Cambridge Industrial Innovation Policy

UK INNOVATION REPORT

Benchmarking the UK's industrial and innovation performance in a global context

Institute for Manufacturing, University of Cambridge
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What makes this report different

While numerous sources of data on the topic of innovation exist, the **UK Innovation Report** aims to make a contribution by bringing together, in a single place, **innovation and value added indicators** in a concise and accessible format. The report seeks to demonstrate the value of combining different types of indicator and data sets to facilitate **policy discussions on innovation and industrial performance – and the interplay between them**.

Instead of structuring the report according to input and output indicators, as is typically done in reviews of innovation activity, the focus has been on bringing together indicators that provide rich quantitative representations that are relevant to the vitality of the **UK's innovation activity and its industrial performance in an international context**. While the report does not make specific policy recommendations, it does highlight areas where additional evidence and policy action may be required.

Motivation

- Review the UK's innovation and industrial performance and compare it with that of other selected countries.
- Facilitate discussions on the relation between sectoral competitiveness and innovation.
- Stimulate the debate on the evidence base required to inform industrial strategy and innovation policy.

Executive Summary (1/3)

UK INNOVATION REPORT

STRUCTURE OF THE UK ECONOMY

- **In recent years the UK's labour productivity, as measured by GDP per hour worked, has grown somewhat slower than in other developed economies.** In 2018 the UK's labour productivity was barely above its 2007 level.
- **Sector-level analysis reveals key structural factors behind the relatively slow rates of productivity growth in the UK.** Over the last decade, there has been an increase in the relative contribution of sectors with **low value added per hour worked** (particularly low value services) and a reduction in the share of **high value added sectors** (particularly medium to high-tech manufacturing, oil extraction and finance).
- **Medium to high-tech manufacturing has significantly outperformed other parts of the economy in terms of productivity and wage growth.**

INVESTMENT IN INNOVATION

- **Achieving the UK government's goal of boosting investment in R&D to 2.4% of GDP by 2027 would require a step change in recent trends.** R&D investment as a percentage of GDP has remained almost constant over the last two decades, increasing only from 1.6% in 2000 to 1.7% in 2018.
- **The business sector contributes less to the funding of R&D in the UK (less than 55% of total expenditure) than in countries such as Germany (66%), Korea (76.6%) and Japan (79.1%).** As is the case across developed economies, manufacturing remains the largest contributor to R&D expenditure in the UK, suggesting an important role in achieving the UK's 2.4% target.
- **Between 2007 and 2019 the UK received venture capital investments to a total of US$20.4B, above other European nations.** These investments have been largely concentrated in London and in sectors such as ICT, biotech and health care.

Executive Summary (2/3)

INDUSTRIAL PERFORMANCE	SCIENCE AND ENGINEERING WORKFORCE
▪ Over the last decade, the **UK aerospace industry** became more productive on the basis that value added grew faster than employment. **Automotive** became more productive as value added grew while employment shrank. **Productivity growth collapsed in pharmaceuticals** as value added contracted at a quicker rate than that of employment. ▪ From being the fifth largest net exporter of **pharmaceutical** products in 2009, the UK slipped into the third quartile of countries by 2018. **Aerospace products is a bright spot,** with the sector becoming the **fourth largest net exporter in 2018**. ▪ Business R&D spending in the UK has accelerated in **automotive**, **aerospace** and **machinery,** but it has been on the decline for **pharmaceuticals**.	▪ **Undergraduate enrolment in STEM disciplines has increased steadily in the UK in recent years**. In 2018 graduates in STEM accounted for 44.2% of the total number of graduates in the UK, above **France** (37%), **the United States** (36.8%) and **Canada** (35%). ▪ **In the UK most of the researchers are employed in the government and higher education sector**, as opposed to some comparator countries, where researchers are mainly employed in business enterprises. **Women are underrepresented within the research profession,** although the share of women researchers in the UK is well above comparator countries. ▪ **The UK education system is marked by a "missing middle" of higher technical education** (i.e. enrolment in post-secondary education courses, below the standard three-year Bachelor's degree) that is usually designed to provide students with technical skills to enter the job market.

