw the greatest decreases in productivity post-crisis.

- The evidence points to the drivers of TFP growth differing across sectors, with high-tech industries reliant on in-house innovation and R&D investment, medium and low-tech sectors driven by adoption and diffusion of existing technologies, and service industries disproportionately relying on intangible capital investment.

- The negative impact of the post-crisis weakness in business investment was concentrated in a handful of industries, with manufacturing, and information and communication most sensitive to the slowdown in capital investment.

- The increase in the average qualification level of the workforce has made a positive contribution to productivity across most sectors. Two industries,
construction and transportation and storage, have seen disproportionate increases in the contribution of lower skilled workers.
1 Sectoral landscape

Economy-wide perspectives on productivity and economic growth, while inevitably useful, by definition miss the diversity between and within sectors\(^1\) and firms. While macro-level, horizontal interventions, are the main policy instruments that governments use to drive economic growth, it is also crucial that they have a clear picture of the variation in the characteristics of individual sectors and their operating environment in order to better target their interventions.

The Industrial Strategy White Paper has set out a programme of policies aimed at raising the UK’s productivity, competitiveness and individuals’ earning power.\(^2\) As well as including economy-wide polices, in the areas of skills, infrastructure, innovation and the business environment, it also re-established the Government’s commitment to selective policies in the form of the Sector Deals.

Historically, selective policies in the UK have been associated with the debated ‘National Champions’ approach of the 1970s, characterised by “picking winners” and investing in industries predicted to make most benefit. More recently, it has been recognised that selective policies can be a useful tool for the Government. Well-designed selective policies have a role to play in responding to the UK’s productivity puzzle and may contribute to increasing the long-term competitiveness of the UK.

Recognising the difficulties in designing an effective selective policy, this research paper aims to establish a robust evidence base on which the UK’s modern selective policies can be built, developed and assessed.

This evidence review provides an overview of the characteristics and economic performance of the UK’s sectors.

1.1 Defining sectors

The first challenge in the design of selective policy is identifying and choosing the correct level of aggregation of firms to be targeted.

Today’s modern sectors, characterised by cross-cutting technologies and opportunities for inter-industry linkages, provide challenges for both defining sectors and measuring sectoral performance. The continuous evolution of the breadth and reach of sectors, particularly those highly dependent on innovation, will in future also require sectoral definitions to evolve.

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\(^1\) To note: ‘sectors’ refer to industry sectors (manufacturing, services etc) which is different to the System of National Accounts which refer to institutional sectors (households, government etc).

Sectors have traditionally been defined according to the Standard Industrial Classification (SIC). The guidance provides consistent, internationally comparable definitions for establishment-level classifications. While the precision of the SIC system is not a new issue, it has recently come under renewed criticism.

Coyle (2016a)\(^3\) suggests that the categories were defined for an economy in which manufacturing was far more important and, in today’s society, do not allow firms to accurately identify their classification by the type of activities they engage in. Similarly, Nathan and Rosso (2013)\(^4\) suggest that the SIC no longer provides an adequate classification with one in ten companies in the UK classified vaguely as ‘other’, and one in five without any classification. Specifically, they suggest that SIC-based definitions of the digital economy exclude industries including business and domestic software, architectural activities, and engineering-related scientific and technical consulting.

In their recent report, Hauge and O’Sullivan (2020)\(^5\) reiterated the issue, suggesting there are some flaws in the way official statistics on industrial classification are compiled. They suggest that the main problem is the system of national accounting which employs categories of economic activity that don’t accurately reflect how firms identify themselves. For example, services requiring production knowledge such as R&D and testing, and regulatory services such as intellectual property and consultancy are increasingly tailored towards manufacturing industries, but currently are not recorded in official statistics as ‘manufacturing’.

The gaming industry is another example of a sector which is not fully captured by the official statistics. A report by Mullen et al. (2019)\(^6\) points out that often the available data do not capture the breadth of the industry and suggests that there are issues with the self-reporting of industry classifications. The report suggests that the industry fragmentation, high number of small companies and freelancers, high rate of change, and diversity of participants and activities may contribute to the data limitations.

As highlighted by Hicks (2011)\(^7\) in relation to the flaws in the North American Industrial Classification System, the invisibility of firms and establishments within official classifications have consequences. Without an official classification there will be no information on, for example, employment trends, regional concentration, export trends, or R&D activity, resulting in the absence of adequate research and policy support.

The possible underrepresentation of some sectors within key statistics provides challenges for policy analysis and design. However, despite of the criticism, the SIC remains the most applicable and robust method of classifying establishments into

\(^{3}\) Coyle D. (2016), *The Sharing Economy in the UK*, Sharing Economy UK
\(^{5}\) Hauge J. and O’Sullivan E. (2020), *Inside the Black Box of Manufacturing*, University of Cambridge
\(^{6}\) Mullen H., Barr M. and Mason C. (2019), *Data Provision in the Games Industry in Scotland*, University of Glasgow
\(^{7}\) Hicks D. (2011), *Structural Change and Industrial Classification*, Georgia Institute of Technology
industries. The classification is widely used to evaluate performance across and within sectors, over time and internationally. While there are arguments in favour of radically updating the Standard Industrial Classification and research in the area is welcomed, the huge cost in monetary terms, as well as in the need for comparability over time of economic statistics should not be underplayed.

Therefore, this paper aims to flag the limitations of the available data architecture in order to encourage a degree of caution when using official sectoral data for sectoral policy design, in the hope that this will result in more accurate and effective sectoral interventions. Rather than defaulting to the SIC classification, analysts and policymakers should consider whether an alternative or complementary approach should be used when greater precision is required. In the near future, new approaches to sector classification might be required in order to reflect the transforming economic reality, and to design government policy in a way that accurately targets the emerging areas of the economy. The box below summarises selected alternative approaches to describing the UK sectors.

Box 1: Describing UK sectors

The Office for Life Sciences report presenting bioscience and health technology sector statistics recognised the limitations of using the traditional sector taxonomy to capture the size of the life sciences industry in the UK. In order to get a more accurate picture, they built a database of companies active in this area using several proprietary datasets and a network of industry partners. They estimated the number of employees in the life sciences industries to be over 248,000 in 2018, more than double the figure indicated by the official data.8

In their 2019 report “Innovation mapping now”, Nesta also suggested that many of the new industries, from modern applications of artificial intelligence, to the immersive economy and clean technologies, do not easily fit the standard classification. They recognised that traditional data sources, such as business and innovation surveys, aggregate measures of R&D spend, and STEM graduate supply and patenting, were not designed to capture the fast-changing reality of a digital economy. In their research, they therefore combine data science techniques with new online sources to map these new industries in almost real time.9

The creative industries provide another example of how the limitations of the standard industrial classifications can be overcome. As early as 2002, the Department for Culture, Media and Sport for the first time released the Creative Industries Economic Estimates in order to address inconsistencies and gaps in the then available data on the sector. That, however, did not resolve all the limitations of the standard classification. As a result, Nesta developed a new methodology for identifying creative industries based on specific definitions of creative occupations

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8 HM Government (2018), Bioscience and health technology sector statistics 2018
9 Nesta Innovation Mapping Team (2019), Innovation Mapping Now, London, Nesta
and used those to estimate the ‘creative intensity’ of each sector (i.e. their share of creative occupations). The new estimates released in 2015 estimated the employment in the creative economy in 2010 to be approximately 2.5 million, which meant that the official statistics available at the time understated the size of the creative economy by almost one million employees.\textsuperscript{10}

\textsuperscript{10} Nesta (2015), \textit{The Geography of the UK’s Creative and High-tech Economies}, January 2015
1.2 Drivers of changing sectoral composition in the UK

The sectoral composition of the UK economy has changed over time. This chapter presents a brief overview of the drivers of the changes.

The economy has shifted from manufacturing-based industries towards services-based industries.

Figure 1: Proportion of GVA by sector, UK, 1970 – 2016

Source: Bank of England

Figure 1 shows that in 1970, the services sector accounted for 56% of the UK economy, compared with 80% in 2016. Over the same period, total employment in the sector increased from 15.4 million to 28.9 million. Within the professional scientific and technical services industry, employment almost tripled from 3.7 million in 1970 to 10.3 million in 2016. The rapid increase in the size of the services sector means that modern industrial policies will need to give it much greater prominence than in the past.