Executive Summary (3/3)

UK INNOVATION REPORT

IMPLICATIONS FOR POLICY

- **Important patterns related to the vitality of the UK's industrial and innovation activity can be lost in aggregation.**

- **Sector-level analyses are necessary, not only to uncover underlying trends affecting national performance but also to identify areas of comparative advantage, constraints to technology adoption and required policy responses**. Industrial and technological know-how is needed to identify and interpret key sector trends that are not immediately observable from economy-wide figures.

- **This report raises important questions about the interdependence between innovation activity and sector competitiveness.** A more comprehensive evidence base for industrial strategy (and related policy areas), however, should also include analyses of other important variables influencing industrial performance, including, for example, capital investment, finance and firm survival rates.

Introduction

The UK faces significant challenges as it seeks to return to sustained and inclusive growth following the deepest economic recession since the Second World War. There is a pressing need to support a swift economic and social recovery from the impacts of COVID-19. Moreover, fundamental challenges present before the pandemic are likely to dictate the shape of the UK economy for years to come: increasing international competition; erosion of market share in key industries; hollowing out of supply chains; the need to reduce carbon emissions; and regional imbalances.

Innovation is critical to tackling these challenges. While the UK's expenditure on innovation has historically been lower than some of its closest competitor countries, the government has committed to boosting investment in R&D to 2.4% of GDP by 2027 and to increasing public funding for R&D to £22 billion per year by 2024–25.

The UK is internationally recognised for its leadership in research and the excellence of its scientific institutions. However, securing economic and social benefits from research requires further efforts to deploy new technologies and solutions towards commercial success and practical application. **Innovation needs to be leveraged to continue to improve productivity, shift into higher value activities, rejuvenate existing industries and build the foundations for the new industries of tomorrow.**

In common with other advanced economies, there has been a marked shift in the structure of the UK economy away from manufacturing towards services. Contrary to common perceptions, however, these new **service activities are not always high value adding or innovative**. It is therefore critical to analyse innovation trends in the context of broader economic developments.

To help advance the debate in this area, this report provides a review of the UK's industrial and innovation performance in a global context, drawing upon the latest available international indicators. **A distinctive feature of this report is that it brings together, in a single place, innovation and value added indicators typically found in disparate sources and presented independently. Rather than producing a voluminous report, the intention is to present a concise selection of the most important indicators, in a format that is easily accessible to a wider audience.**

Overview of the report

	Theme	Key policy questions addressed	Pages
1	STRUCTURE OF THE UK ECONOMY	▪ How has the structure of the UK economy changed in the last few years? ▪ Are these changes affecting economic performance? ▪ How does this compare with other countries?	10–21
2	INVESTMENT IN INNOVATION	▪ Are the UK government and the private sector spending enough on R&D? ▪ How does this compare with the level of investment in other countries? ▪ How big is the gap to achieving the 2.4% R&D expenditure target?	22–39
3	INDUSTRIAL PERFORMANCE	▪ Are the UK's key industries becoming more or less competitive internationally? ▪ How are UK industries performing in terms of productivity, value added and employment? ▪ Are key industries in the UK investing enough in R&D compared to their international competitors?	40–58
4	SCIENCE AND ENGINEERING WORKFORCE	▪ Is the UK producing enough scientists and engineers? ▪ Is the UK government investing enough in technical and vocational education? ▪ How does this compare with other countries?	59–69

List of charts (1/2)

List of charts (2/2)

Theme		Contents
3	INDUSTRIAL PERFORMANCE	
4	SCIENCE AND ENGINEERING WORKFORCE	

Theme 1: Structure of the UK Economy

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Policy questions addressed in Theme 1