Figure 1 also shows the relative decline in the manufacturing sector which accounted for 30% of the economy in 1970 and 10% in 2016. Total employment in the sector decreased from 7.7 million to 2.6 million over the same period. More advanced technology became embedded as the sector specialised in higher value-added goods and services and relied upon global supply chains. This transformation suggests that the selective policies of the past, aimed at manufacturing, were a product of a completely different economic reality than the one that currently characterises the UK. It is, therefore, risky to use past selective approaches as a guide for present-day policymaking.
However, there is growing evidence for blurring of boundaries between manufacturing and services. Falk and Peng (2013)\textsuperscript{11} point to two key factors shaping that trend: \textit{outsourcing of business services by manufacturing firms and an increased service content of manufacturing products}.

Berlingieri (2014)\textsuperscript{12} finds that the shift from manufacturing to services noticeable in the data is partly explained by outsourcing. Looking at the US economy, the study shows that over the period 1948-2002 outsourcing of professional and business services accounted for 36% of the increase in services and 25% of the fall in manufacturing jobs.

That observation is echoed by Ciriaci and Palma (2016)\textsuperscript{13} who point out that failing correctly to account for manufacturing outsourcing to knowledge-intensive business services may lead to an overestimation of the size of services and underestimation of manufacturing. Hauge and O’Sullivan (2020) reiterate that manufacturing-related services are neglected by the official statistics recording the sector.

Analysis by PwC suggests that \textit{viewing services and manufacturing as distinct sectors is overly simplistic, as manufacturing and services are becoming increasingly merged}.\textsuperscript{14} Bamber et al (2017)\textsuperscript{15} find more than one-third of the global value of manufacturing exports are from embedded services, primarily from distribution and business services.

Both trends are confirmed by Christiansen and Drejer (2007)\textsuperscript{16} who, based on a study of Danish companies, find that a significant proportion of knowledge-intensive business services firms have collaborated with suppliers of physical products, as well as that a significant proportion (in some subsectors up to a third of the firms studied) of product-innovative manufacturing firms have developed services to be delivered as a part of their product package.

Firms such as Rolls Royce (shown in box 2 below) may operate in both sectors, or bundle goods and services together in packages.

Box 2: Case Study of Rolls-Royce

\textbf{Rolls-Royce has made a significant and successful transition from a pure manufacturing company in the past, to an integrated solutions provider which captures value across the full lifecycle of its products. They “combine knowledge


\textsuperscript{13} Ciriaci D. and Palma D. (2016), \textit{Structural change and blurred sectoral boundaries: assessing the extent to which knowledge-intensive business services satisfy manufacturing final demand in Western countries}, Economic Systems Research

\textsuperscript{14} PwC UK (2009), \textit{The future of UK manufacturing}, Retrieved from: http://www.pwc.co.uk/assets/pdf/ukmanufacturing-300309.pdf


\textsuperscript{16} Christiansen J. L., Drejer I. \textit{Blurring boundaries between manufacturing and services}, ServINNo
inherent to the designer with the data generated from the engines in operation and supply chain network to deliver services which create value for customers.\footnote{Rolls-Royce. Retrieved from: https://www.rolls-royce.com/products-and-services/defence/aerospace/services.aspx}

Rolls-Royce reported turnover of around £6 billion in 2001, of which 38% came from services. In 2018, turnover was £7.4 billion with 58% coming from services.\textsuperscript{17}

PwC analysis suggests that the most successful firms (and whole economies) of the future will be those who turn the bridge between manufacturing and services into competitive advantage.

The increasing blurring of the boundaries between manufacturing and services has implications for sectoral policy.\textsuperscript{18} Ciriaci et al. (2016) and Christiansen et al. (2007) encourage policy makers to conduct a correct evaluation of the interdependent role of manufacturing and knowledge-based services when designing industrial policy, as services appear to be crucial for the competitiveness of the manufacturing sector.

Ciriaci et al. (2016) stresses that KIBS are crucial for the production, diffusion and use of technology in manufacturing and, therefore, for their long-term growth. One study (Baker (2007)\textsuperscript{18}) shows that each euro worth of input of KIBS increases the value of total manufacturing output by around 1.67 euros.

The study also stresses that the extent to which KIBS contribute the final demand of manufacturing may be seen as a proxy for the need of manufacturing firms to acquire external intangible resources and enhance product differentiation and quality. Perhaps not surprisingly involvement of KIBS is the highest in high-tech manufacturing.

However, the study also finds that the degree of and the growth in service intensity of manufacturing output has been lower in the UK than in France or Germany, and link that to a much faster tertiarization of the UK economy that took place from 2000 onwards. Only the UK high-tech manufacturing sector bucked that trend.

For further analysis, see Rowthorn and Coutts (2013)\textsuperscript{19} and evidence review, see Schettkat and Yorcarini (2003).\textsuperscript{20}

The impact of net zero

The Government’s commitment to reduce greenhouse gas emissions to net zero by 2050 will have a disproportionate impact on some sectors.

As illustrated in Figure 2, over 50% of total greenhouse gas emissions are concentrated in only 4 industries: electricity, gas, steam and air conditioning; manufacturing; transport and storage; and agriculture, forestry and fishing.

As highlighted in the report Net Zero North (2017)\textsuperscript{21}, active support for industries transitioning towards low-carbon production will be needed, as many of the energy-intensive industries are already facing significant competitive pressures. Large scale investment in green technologies needed for this transition can further decrease the short-term competitiveness of those industries.

**Industrial decarbonization will be a major milestone on the road to net zero.** There are large differences between industrial sub-sectors in the end-use applications of energy, especially in terms of products manufactured, processes undertaken, and technologies employed. They range from highly energy-intensive steel production and petrochemicals processing to low-energy electronics fabrication (Dyer et al., 2008)\textsuperscript{22}. The 2018 data reveal a large variation in energy consumption across manufacturing subsectors (see Figure 3). Chemicals, food, drink and tobacco, and mineral products are by far the most energy-intensive 2-digit sectors in the sample.

As pointed out by Cooper and Hammond (2018)\textsuperscript{23} the large variation across industries does not facilitate a cross-cutting, ‘one size fits all’ approach to the adaptation of new technologies in order to reduce energy demand but, rather, requires tailored solutions for separate industries (Dyer et al., 2008). This is especially crucial as the Committee on Climate Change has classified industrial decarbonisation as a ‘difficult’ area in which to secure appropriate carbon dioxide savings.

Cooper and Hammond (2018) also stress that much of the activity in some of these sectors is due to a relatively small group of major players whose actions have a large influence on the bulk of sectoral performance.

The UK government has already set out their approach to industrial decarbonisation in the 2017 Clean Growth Strategy\textsuperscript{24} and in the accompanying action plans for the most affected industrial sectors: cement, ceramic, chemicals, food and drink, glass, oil and refining, and pulp and paper. Any future sectoral policy will need to build on this work.

\textsuperscript{23} Cooper S.J.G., Hammond G.P. (2018), ‘Decarbonising’ UK industry: towards a cleaner economy, ICE publishing
Figure 2: Total greenhouse gas emissions by industry section, 2018 (provisional)\(^{25}\)

![Pie chart showing the percentage of greenhouse gas emissions by industry section.]

- Manufacturing: 15%
- Electricity, gas, steam and air conditioning supply: 17%
- Transport and storage: 15%
- Agriculture, forestry and fishing: 8%
- Water supply; sewerage, waste management and remediation activities: 4%
- Mining and quarrying: 4%
- Wholesale and retail trade:...
- Construction: 2%
- Other: 5%
- Consumer expenditure: 26%

Figure 3: Manufacturing industry’s energy consumption at 2 digit SIC level, 2018

![Bar chart showing energy consumption by manufacturing subsectors.]

ONS, Greenhouse gas emissions in the United Kingdom, 1990 to 2017 and (provisional) 2018

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\(^{25}\) ONS, Greenhouse gas emissions in the United Kingdom, 1990 to 2017 and (provisional) 2018
1.3 Measuring a sector

Productivity is one of the main metrics of interest in the Industrial Strategy White Paper. The Industrial Strategy aims to boost productivity by backing businesses to create good jobs and increase the earning power of people throughout the UK with investment in skills, industries and infrastructure.

Productivity varies across sectors. Understanding these differences is critical when designing selective policy that will be tailored to the needs of each sector and will have an impact on the aggregate level of productivity.

Measuring productivity at the sectoral level

The relative size of a sector determines the potential impact of targeted intervention, and the scale of the challenge involved in supporting that sector’s performance. This section presents key statistics describing relative sizes and productivity performance of key industries in the UK.