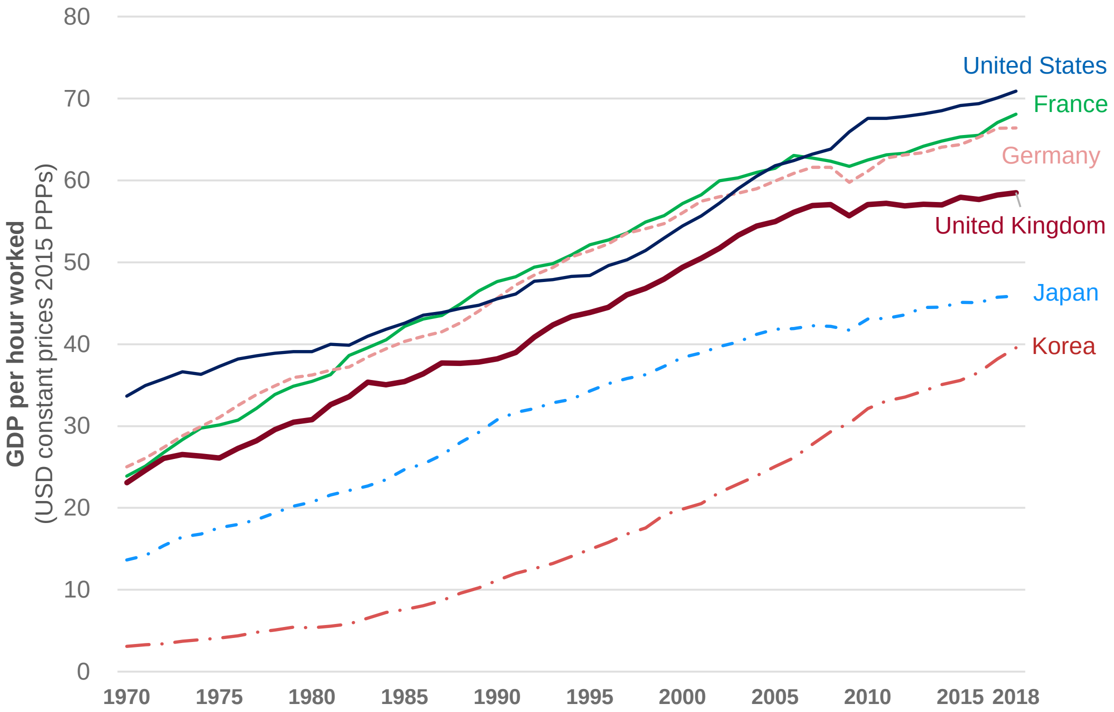
- How has the structure of the UK economy changed in the last few years?
- Are these changes affecting economic performance?
- How does this compare with other countries?

What the data tells us

- **In recent years the UK's labour productivity, as measured by GDP per hour worked, has grown somewhat slower than in other developed economies.** In 2018 the UK's labour productivity was barely above its 2007 level (Chart 1.1).
- **Sector-level analysis reveals key structural factors behind the relatively slow rates of productivity growth in the UK.** Over the last decade, there has been an increase in the relative contribution of sectors with **low value added per hour worked** (particularly low value services) and a reduction in the share of **high value added sectors** (particularly medium to high-tech manufacturing, oil extraction and finance) (Charts 1.2 and 1.3). There has also been a **shift in employment between sectors**, with the share of jobs in **lower value added services** experiencing the largest increase (Chart 1.4).
- **Medium to high-tech manufacturing has significantly outperformed other parts of the economy in terms of productivity and wage growth** (Chart 1.5). While this sector represents only 4.8% of gross value added and 2.9% of employment, it accounts for **34% of the UK's exports** and almost **two-thirds of business R&D expenditure** (Chart 1.6). **Medium to high-tech manufacturing** represents a significantly higher share in countries such as **Germany** (14.1%) and **Korea** (21.1%), compared to **the UK** (4.8%) (Charts 1.7 and 1.8).
- While **the UK** records a surplus in its trade in services, this is more than outweighed by a deficit in the trade in goods. In 2018 the trade deficit was around 1.8% of GDP. In other countries, such as **Germany** and **Korea**, **manufactured goods have historically underpinned a positive trade balance** (Chart 1.9).
- The **COVID-19** pandemic has disrupted global **supply chains**, **production activities** and **demand** across industries and countries. Unlike **China** and **Korea**, countries such as **the UK**, **Germany** and **the US** have not yet managed to return to pre-COVID production levels (Chart 1.10).