Figure 4: GVA share by broad industry group, UK, 2016

<table>
<thead>
<tr>
<th>Industry Group</th>
<th>GVA Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real estate activities</td>
<td>13.8%</td>
</tr>
<tr>
<td>Wholesale and retail trade; repair of motor vehicles and motorcycles</td>
<td>10.4%</td>
</tr>
<tr>
<td>Health and social work</td>
<td>7.5%</td>
</tr>
<tr>
<td>Financial and insurance activities</td>
<td>7.3%</td>
</tr>
<tr>
<td>Information and communication</td>
<td>6.3%</td>
</tr>
<tr>
<td>Public administration and defence; compulsory social security</td>
<td>4.7%</td>
</tr>
<tr>
<td>Transportation and storage</td>
<td>4.3%</td>
</tr>
<tr>
<td>Professional, scientific, technical, administrative and support service activities</td>
<td>12.3%</td>
</tr>
<tr>
<td>Total manufacturing</td>
<td>10.0%</td>
</tr>
<tr>
<td>Construction</td>
<td>6.0%</td>
</tr>
<tr>
<td>Education</td>
<td>5.9%</td>
</tr>
<tr>
<td>Accommodation and food service activities</td>
<td>3.0%</td>
</tr>
<tr>
<td>Other service activities</td>
<td>2.1%</td>
</tr>
<tr>
<td>Arts, entertainment and recreation</td>
<td>0.1%</td>
</tr>
<tr>
<td>Electricity, gas, steam and air conditioning</td>
<td>0.0%</td>
</tr>
<tr>
<td>Water supply, sewage and waste disposal</td>
<td>0.0%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>0.0%</td>
</tr>
<tr>
<td>Mining and quarrying</td>
<td>0.0%</td>
</tr>
<tr>
<td>Activities</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Source: EU KLEMS

As shown in Figure 4, over 45% of UK’s total GVA is generated by only four largest broad industry groups. These are real estate activities, business support services, wholesale and retail trade, and total manufacturing. This ratio increases to around 74% when the next four largest sectors (health and social work, finance and insurance, information and communication, and construction) are included.

While the economic activity is concentrated in a relatively few large industry groups, there is a significant variation in fragmentation within those groups. Manufacturing, accounting for over 10% of UK’s GVA, is much more fragmented than other sectors, with its 24 different SIC divisions split further into further 95 activities (3-digit SIC codes). By contrast, finance and insurance generating 7% of GVA is subdivided into only 3 divisions and 10 activities. Similarly, information and communication (6.3% of GVA) comprises 9 divisions and 23 activities. This is also another reflection of the imperfection of the standard industry classification highlighted in section 1.1 above.

In terms of productivity performance, Figure 5 shows which industries have the greatest potential on a macroeconomic level to affect the wider economy if their productivity were to improve.
Figure 5: Productivity and GVA share by industry, UK, 2016

Source: EUKLEMS
Figure 6: Cumulative growth in value added per hour worked by industry, UK, 1995 - 2016

Source: EUKLEMS
While the two largest service industries (wholesale and retail trade, and business support services) account for nearly a quarter of UK GVA, their productivity level is over a quarter lower than the whole economy average.

By contrast, two productivity success stories within the service sector (finance and insurance, and information and communication) account for a smaller, but still considerable, 13.6% of the UK’s total GVA. The productivity of the finance industry is twice as high as the economy average of £33 in 2016, while for information and communication it is 35%.

Productivity of the manufacturing industry also exceeds the economy average and with a 10% share of the total GVA, it could hold the key to an improvement in aggregate productivity. However, there is a considerable variation in productivity across its constituent parts, something that is also likely to be true of other broad industry groups. Manufacturing includes two of the most productive industries in the UK (pharmaceuticals, and the manufacture of coke and petroleum products) as well as those with much more modest productivity record, such as the manufacture of wood and paper products, and basic metals.

Another group of laggards with a potential significant impact on the economy are construction, transportation and storage, and accommodation and food services. All three combined account for 13.2% of the total GVA in the UK. Together with the retail sector, they are characterised by a high concentration of low-wage jobs and a growing share of employment.

Finally, mining and quarrying, and energy complete the list of high productivity industries. While combined they account for only under 3% of total GVA, they are 4 and 3.5 times as productive as the economy average respectively.

Unsurprisingly, the patterns of productivity growth over the last two decades have also differed across industries. Figure 6 presents cumulative growth in value added per hour worked for the main industry groups across the UK economy (panels A and B) and the subsectors of the manufacturing industry (panels C and D). Across the whole economy (top panels) the sectors can be broadly split into those with steady growth in productivity (panel A) and those that have seen their productivity fall or stagnate (panel B). The former includes such sectors as finance and insurance, information and telecommunication and total manufacturing (top three in the sample) but also agriculture, retail and transport and storage. The group of sectors with falling or stagnant productivity comprises mining and quarrying, real estate and arts, entertainment and recreation (all three on a downward trend) as well as construction, accommodation and food services and utilities (flat trend). The picture is more consistent within manufacturing where most subsectors grew over the period analysed but with varying speeds. The top performers included pharmaceuticals, transport equipment and chemicals. Food, wood and paper, rubber, and basic metals form the group of subsectors with slower growth. The only manufacturing subsector that saw its productivity decrease was coke and refined petroleum products.
International comparison

The productivity of UK firms and sectors relative to their competitors in other countries is a key indicator of their performance.

International comparisons are particularly difficult due to the different methodologies followed internationally on assembling estimates of labour inputs (workers and hours worked). Research by the OECD (2018) found the adjustments made to align measures of labour input with the corresponding measures of production (particularly hours worked) vary considerably across countries. They conclude that countries (such as the UK) who extract hours worked data from the original source (self-reported hours worked from the Labour Force Survey) without making adjustments seem to systematically over-estimate labour input and therefore under-estimate labour productivity. Once accounting for differences, the OECD analysis finds an improvement in the productivity position relative to the United States for multiple countries including a 10.4% improvement for the UK. Therefore, caution is needed when trying to compare sectoral productivity across countries.

That said, a tentative conclusion one can draw from available data is that the UK's middling productivity is an economy-wide phenomenon and not a sector specific issue, with only a few broad industry groups outperforming the EU average.

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27 Rafał Kierzenkowski, Gabriel Machlica, Gabor Fulop, (2018). The productivity puzzle through the magnifying glass: A sectoral perspective, OECD Economics Department Working Papers No. 1496
Figure 7 shows that the UK lags behind its international peers in almost every sector. When the sample is extended to all European countries the UK’s relative performance improves from low to middling but, in either case, most UK sectors are far from the global productivity frontier.

Unsurprisingly, this international productivity comparison gets more nuanced at a more granular level showing that in some sectors the UK is a European leader. Out of smaller 34 subsectors, those ranked in the top 6 for the productivity level (out of 27 EU countries) included among others: other service activities (e.g. hairdressing or dry-cleaning); chemicals and chemical products; mining and quarrying; postal and courier activities; trade and repair of motor vehicles; manufacturing of textiles; publishing, audio-visual and broadcasting activities; and retail trade. (for the full list see Annex C)

One the other hand, the data suggest that in 2014 the largest gap relative to the European peers existed in such sector as: arts, entertainment and recreation (however, as this sector is very reliant on labour inputs the estimation error might be
particularly large in this case explaining the poor relative performance); transport and storage; IT and other information services; electricity, gas and water supply; professional, and other service support activities; finance and insurance; telecommunications.

Forth and Aznar (2018) confirm that the level of productivity in the UK’s low-paying sector lags behind that found in the equivalent sector in a number of economies, including Germany, France, the Netherlands and the United States. In each of these economies, the low-wage sector outperforms the UK in productivity terms by between 20% and 30%, depending on the country. Looking within the low-paying sectors, there are several specific industries where the gaps are particularly large. Once again, arts, entertainment and recreation is a notable example, but the UK gap is also relatively large in agriculture, administrative and support services, and social care. The low-wage sectors where the UK is performing relatively well include textile and clothing manufacture, the sale and repair of motor vehicles, and other service activities.29

Within-sector differences in productivity

Sectoral averages of economic performance also mask differences within sectors, i.e. the differences in the incidence of low productivity firms. While on average most UK sectors might be lagging behind their peers, there is no question that the UK is home to some of the most productive companies in the world. Unfortunately, it is also home to a large group of underperforming firms.

Economic literature often refers to ‘the long tail’ of UK firms, described by the OECD as the labour productivity divergence between the global frontier and laggard (non-frontier) firms30. The shape of the distribution shows less productive firms in the left-hand tail, a concentration of firms within the £5,000 to £50,000 output per worker range, and a gradually diminishing right-hand tail, representing the smaller number of businesses at higher levels of labour productivity. Smaller firms tend to be less productive than larger firms, with globally leading firms ‘the frontier firms’ pulling ahead of the rest. This pattern varies across sectors.

As shown in Figure 8, services have a much higher proportion of low productivity firms that other industries in the sample. This suggests that intervention in such sectors will inevitably have to focus much more on rising productivity of the least productive firms. Exploring the long tail more closely, Figure 9 shows the sectoral makeup of firms in the bottom 10%.

Source: ONS

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Figure 9 shows that firms in the more labour-intensive services industries accounted for the vast majority of firms in the bottom 10%, at least 8 in 10 of these firms across the years. Those in the more capital-intensive production (manufacturing and non-manufacturing production) and construction industries accounted for the remainder.

Finally, OECD (2017)\(^\text{32}\) presents yet another take on the within-sector distribution of productivity. The research analyses the differences between individual firm’s productivity and their sector-specific productivity frontier. The results once again confirm that, while the productivity gap is a large in all sectors, there is still some variation between them. As shown in Figure 10, the gap is the widest in business services and the narrowest for low-tech manufacturing. According to the authors, these differences are driven by the barriers to diffusion of innovation and knowledge across industries.

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Figure 10. Median distance from the productivity frontier by sector (In logarithmic scale, 2013-14 average).

Source: OECD, Median productivity (in logarithmic scale) is shown on the second line of the x-axis' label. Frontier firms are defined as the top 5% in terms of productivity within each 2-digit sector.

**Measuring comparative advantage at the sector level**

**Information about country’s comparative advantage is an important factor shaping any government’s approach to selective policy.** Whether it’s by providing information about relative strengths, warning about the risks of relative decline or cautioning against trying to design interventions in contradiction of global trends, comparative advantage data helps in more accurate targeting of key sectors.

The section below uses measures of comparative advantage to paint a picture of UK’s relative trade strengths.

Comparative advantage is challenging to measure because it requires characterizing the differences between world prices and domestic prices that would have prevailed under autarky. As the counterfactual prices cannot be observed, prices are inferred.

The analysis presented below was set out in a paper by Boz et al (2019) and is based on a gravity model of trade.**33 Perhaps unsurprisingly, it shows a significant shift in UK’s comparative advantage away from manufacturing and in favour of services.**

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Figure 11: Gravity based comparative advantage over time for China, Japan, France, Germany, United Kingdom and the United States, 1970 – 2014

Solid lines are estimates based on data from Johnson and Noguera (2017), dashed lines are based on the 2016 World Input Output Database.

Source: Boz et al (2019)³⁴

The estimates in Figure 11 show that comparative advantage in manufacturing in the UK have been declining since the early 1990s.

The UK now has a strong comparative advantage in services trade including financial services, business and professional services, IT and communications, design and media, and travel and tourism. These tradable services play a strong role in the UK services sector, with the result that the UK exports a higher share of GDP than any other G7 economy. The services export share is around 12% of GDP, compared to about 8% in Germany and France, 4% in the United States and 3% in Japan. In absolute terms, the UK is the second-largest exporter of services in the world behind the United States.\textsuperscript{35}

According to Eurostat the UK is its third biggest services supplier after the US and Germany.\textsuperscript{36} The latest official trade statistics confirm the continuing good performance in services. The ONS states that the total UK exports of services (excluding travel, transport and banking) increased by 14.3% in 2018 to £185.3 billion. It also indicates that the services surplus widened 11.7% in 2018, from £83.4 billion in 2017 to £93.2 billion.\textsuperscript{37}

Services export was relatively concentrated in 2018 with the professional, scientific, and technical activities; and information and communication accounting for a combined 54.8% of UK services exports.

However, it’s crucial to point out that caution is necessary when using these statistics as they don’t cover the full extent of the UK’s service economy. In addition, the ONS has previously suggested that a comparison of the UK and other countries’ trade data suggest that the UK might be underestimating the imports of services to the UK which would have resulted in a much narrower trade surplus in services.\textsuperscript{38}

The revealed comparative advantage (RCA) measure, which indicates whether a country is in the process of extending the products in which it has a trade potential or whether exports are static, points to a similar pattern of manufacturing decline.

Figure 12 shows the revealed comparative advantage for selected countries over time for agriculture and manufacturing.

\textsuperscript{36} Pindyuk O. (2019), The Future of UK Services Trade Post-Brexit Unlikely to Be Bright, Vienna Institute for International Economic Studies
\textsuperscript{38} UK statistics glitch could mask Brexit disruption to service, published in the Financial Times, 31 August 2018, https://www.ft.com/content/9f1d7ad2-ac5a-11e8-89a1-e5de165fa619
A value of less than unity implies that the country has a revealed comparative disadvantage in the product. Similarly, if the index exceeds unity, the country is said to have a revealed comparative advantage in the product.

Source: The World Bank

Figure 12 shows that only the UK has a relative disadvantage with all other countries in manufacturing goods. However, a crucial point revealed by the RCA data is that the decline in comparative advantage in manufacturing has not been uniform across all products (see Figure 13 below).

Figure 13: Revealed comparative advantage by product for the UK in 2000 and 2014

Source: The World Bank

The UK had comparative advantage in food products, intermediate goods and transportation in 2014. This has improved in each of these goods since 2000. All other
goods presented in the figure are at relative disadvantage compared to the rest of the world. Over time their position has improved, except for fuels, manufactures, and raw materials. In 2014, the UK did not have comparative advantage in agricultural raw materials, fuels, manufactures, raw materials, and textiles and clothing.

Geographical specialisation

While the evidence suggests that the sectoral composition does not vary greatly across UK regions, employment in some sectors is relatively concentrated and any selective policy will, by definition, have a very localised character. Figure 14 shows sectoral composition of each region’s GVA.

Figure 14: Industrial variation in total GVA in NUTS1 regions, 2018

![Bar chart showing sectoral composition of each region’s GVA](image)

Source: ONS

Figure 14 demonstrates that, when looking at broad industry groups, only London and the South East are significant outliers, with much larger proportion of GVA coming from finance, and information and communication.

In line with the broad-brush picture painted by Figure 14, the prevalent narrative in academic literature is that differences in the sectoral mix don’t explain the variation in regional productivity.
As highlighted by the ISC report UK Regional Differences: An Evidence Review, a number of studies (ONS (2019)\textsuperscript{39}, Martin et al. (2019)\textsuperscript{40}) suggest that differences in sectoral composition across regions do not explain the productivity difference between them and point to within-industry differences as the key reason.

Figure 15 shows that only a small proportion of regional productivity differences can be explained by differences in sectoral composition. The overall size of each bar indicates the total percentage productivity gap of each region relative to the UK average. It indicates that only 4 percentage points of London’s productivity advantage can be explained by the industry structure, as can 3 percentage points of the East Midland’s productivity disadvantage. Most of the differences instead seem to arise from regions differing in their productivity within the same industries.

However, as highlighted by Massey (1979)\textsuperscript{41}, while there might be relatively little difference in sectoral make-up of different regions, there still might be a difference in the types of occupations and functions more prevalent in different sectors. This is also the conclusion of Beatty et al (2019)\textsuperscript{42} who find that regional productivity differences might be partly explained by the variation in occupations – in other words, by the fact that managers and professionals tend to be located in some places, whereas more routine occupations elsewhere. Similar, if less radical, conclusions were reached by Rice et al. (2004)\textsuperscript{43}.


\textsuperscript{41} Massey D. (1979), In What Sense a Regional Problem?, Centre for Environmental Studies, London


Productivity is measured as gross value-added (GVA, in £) per hour. The contribution of industry composition is calculated for each region as the UK average industry productivity in each of 16 broad SIC categories, multiplied by a region’s share of hours in this category, and summed over all categories.

Source: Industrial Strategy Council - UK Regional Productivity Differences: An Evidence Review

**It should be noted that at a higher level of granularity some sectors have a very localised impact.** Figure 16 shows the regional employment footprint of three key sectors targeted by the Sector Deals (automotive, aerospace and life sciences), and of manufacturing as a whole. Annex A provides the maps for a wider selection of UK industries.

**As shown in Figure 16, the three key sectors targeted by the Sector Deals are concentrated in a handful of local areas.** While it is clear that a large proportion of jobs in the manufacturing sector are concentrated in the Midlands and the North, generally every region has a significant number of manufacturing jobs. That said, the degree of regional specialisation increases with the increase of granularity of sectoral classification.
Figure 16: Employment by sector in the UK’s NUTS3 regions.

Source: ONS Business Register and Employment Survey
The importance of low wage sectors

It is critical to recognise the contribution of low wage sectors to the UK economy. While sectoral interventions have been more often used to support strategic, tradeable sectors, it is becoming clear that the needs of industries further down productivity scale should not be overlooked by governments.