Chart 1.1. Labour productivity: international comparison

GDP per hour worked, selected countries, 1970–2018



- In recent years **the UK's labour productivity**, as measured by GDP per hour worked, has grown somewhat slower than in other developed economies.
- In 2018 the UK's labour productivity was US$58.5 (constant prices 2015 PPP), **barely above its 2007 level** (US$56.9).
- Between 1999 and the outbreak of the global financial crisis in 2007, the average annual growth rate of UK labour productivity was 2.2%; between 2010 and 2018 it was only 0.3%.
- On a GDP per hour worked basis, UK productivity in 2018 was:
  - Lower than that of **the United States** and **Germany,** by 21 and 32 percentage points, respectively.
  - Above that of **Japan** and **Korea,** by 22 and 32 percentage points, respectively.

Source: OECD (2020). Level of GDP per capita and productivity data set.

Chart 1.2. Labour productivity: sector-level analysis (1)

Gross value added per hour worked and UK share by sector (2007–2017)

Higher value added per hour

Lower value added per hour

Sector	Industries covered	Value added per hour worked (£, 2015 prices) *			Share in UK value added**		
		2007	2017	Change	2007	2017	Change
Medium/ high-tech manufacturing	Pharmaceuticals, aerospace, automotive, etc.	37.1	57.1	53.6%	5.0%	4.8%	-0.2%
Other production	Oil extraction, agriculture, forestry, etc.	61.5	50.3	-18.2%	11.6%	10.4%	-1.1%
Knowledge services	Education; finance, professional, scientific, etc.	37.2	40.2	7.8%	27.0%	27.3%	0.3%
Low/ medium-tech manufacturing	Food, textiles, wood, rubber, etc.	25.9	26.9	3.9%	6.2%	5.4%	-0.8%
Other services	Retail, hospitality administrative, real estate, health and social services, etc.	21.4	25.0	16.7%	50.3%	52.1%	1.8%

Source: OECD (2020). STAN Industrial Analysis database; Office for National Statistics.
Notes: See Appendix 1 for sector definitions.
* Median value; ** because of rounding, it may not always appear to add up to 100%.

- **Sector-level analysis can help explain the relatively slow rates of productivity growth in the UK.**
- Over the last decade there has been an increase in the relative contribution of **sectors with low value added per hour worked**, notably **"Other services"** (e.g. retail, hospitality and administrative services), which have increased their share in the UK economy from **50.3% in 2007** to **52.1% in 2017**.
- Meanwhile, **sectors with high value added**, such as **medium to high-tech manufacturing** (which includes pharmaceuticals, aerospace and automotive) and **other production** (which includes oil and gas extraction), have seen their share in the UK economy reduced.

Chart 1.3. Labour productivity: sector-level analysis (2)

Gross value added per hour worked and UK share, top value-adding activities (2007–2017)