The importance of low wage sectors stems, among other factors, from their size. In their study, Forth and Aznar (2018) estimate that ten low wage sectors in the UK (defined as sectors where a quarter of average wages are lower than two-thirds of the UK median) account for almost one-quarter of the country’s value added and approximately two-fifths of all hours worked.44

Forth and Aznar (2018) show that productivity in the UK low wage sectors is 20-30% below that of Germany, France, the Netherlands and the US, even though UK’s relative position in low wage sectors is better than in higher productivity sectors. More importantly, they point out that increasing productivity in low wage sectors to the US levels would close between a fifth and a quarter of the UK’s productivity gap with France, Germany and the Netherlands.

In two separate studies, the OECD also points to the importance of low wage sectors. In the Compendium of Productivity Indicators 2019, OECD finds that the top three sectors generating the largest net employment gains since 2010 across developed OECD countries had below average productivity. Another OECD paper (2018) also show that much of the post crisis slowdown in TFP growth in non-financial services (including real estate and business services, government services, transportation and storage and information and communication) can be explained by a rapid expansion in self-employment related to the rise in the gig economy jobs.45

Low wage sectors also matter because they tend to be more concentrated in some parts of the country than in others. For example, 48% of jobs in Cornwall and the Isles of Scilly are associated with low wage sectors, compared to approximately 36% in Inner London.46

Global trends are likely to disproportionately affect low wage sectors. The probability of automation could be as high as 47% for employment in low wage sectors due to their reliance of low skilled occupations.

Finally, as outlined below in more detail, low wage industries, and especially services, are likely to require different interventions than their higher wage counterparts. High tech industries, particularly manufacturing, rely more heavily on R&D for the TFP increases as they capitalise on innovations at the technology frontier. Lower technology sectors are more reliant on improvements in management quality, better workforce skills and technology adoption.
2 Drivers of sectoral productivity differences

Growth accounting framework we use here identifies three main drivers of productivity growth: multifactor (total factor) productivity, capital intensity and labour composition. Below we look into all three and ask how they differ between sectors and how they can explain differing productivity performance across sectors.

The post-crisis productivity slowdown that affected the UK and other advanced economies is used here as a starting point for a discussion about variations in sectoral drivers of productivity in the UK.

Figure 17: Growth in output per hour from 1994 and contributions to the productivity gap from 2008, UK, market sector

Source: ONS

There has already been a number of studies that decomposed the recent productivity slowdown into relative contributions of TFP, capital and labour, including Riley et al.

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45 Rafał Kierzenkowski, Gabriel Machlica, Gabor Fulop, (2018), The productivity puzzle through the magnifying glass: A sectoral perspective, OECD Economics Department Working Papers No. 1496
46 BEIS analysis based on Business Register and Employment Survey
All of them find that in the period following the crisis, the productivity gap was driven almost completely by a decrease in multifactor productivity. More recently, capital shallowing (reduced capital investment for every hour worked) is estimated to have contributed to around one third of the gap. As for labour, literature finds that throughout this period labour composition has made a small but positive contribution to overall productivity growth, the implication being that productivity growth would have been even weaker in the UK in recent years had it not been for the continued upskilling of the workforce.

**Once again, this aggregate picture hides sectoral differences in productivity performance.**

As shown in OECD (2018) there has been significant heterogeneity in productivity performance across sectors since the crisis and a marked increase in the dispersion of productivity. Measured by the difference between actual productivity and its level implied by the pre-crisis trend growth rate, dispersion in productivity shot up in 2007/08 (Figure 18).

Figure 18: Cross-sector differences in productivity since the financial crisis

There are important sectoral differences that explain the post-crisis productivity decline. According to OECD, in the fourth quarter of 2016 (most recent data at the time

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51 Rafał Kierzenkowski, Gabriel Machlica, Gabor Fulop, (2018), op cit
of publication), over half of the total productivity shortfall was accounted for by non-financial services, nearly a fourth by financial services, around 15% by manufacturing and more than 10% by other production and construction (Figure 19). All but non-financial services and construction contributed disproportionately to the productivity shortfall compared to their shares in total output and employment.

Crucially, OECD (2018) also shows that much of the post-crisis productivity shortfall was due to within-industry slowdown rather than the reallocation of workers from more to less productive industries. Non-financial services saw the largest slowdown, followed by financial services and manufacturing (see Figure 19).

Figure 19. Contributions to the productivity shortfall relative to 1997-2007 trend growth, percentage points and percentages in brackets, Q4 2016

Within the non-financial services information and communication (ICT) was the major contributor to the overall slowdown, explaining 20% of the gap, followed by transport and storage, and real estate and business services, accounting each for about 8-8.5% of the overall shortfall (see Figure 20).

Figure 20: Contributions of sectors of non-financial services to the productivity shortfall relative to 1997-2007 trend growth, percentage points and percentages in brackets, Q4 2016
As shown below in more detail, subdued TFP is the key driver of the aggregate productivity shortfall in all sectors. In particular, TFP has significantly held back productivity in financial services and other production sectors. Capital deepening has also had a large impact on the productivity shortfall, especially in non-financial services and manufacturing, where its impact has been nearly as high as that of TFP. Annex B provides productivity decompositions for a wider selection of UK industries.

Below we look at each of the productivity drivers in more detail.

2.1 Total factor productivity

As shown above, total factor productivity (TFP) is key for understanding the decrease in the UK productivity growth in the aftermath of the financial crisis. It also helps explain productivity differences across sectors.

Looking at long term contributions of TFP to productivity of different industries one can notice a relatively clear pattern of the reliance on TFP growth (see Figure 21). As TFP is associated with technology growth it has had the greatest importance for high-tech industries such as information and communication, finance, professional business services and manufacturing.

On the other end of the spectrum we have those industries that very heavily rely on one of the two remaining drivers of productivity, capital or labour. This includes capital-intensive utilities and mining as well as labour-intensive arts, entertainment and recreation and education.
The industries most reliant on TFP growth over the longer term are some of the same industries that saw the largest TFP-driven decreases in productivity after the financial crisis. Riley et al. (2018) shows that TFP growth slowdown played a crucial role in explaining the decrease in overall productivity following the economic downturn in finance (excluding insurance), manufacture of pharmaceuticals, and manufacture of machinery and equipment.\(^5\)

OECD (2018) also identifies finance, information and communication and manufacturing, but also government services and construction (Figure 22) in this category. It is worth noting that as of Q2 2019, non-financial services are the only broad sector that has been making a positive contribution to TFP growth since the crisis (see Figure 23).

However, Forth and Aznar (2018) suggest that TFP is also an important factor explaining poor performance of the low wage industries in the UK. They suggest the UK’s TFP gap relative to other countries is smaller in industries with a relatively high share of on-the-job training and use of ICT, high share of employees subject to management practices such as performance related pay or continuous improvement,

low share of employees on temporary contracts, and less restrictive product market regulations in upstream industries.53

Figure 22: Decomposition of shortfall relative to 1997-2007 trend growth, per cent, 2015

![Graph showing decomposition of shortfall](image)

Source: OECD

Figure 23. Industry contribution to cumulative multi-factor productivity growth, UK, market sector54

![Graph showing industry contribution to productivity growth](image)

Source: ONS

54 ABDE is Agriculture, forestry and fishing; Mining and quarrying; Electricity, gas, steam and air conditioning supply and water supply; Sewerage, waste management and remediation activities
Determinants of TFP growth

R&D, or broadly defined knowledge creation, has been identified as the key driver of TFP growth in a number of studies and there is a degree of variation in the relative importance of R&D across sectors.

The most obvious reason for this is that some sectors tend to engage more in knowledge creation activities than others.

Figure 24 provides more detail on the sectoral differences in R&D intensity. Unsurprisingly, electronics and optical products, aerospace, and pharmaceutical are by far the most research-intensive industries (contributing to a relatively high R&D intensity of the manufacturing industry as a whole of 4.7% of industry’s gross value added). In comparison, the average R&D intensity of the service industry was only 0.8% of its GVA in 2014. It is worth noting that the UK exceeds the OECD average R&D intensity level only in the aerospace industry.

Also Hooker and Achur (2016) suggest that product and process innovation tends to be lower in the service sectors than in manufacturing, and lower in sectors such as retail, and accommodation and food service, than it is in higher value-added services such as finance and business services.55

Figure 24: R&D intensity by industry: business enterprise R&D expenditure (BERD) as a proportion of gross value added (GVA), 2014 or nearest year (UK in purple)

Source: OECD Health at a Glance (2019)

Research also finds that there is a large variability in the effect of R&D on different sectors’ TFP. For example, Ortega-Argilés et al. (2009)\textsuperscript{56} concluded that the effect of R&D investment on productivity increases with R&D intensity. Similarly, Kumbhakar et al. (2009)\textsuperscript{57} found that R&D activities explain a small part of productivity growth in low-tech industries. In these industries, investment in fixed capital appears to be a more important determinant.