Sector/economic activity	Value added per hour worked (£, 2015 prices)			Share in UK value added		
	2007	2017	Change	2007	2017	Change
Medium/high-tech manufacturing						
Pharmaceuticals	170.9	151.4	-11.4%	0.9%	0.7%	-0.2%
Coke and refined petroleum products	121.8	96.0	-21.2%	0.1%	0.1%	0.0%
Chemicals	36.6	64.4	76.0%	0.7%	0.7%	-0.1%
Other production						
Extraction of crude petroleum and natural gas	1,212.9	459.1	-62.1%	1.5%	0.6%	-0.9%
Electricity, gas, steam and air conditioning supply	117.6	88.9	-24.4%	1.5%	1.4%	-0.1%
Water supply, sewerage, waste management, etc.	80.6	60.5	-25.0%	1.3%	1.3%	0.0%
Knowledge services						
Financial and insurance activities*	108.2	120.2	11.1%	8.0%	7.0%	-1.0%
Scientific research and development	69.3	68.0	-1.9%	0.7%	0.7%	0.0%
Information and communication*	51.5	63.4	23.1%	6.4%	6.8%	0.4%
Low/medium-tech manufacturing						
Food products, beverages and tobacco	37.3	34.7	-7.0%	1.8%	1.6%	-0.3%
Basic metals and metal products	26.3	30.4	15.4%	1.3%	1.1%	-0.2%
Textiles, wearing apparel and leather products	26.2	27.9	6.4%	0.3%	0.3%	0.0%
Other services						
Real-estate activities (excluding imputed rent)	313.7	279.9	-10.8%	3.0%	4.0%	1%
Water transport	133.1	232.2	74.4%	0.2%	0.3%	0.1%
Rental and leasing activities	56.6	63.3	11.9%	1.1%	1.1%	0.0%

Source: OECD (2020). STAN Industrial Analysis database; Office for National Statistics.
Notes: See Appendix 1 for sector definitions.
* Median values.

- Chart 1.3 presents a breakdown of productivity figures (as measured by value added per hour) for the **three economic activities with highest value added within each sector**.
- **Extraction of crude petroleum and natural gas** reports the highest value added per hour, although this figure has declined by over 60% in the last 10 years. Meanwhile, its contribution to the UK's value added has been reduced from 1.5% to 0.6%. These figures reflect the decline of UK oil and gas production as well as drops in international prices.
- Within **knowledge services**, **financial and insurance activities** show the highest value added per hour. However, their share in UK value added has dropped significantly (from 8% in 2007 to 7% in 2017).

Chart 1.4. Employment in the UK

Value added per hour worked and employment shares (2007–2017)

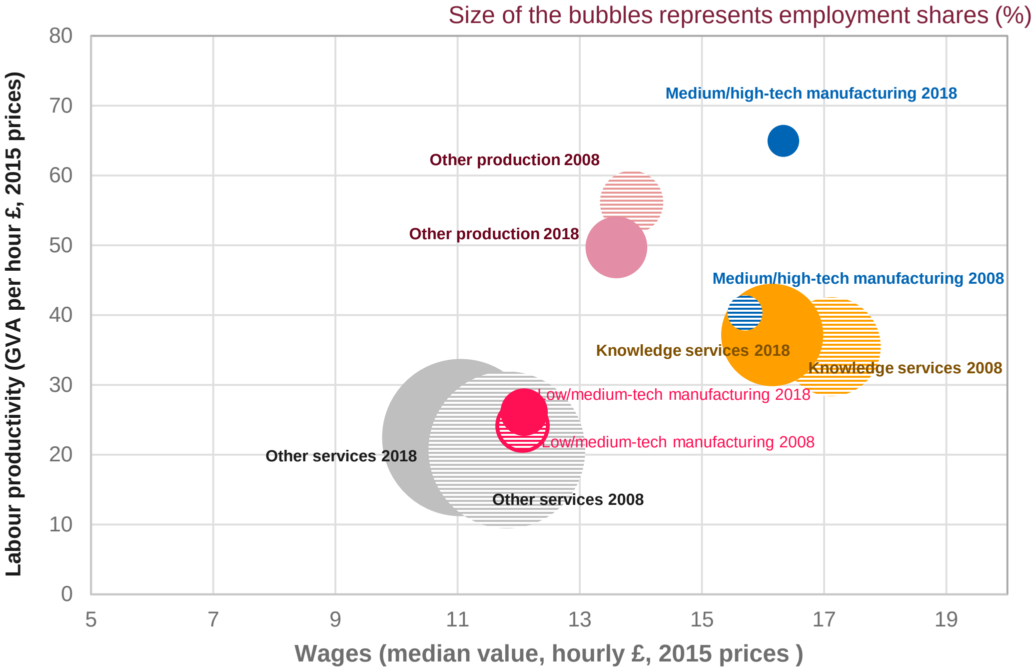
	Sector	Value added per hour worked (£, 2015 prices) *			Share in UK employment		
		2007	2017	Change	2007	2017	Change
Higher value added per hour	Medium/ high-tech manufacturing	37.1	57.1	53.6%	3.4%	2.9%	-0.5%
	Other production	61.5	50.3	-18.2%	7.1%	6.8%	-0.3%
	Knowledge services	37.2	40.2	7.8%	23.5%	24.3%	0.8%
	Low/ medium-tech manufacturing	25.9	26.9	3.9%	6.7%	5.6%	-1.1%
Lower value added per hour	Other services	21.4	25.0	16.7%	59.3%	60.4%	1.1%