In a study of Belgian industry in the period 1988-2007, Biatour, Dumont and Kegels (2011) confirm that R&D is an important determinant of TFP, either through the R&D accumulated by the industry (intra-industry) or R&D accumulated by other domestic or foreign industries, but also find a significant variation of the effect of R&D across sectors, especially between manufacturing and services.\textsuperscript{58}

IMF (2015) confirms that unlike the manufacturing and ICT sectors, innovation in services does not stem primarily from R&D spending.\textsuperscript{59} Instead, investment in tangibles (particularly automation and ICT) and intangibles (e.g., business processes, organizational structure) are important sources of productivity growth in many services (Uppenberg and Strauss 2010).\textsuperscript{60}

Even the group of manufacturing industries appears to be heterogeneous. The impact of intra-industry R&D investment is only significantly positive for high-tech industries, the positive domestic inter-industry spill-overs only for medium-tech and high-tech industries and the foreign knowledge spill-overs only for medium-tech industries. The paper finds no significant positive impact of R&D stocks for low-tech industries.

Harris et al. (2015) confirm that, on average, plants in such high-tech manufacturing as chemicals excl. pharmaceuticals, machinery and equipment, electrical machinery, motor vehicles, other transport equipment, ships and boats, and aircraft and spacecraft, saw the greatest impact of R&D on TFP growth. They also show that the importance of R&D for TFP growth is significantly higher in manufacturing industries and high-tech knowledge intensive services, and much less important for less knowledge intensive services.\textsuperscript{61}

\begin{footnotesize}
\begin{enumerate}
\item IMF (2015), The New Normal: A Sector-Level Perspective on Productivity Trends in Advanced Economies, IMF Stagg Discussion Note
\item Richard Harris and John Moffat, 2011. Plant-level Determinants of Total Factor Productivity in Great Britain, 1997-2006,” SERC Discussion Papers 0064, Spatial Economics Research Centre, LSE.
\end{enumerate}
\end{footnotesize}
From a policy perspective, these results seem to justify public support for private sector R&D, e.g. through direct subsidies or fiscal incentives. However, these incentives should take into account the heterogeneity between industries. **Own R&D activities should mainly be encouraged in high-tech manufacturing industries whereas for medium- and low-tech manufacturing and services, public support should be oriented more towards enhancing the absorptive capacity of companies and technology diffusion.** As for services industries as a whole, the literature suggests that productivity relies less heavily on R&D investment.

R&D is not the only driver of TFP growth and cross-sectoral differences. Literature points to such factors as agglomeration, management quality, the quality of human capital, technology diffusion and ICT-intensity, market regulation and competition. As detailed evidence on sectoral differences across this full range of drivers is not readily available, below we offer only a cursory review of two of those – agglomeration and management quality.

**Box 3 Other determinants of TFP growth**

**Agglomeration**

Graham et al. (2018)\(^{63}\) reviews estimates of productivity elasticities with respect to changes in agglomeration in a study of wider impact of transport projects. They find that the unweighted mean elasticity from 47 international empirical studies is **0.046** (meaning that a 10% increase in spatial density leads to 0.46% increase in firm productivity). Crucially, the study also points to differences in agglomeration elasticities across sectors. For manufacturing and consumer services estimated elasticity is **0.02**, for construction **0.03**, and for business services **0.07**, suggesting that agglomeration has a much stronger effect on productivity of the latter.

Figure 25. Confidence intervals for the Graham et al. (2009) and SERC elasticities

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\(^{62}\) e.g. Biatour et al (2011).

\(^{63}\) Graham D.J., Gibbons S. (2018), *Quantifying Wider Economic Impacts of Agglomeration for Transport Appraisal: Existing Evidence and Future Directions*
Harris and Moffat\textsuperscript{64} (2012) arrive at similar conclusions in their analysis of the drivers of plant-level TFP across 8 broad sectors: high-tech manufacturing (e.g. pharma and aerospace), medium high-tech manufacturing (e.g. chemicals, auto), medium low-tech manufacturing (e.g. petroleum, rubber), low-tech manufacturing (e.g. food, textiles), high-tech KI services (e.g. telecoms), KI services (e.g. legal, air transport), low KI services (e.g. hospitality, land transport) and other low KI (e.g. postal services).

They find that industry agglomeration (concentration of the same activity in an area where a plant is located) is more important for service industries than manufacturing. The agglomeration variable used in their study is positive and significant for three of the four service sectors (High KI, Medium KI and Other Low KI) but only for one out of four manufacturing sectors (medium high-tech). However, they also find that the clearest marker of productivity performance is being inside or outside of the London and greater South East Region.

Management and competition

In a seminal paper van Reenen et al. (2006)\textsuperscript{65} link inferior management practices to a high incidence of low productivity firms in the UK. The paper puts this down to a combination of low product market competition allowing poor management practices to persist, and to the tendency of family firms to pass on control based on family connections. They also estimate that together competition and family firm status accounts for around one-third of the gap between the US and the UK.

As shown in Figure 25 above, the distribution of low productivity firms differs across sectors with professional, scientific and technical activities and information and communication having a much lower proportion of low productivity firms.

ONS (2018) published a series of estimates of the management practice scores including data on the variation of management quality across sectors.

As illustrated by Figure 26 below, a large gap between high and low productivity firms within a sector is a feature of almost all industries in the UK. That said, the mean management scores form a clear pattern, suggesting that some sectors have on average better management scores than others. The energy sector, information and communication, and healthcare and social care have the highest average management practice scores in the UK. They also have a relatively small within-industry dispersion of scores. On the other end of the scale we have accommodation and food services, transportation and storage, and construction.


\textsuperscript{65} Van Reenen J., Bloom N. (2006), Measuring and Explaining Management Practices Across Firms and Countries, CEP Discussion Paper No 716
is worth noting that real estate activities have the lowest scores at the 10th percentile threshold and the largest gap between the top and bottom ends of the distribution.

Figure 26. Percentile distribution of management scores by industry sections, Great Britain, 2016

Key to industry sections: B (Mining and quarrying), C (Manufacturing), D (Electricity, gas, steam and air conditioning supply), E (Water supply; Sewerage, waste management and remediation activities), F (Construction), G (Wholesale and retail trade; Repair of motor vehicles and motorcycles), H (Transportation and storage), I (Accommodation and food service activities), J (Information and communication), L (Real estate), M (Professional, scientific and technical activities), N (Administrative and support service activities), P (Education), Q (Human health and social work activities), R (Arts, entertainment and recreation), and S (Other service activities).

Source: ONS
2.2 Capital intensity

Capital intensity is the amount of both tangible and intangible capital used in a sector relative to other factors of production. Capital intensity has been shown to have a positive correlation with productivity.66

Figure 27: Capital to labour ratios by industry, 2016.

Looking at capital-labour ratio levels across UK sectors, mining and utilities are by far the most capital-intensive industries in the UK, followed by information and communication, transportation and storage, and manufacturing. Accommodation and food services, wholesale and retail trade, and business support activities are on the other end of this spectrum with the lowest capital to labour ratios in the sample.

There is also a large variation in capital intensity within the manufacturing industry.

66 https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/articles/firmlevellabourproductivitymeasuresfromtheannualbusinesssurveygreatbritain/2017
The four industries disproportionately reliant on capital include coke and petroleum products, pharmaceuticals, transport equipment, and chemicals. On the other hand, textiles, wood and paper products, and basic metals are least capital intensive in the sample.

As for the contribution to productivity growth, Riley et al. (2018) confirm much greater reliance of production industries on capital deepening. The study sets out that historically in manufacturing and agriculture, forestry and fishing around 20 per cent of annual labour productivity growth contributions arise through increases in the capital intensity of production. In construction that's around 50 per cent, while in utilities this figure averages 100 per cent. Capital intensity also plays an important role in wholesale and retail industries, but in most other service sectors almost all of the contribution to growth comes via TFP. Figure 29 shows the percentage point change in productivity for each sector attributed to a change in capital intensity.
Figure 29: cumulative contribution of capital intensity to total productivity growth since 2008 by sector (percentage points).

Source: ONS

Since 2008, changes in capital intensity made a negative contribution to productivity growth in the market sector as a whole, decreasing it by -1.05 percentage points (compared to cumulative labour productivity growth of around 0.7 over the same period). Figure 29 shows how the contribution varies substantially across sectors with the highest positive impact in the construction, and the financial and insurance activities sectors.