Source: Office for National Statistics; OECD (2020). STAN Industrial Analysis database.
Notes: See Appendix 1 for sector definitions.
* Median values.

- There has been a worrying shift in employment between sectors over the last decade. **Low value services report the largest gain in employment share (1.1%)**.
- Meanwhile, **medium to high-tech manufacturing**, the sector with the highest value added per hour worked, reports a **significant contraction in its share of UK employment** (from 3.4% to 2.9%). In absolute terms, employment in this sector stood at 786 thousand people in 2017, a 9.5% decline from 2007.
- **Knowledge services**, in contrast, have experienced an **increase** in both, **labour productivity** and **share in UK employment**. In absolute terms this sector employed 6.6 million people in 2017, a figure 10.1% higher than in 2007.

Chart 1.5. Changes in the structure of the UK economy

Labour productivity, employment and wages by industry (2008-2018)



Note: £ values deflected using PPI (labour productivity) and CPI indices (wages); see **Appendix 1** for sector statistical definition.
Source: Based on data from Office for National Statistics and Department for Business, Energy & Industrial Strategy.

- The largest share of **employment** is concentrated in **other services** (growing from 58.1% in 2008 to 58.4% in 2018), but it has experienced a decrease in wages in real terms.
- Meanwhile, **medium to high-tech manufacturing** has significantly outperformed other parts of the economy in terms of **productivity**, with an average annual growth rate of 4.9% in the last decade. This sector reports both the highest wages and the largest increase in their real values over the last decade.
- **Low to medium-tech manufacturing** also reports productivity improvements, albeit more modest.

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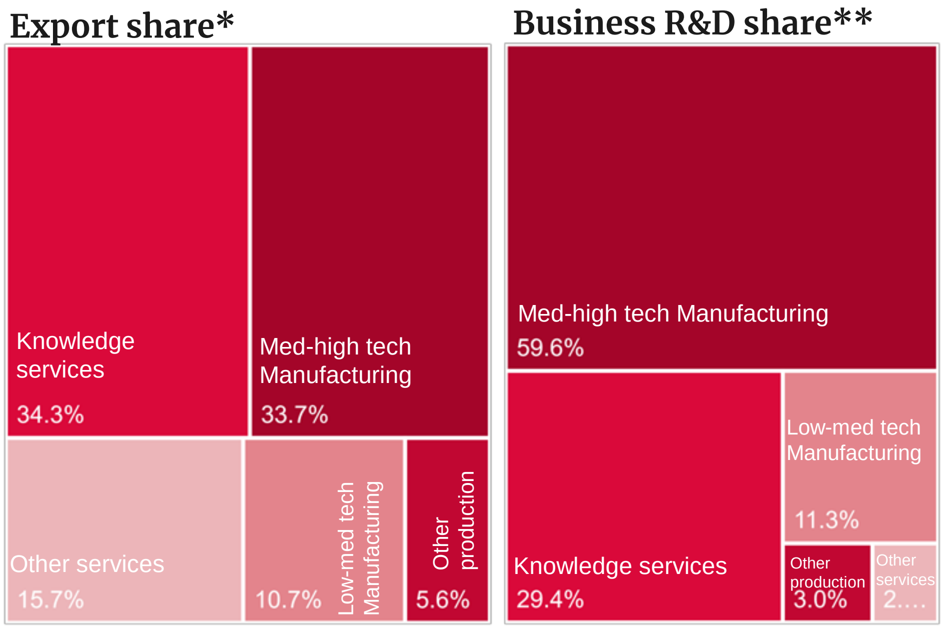
Chart 1.6. Structure of the UK economy