Information and communication, and agriculture, forestry and fishing and similar industries show a large negative contribution to around 6% of productivity growth in those sectors.

These results are broadly reflected in the wider research on the UK’s productivity slowdown.

Goodridge, Haskel, Wallis (2016) find that in the immediate aftermath of the crisis the contributions to productivity slowdown due to decreases in capital intensity were concentrated in agriculture, mining and utilities; information and communication, manufacturing, but also in wholesale and retail trade.

Riley et. al (2018) also show that capital shallowing reduced labour productivity growth mainly in those industries where capital deepening had previously contributed to growth: manufacturing and utilities. They point out that while capital shallowing effects were already evident during the recession years in these sectors, in the period 2011 to 2015 these effects also became material in service sectors, as strong employment growth resumed.
According to Riley et al. (2018) only half of industries saw a reduction in the rate of capital deepening in the immediate aftermath of the recessions. By the years 2011 to 2015 three quarters of industry groups experienced slower growth in the ratio of capital services to labour than they did during 1999 to 2007, due to relatively weak investment and remarkable growth in hours worked.

The most affected industries according to that research in the period 2011 - 2015 included telecommunications, utilities, retail trade, manufacturing (including pharmaceuticals, metals and metal products, automotive and food) and agriculture.

OECD (2018) confirm that capital deepening has also had a large impact on the productivity shortfall, especially in non-financial services (ICT, real estate and business services, transport, distribution) and manufacturing.

Finally, OECD (2017) provides a measure of where additional capital investment would be most beneficial to the sector productivity. The paper estimates the effect of sector-level increase in capital-intensity on a productivity gap relative to the sector-specific productivity frontier.

The estimates indicate that in most sectors, the productivity gap narrows after an increase in capital intensity. That said, it also shows that this effect is small or uncertain in some sectors (utilities, construction, accommodation and food, car manufacturing, agriculture and food). This might be due to current high level of capital-intensity, sector structure and high capital concentration.

The paper finds that the greatest potential to close the productivity gap is by raising the capital intensity of services sectors. In particular, the largest and most widespread impacts are in knowledge intensive services sectors – ICT and business services – and in the wholesale and retail trade sector. Increasing the capital intensity of the manufacturing sector is also found to be also effective but not to the same degree. As already indicated in section 2.1, the analysis suggests that R&D spending could be effective in raising the productivity of the manufacturing sector.

Intangible capital

Intangible assets, also known as knowledge assets or intellectual capital, encompasses software, reputation and branding, design, and research and development, which contribute to the long-term accumulation of a business’ knowledge capital. Figure 30 shows intangible investment as a share of GVA by industry.

Intangible investment varies across industries even after controlling for their size. The most “intangible intensive” industries are typically service industries. Intangible investment in the information and communications industry was equal to 15.2% of GVA in 2016. However, this has been declining persistently over time, from a peak of 23% in 1997, driven by strong increases in GVA and slower increases in intangible investment. Intangible intensity in most industries has been stable or slowly declining since around the time of the economic downturn.

Production industries are relatively less “intangible intensive” relying more heavily on tangible capital. Of these industries, the manufacturing industry is the most intangible intensive, driven primarily by investment in research and development.

Niebel et al. (2017) shows in a study of EU countries that the growth accounting contribution of intangibles to productivity growth is generally highest in manufacturing and finance. The UK exhibits higher shares of intangible investment in value added in business services and financial intermediation than other countries. Niebel et al. also point to some differences in the types of intangible investment driving growth in some sectors. The high overall intangible investment in manufacturing is mainly driven by R&D, while financial services have a category of

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Niebel T., O’Mahony M., *The contribution of intangible assets to sectoral productivity growth in the EU*, Review of Income and Wealth, Feb 2017
intangible investment unique to that industry, which accounts for 10–30 percent of its total intangible investment. Crucially, in contrast to manufacturing, intangible investment in a number of service industries is shown to be driven by high levels of organisational capital. The research also finds that business services in the U.K. also exhibit a higher share of R&D investment than observed in other countries.

2.3 Labour composition

In the growth accounting framework used here, changes in labour composition are defined as changes in the proportion of the workforce accounting for their productivity-enhancing characteristics, such as skills. It captures both the changes in the number of hours worked and the skill composition of workers in different sectors. This means that a sector in which a greater share of hours is supplied by higher-skilled workers, or in which the ratio of high-skilled to low-skilled wages is greater, will then have a higher measure of relative labour quality per hour.

Impact of labour quality on aggregate productivity growth

Overall, empirical evidence suggests that labour composition has not played a decisive role in the recent productivity slowdown. As highlighted in BoE (2018) changes in labour do not explain the majority of the recent productivity slowdown. This is broadly in line with long-term trends in labour’s contributions to productivity growth. A report for the Department for Business, Innovation and Skills (2015) shows that for the decade from the mid-1990s to the mid-2000s changes in labour quality accounted for around one sixth of the overall growth of productivity.

That said, the quality-adjusted labour data suggest that human capital variations have made a small, positive contribution to the post-crisis productivity growth and have helped lessen the slowdown. The positive contribution of labour composition to the post-crisis productivity growth is confirmed by Riley et al. (2018) and the ONS analysis (see Figure 30).

The contribution of labour quality has remained positive through the recent period mainly due to an on-going increase in the average skill level of the UK’s employed population. In the run-up to the financial crisis, the up-skilling of the UK’s workforce accounted for around 20% of total labour productivity growth. As shown in Figure 31, the contribution from changes in labour composition can be attributed to increases in the shares of the workforce with secondary and tertiary education, and a corresponding decline in the share of those with only primary education. (Figure 31)

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70 Department for Business Innovation and Skills (2015), UK skills and productivity in an international context, BIS Research Paper Number 262
Figure 31: Decomposition of cumulative quarterly growth of output per hour, Q1 1994 to Q3 2019, UK market sector

Source: ONS

Figure 32: Cumulative contributions to changes in hours worked by highest level of education, Quarter 1 (Jan to Mar) 2008 to Quarter 3 (July to Sept) 2019, UK, market sector

Source: ONS

https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/articles/multifactorproductivityestimates/julytoseptember2019
Sectoral differences in labour quality

While the contribution of labour composition to productivity has in general been positive in recent years, the extent to which productivity growth was driven by labour composition has varied across sectors and there has also been a large variation in the expansion of hours and labour quality across industries (see Figure 32).

Figure 33: Average annual growth in labour input, 2008-2016

Source: ONS

While most sectors have seen an expansion in the labour inputs since 2008, the average annual growth was by far the fastest in energy and utilities, followed by real estate activities, health and social work, and professional and administrative services. Total labour contribution decreased in three sectors: mining and quarrying, public administration and defence, and manufacturing.

Expansion in hours worked was still the main driver of labour input growth in most industries except for mining, construction, finance, retail and arts and entertainment where changes in labour quality were larger in magnitude.
What’s striking is that the expansion of hours worked by the lowest skilled has been dominated by two sectors, construction, and transportation and storage. These two industries have seen by far the fastest expansion in the contribution of lower skilled workers total hours worked. (Figure 33)

Perhaps unsurprisingly, sectors most reliant on high skilled workers included information and communication, finance and insurance, and manufacturing, but also government services. Finance and insurance has also seen the fastest fall in the share of workers with qualifications below degree level.

In general, Figure 33 also confirms that the over the last 5 years the expansion of workers with degree level qualifications has been the main driver of improvements in labour quality.

While evidence suggests that labour has had a positive direct contribution to productivity growth post-crisis, changes in the labour market might have negatively contributed to the UK’s TFP performance. OECD (2018) point out rising self-employment may have been one the factors weighing down on TFP. In addition,
they also suggest that greater mismatches between changing skills and created jobs may have also had a dampening effect on TFP.

In future, one of the key trends shaping the UK labour market will be automation and its effect is also likely to vary across sectors, as highlighted in box 4.

Box 4: Automation and the labour market

Using Frey and Osborne’s (2013) methodology, the ONS find 35% of jobs are at risk of automation in the UK. The probability of automation will depend on the proportion of time spent on manual and routine tasks and the role’s educational requirements.

ONS analysis finds the risk of automation tends to be higher for lower-skilled roles, and suggests the three occupations with the highest probability of automation are waiters and waitresses, shelf fillers and elementary sales occupations. Medical practitioners, higher education teaching professionals, and senior professionals of educational establishments are less likely to be automated.72

PwC find that countries and industries with a greater focus on manual and routine tasks, such as within the manufacturing sector typically have a higher risk of automation. On the other hand, in many service sectors, there is an increased focus on social and literacy skills and where those employed are typically more highly educated, such as within the healthcare, technology and finance sectors, the likelihood of automation is lower73.

Figure 35: Percentage of jobs at high risk of automation by 2030, by geographic region and industry sector

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3 Conclusions

Selective policies are now a fact of economic life in the UK. After a period of almost complete dominance of horizontal approaches, the Industrial Strategy White Paper, through Sector Deals, reintroduced vertical interventions to the UK’s economic policy lexicon. However, the case for selective interventions is still a contentious topic in economics and the debate about how to make the best use of selective policies is far from over.

This research paper aimed to take a step back and reassess the UK’s sectoral landscape in order to inform that debate and to establish a robust evidence base on which the UK’s modern selective policy can be developed and assessed.

Most importantly, this research paper emphasises the heterogeneity of the UK’s sectoral landscape. Each sector faces its unique challenges and requires unique solutions. The evidence presented in this research paper highlights that, while many industries need policies aimed at increasing productivity, no two sectors will require the same type of intervention - understanding the nature and the scale of the challenge facing each sector is the necessary first step in effective sectoral policy design.

The research reviewed here points to the need for versatility of sectoral policies. It suggests that in order to maximise its effectiveness on industry’s productivity a sectoral intervention will have to be tailored along a number of dimensions, including: the degree of sector’s reliance on capital-intensity, relative importance of tangible vs intangible capital (including management practices), relative importance of R&D vs technology adoption, sector’s distance from the productivity frontier (high vs low-tech), the dispersion of productivity performance within a sector (frontier firms vs the long tail), interaction between sectors, location, and sector’s skills requirements.

Second, this review highlights the importance of services in sectoral policy. Their significance has been widely recognised, not least in the number of service-focused Sector Deals. However, given the traditional notion of industrial policy was rooted in a manufacturing-based economy, this research paper reiterates the number of ways in which services play a significant role in the modern economy. The research reviewed here shows that, in most obvious way, service industries matter and require policy attention due to their sheer scale, their often lagging productivity and the particular difficulty they find themselves in the aftermath of the Covid-19 outbreak. But they are also crucial because of their increasing importance to the manufacturing industry, both as a productivity-enhancing production input, and as an output. This interrelation between manufacturing and services calls for a degree of coordination between policies aimed at manufacturing and services industries. Finally, services have a significant trade potential which the UK is well placed to tap into.
Finally, we point out that, in the near future, new approaches to sector classification will be required in order to reflect the transforming economic reality accurately. If selective policy is to target industries effectively and to succeed in supporting the emergence of new industries and technologies, it will often have to go beyond the confines of the standard industry classification and find more creative approaches of defining and measuring industries.
Annex A

Employment by sector in the UK’s NUTS3 regions, 2018

Accommodation and food services

Aerospace

Agriculture, forestry and fishing

Automotive
Manufacturing of ICT and precision equipment

Manufacturing of food, beverage and tobacco products

Scientific research and development
Annex B

Cumulative decomposition of growth in labour productivity since 2008 by sector

Agriculture, forestry and fishing, mining and quarrying, electricity, gas, steam and air conditioning supply, water supply, sewerage, waste management and remedial activities

Transportation and storage
Real estate activities, professional, scientific and technical activities, administrative and support service activities

Arts, entertainment and recreation, other service activities, activities of households as employers, undifferentiated goods and services producing activities of households for own use, activities of extraterritorial organisations and bodies

Public administration and defence, compulsory social security, education, human health and social work activities

Financial and insurance activities

Source: ONS

Source: ONS
Manufacturing

Wholesale and retail trade, repair of motor vehicles and motorcycles, accommodation and food service activities

Construction

Information and communication

Labour composition
Capital deepening
GVA per hour
### Annex C

#### UK's productivity ranking relative to EU countries by sectors and subsectors

<table>
<thead>
<tr>
<th>Sector</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ARTS, ENTERTAINMENT, RECREATION AND OTHER SERVICES) Other service activities</td>
<td>1</td>
</tr>
<tr>
<td>(MANUFACTURING) Chemicals and chemical products</td>
<td>2</td>
</tr>
<tr>
<td>MINING AND QUARRYING</td>
<td>3</td>
</tr>
<tr>
<td>(TRANSPORTATION AND STORAGE) Postal and courier activities</td>
<td>3</td>
</tr>
<tr>
<td>(WHOLESALE AND RETAIL TRADE + MOTOR VEHICLES) Wholesale and retail trade and repair of motor vehicles</td>
<td>4</td>
</tr>
<tr>
<td>(MANUFACTURING) Textiles, wearing apparel, leather and related products</td>
<td>4</td>
</tr>
<tr>
<td>(INFORMATION AND COMMUNICATION) Publishing, audiovisual and broadcasting activities</td>
<td>5</td>
</tr>
<tr>
<td>(WHOLESALE AND RETAIL TRADE + MOTOR VEHICLES) Retail trade, except of motor vehicles and motorcycles</td>
<td>6</td>
</tr>
<tr>
<td>(MANUFACTURING) Other manufacturing; repair and installation of machinery and equipment</td>
<td>6</td>
</tr>
<tr>
<td>(MANUFACTURING) Coke and refined petroleum products</td>
<td>7</td>
</tr>
<tr>
<td>PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY</td>
<td>8</td>
</tr>
<tr>
<td>(MANUFACTURING) Transport equipment</td>
<td>9</td>
</tr>
<tr>
<td>(MANUFACTURING) Food products, beverages and tobacco</td>
<td>9</td>
</tr>
<tr>
<td>(WHOLESALE AND RETAIL TRADE + MOTOR VEHICLES) Wholesale trade, except of motor vehicles and</td>
<td>10</td>
</tr>
<tr>
<td>CONSTRUCTION</td>
<td>10</td>
</tr>
<tr>
<td>MARKET ECONOMY</td>
<td>10</td>
</tr>
<tr>
<td>WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES</td>
<td>11</td>
</tr>
<tr>
<td>(MANUFACTURING) Wood and paper products; printing and reproduction of recorded media</td>
<td>12</td>
</tr>
<tr>
<td>ACCOMMODATION AND FOOD SERVICE ACTIVITIES</td>
<td>12</td>
</tr>
<tr>
<td>(MANUFACTURING) Electrical and optical equipment</td>
<td>12</td>
</tr>
<tr>
<td>(MANUFACTURING) Basic metals and fabricated metal products, except machinery and equipment</td>
<td>12</td>
</tr>
<tr>
<td>TOTAL MANUFACTURING</td>
<td>12</td>
</tr>
<tr>
<td>(INFORMATION AND COMMUNICATION) Telecommunications</td>
<td>13</td>
</tr>
<tr>
<td>(MANUFACTURING) Rubber and plastics products, and other non-metallic mineral products</td>
<td>13</td>
</tr>
<tr>
<td>AGRICULTURE, FORESTRY AND FISHING</td>
<td>13</td>
</tr>
<tr>
<td>(MANUFACTURING) Machinery and equipment n.e.c.</td>
<td>14</td>
</tr>
<tr>
<td>TOTAL INDUSTRIES</td>
<td>14</td>
</tr>
<tr>
<td>ELECTRICITY, GAS AND WATER SUPPLY</td>
<td>15</td>
</tr>
<tr>
<td>(TRANSPORTATION AND STORAGE) Transport and storage</td>
<td>16</td>
</tr>
<tr>
<td>EDUCATION</td>
<td>17</td>
</tr>
<tr>
<td>INFORMATION AND COMMUNICATION</td>
<td>17</td>
</tr>
<tr>
<td>FINANCIAL AND INSURANCE ACTIVITIES</td>
<td>17</td>
</tr>
<tr>
<td>HEALTH AND SOCIAL WORK</td>
<td>20</td>
</tr>
<tr>
<td>TRANSPORTATION AND STORAGE</td>
<td>21</td>
</tr>
<tr>
<td>ARTS, ENTERTAINMENT, RECREATION AND OTHER SERVICE ACTIVITIES</td>
<td>21</td>
</tr>
<tr>
<td>REAL ESTATE ACTIVITIES</td>
<td>22</td>
</tr>
<tr>
<td>PROFESSIONAL, SCIENTIFIC, TECHNICAL, ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES</td>
<td>22</td>
</tr>
<tr>
<td>(INFORMATION AND COMMUNICATION) IT and other information services</td>
<td>23</td>
</tr>
<tr>
<td>(ARTS, ENTERTAINMENT, RECREATION AND OTHER SERVICES) Arts, entertainment and recreation</td>
<td>23</td>
</tr>
</tbody>
</table>

Source: Authors’ analysis based on EUKLEMS data