Sector of exports and R&D, 2018



Note: See Appendix 1 for sector definitions. *Median values. **Gross domestic expenditure on R&D (GERD) measured by product group. R&D figures should be read with caution, due to difficulties in measuring R&D in services, see for example: Haskel & Pesole (2011). *Productivity and innovation in UK financial services: an intangible assets approach*.
Source: Based on data from Office for National Statistics and Department for Business, Energy & Industrial Strategy.

- Chart 1.6 shows the contribution of UK sectors to export and business R&D (BERD).
- **“Other services”** contributes to around half of the UK’s gross value added but less than one-fifth of exports and only around **2% of business R&D expenditure**.
- Meanwhile, **knowledge-intensive services** (such as finance, professional services and ICT) account for around **30% of both exports and business R&D**.
- **Medium to high-tech manufacturing** accounts for **34% of exports** and almost **two-thirds of business R&D expenditure**.

Chart 1.7. Structure of the UK economy compared (a)

Value added shares by sector, selected countries, 2007 and 2017

Higher value added per hour ⟷ Lower value added per hour

Country	Year	Med/high-tech manufacturing	Other production	Knowledge services	Low/med-tech manufacturing	Other services
UK	2007	5.0%	11.6%	27.0%	6.2%	50.3%
	2017	4.8%	10.4%	27.3%	5.4%	52.1%
	Change	**-0.2%**	**-1.1%**	**0.3%**	**-0.8%**	**1.8%**
Germany	2007	13.7%	7.9%	20.9%	9.3%	48.2%
	2017	14.6%	8.1%	19.7%	8.6%	49.0%
	Change	**0.9%**	**0.2%**	**-1.2%**	**-0.7%**	**0.8%**
France	2007	5.4%	10.1%	21.9%	7.7%	55.0%
	2017	4.7%	9.7%	22.8%	6.7%	56.1%
	Change	**-0.6%**	**-0.5%**	**1.0%**	**-1.0%**	**1.1%**
Korea	2007	19.2%	11.4%	23.3%	8.3%	37.7%
	2017	21.1%	10.9%	21.5%	7.9%	38.7%
	Change	**1.8%**	**-0.5%**	**-1.9%**	**-0.4%**	**1.0%**
US	2007	7.6%	10.1%	26.3%	5.7%	50.4%
	2017	6.8%	8.4%	28.0%	4.8%	52.1%
	Change	**-0.8%**	**-1.7%**	**1.7%**	**-0.9%**	**1.7%**

Notes: See Appendix 1 for sector definitions; value added data is based on chained prices of the previous year. US data is based on current prices.
Source: OECD (2020). STAN Industrial Analysis database.

- **The UK**, **France** and **the US** present a broadly similar economic structure, with **other services** accounting for **over 50% of national value added in 2017**.
- Among the economies analysed, **medium to high-tech manufacturing** represents a significantly higher share in **Germany (14.1%)** and **Korea (21.1%).**
- Meanwhile, in the **UK**, **France** and **the US**, **medium to high-tech manufacturing** accounts for less than 5% of domestic value added.
- Among the countries analysed, only **Germany** and **Korea** have observed increases in the shares of **medium to high-tech manufacturing** over the last decade.

Chart 1.8. Structure of the UK economy compared (b)

Employment shares by sector, selected countries, 2007 and 2017

Higher value added per hour ⟷ **Lower value added per hour**

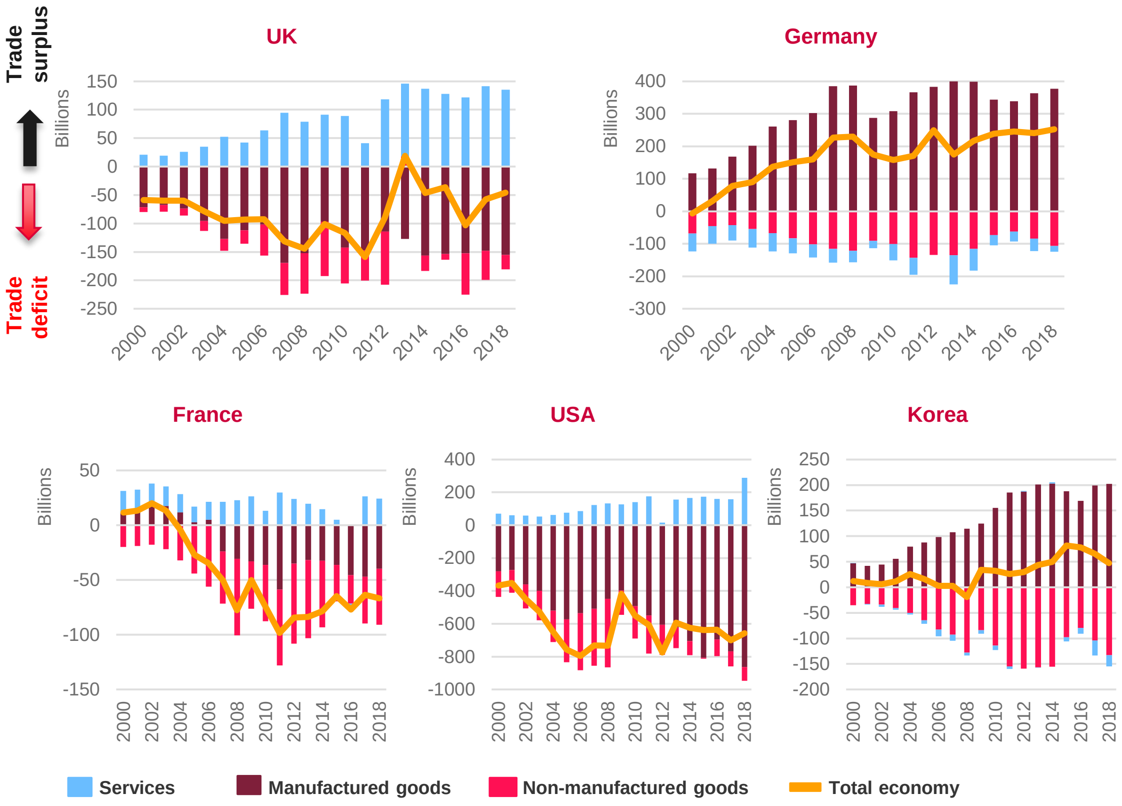
Country	Year	Med/high-tech manufacturing	Other production	Knowledge services	Low/med-tech manufacturing	Other services
UK	2007	3.4%	7.1%	23.5%	6.7%	59.3%
	2017	2.9%	6.8%	24.3%	5.6%	60.4%
	Change	**-0.5%**	**-0.3%**	**0.8%**	**-1.1%**	**1.1%**
Germany	2007	9.0%	7.5%	16.3%	10.5%	56.7%
	2017	8.8%	7.3%	16.6%	9.6%	57.7%
	Change	**-0.3%**	**-0.2%**	**0.3%**	**-0.9%**	**1.1%**
France	2007	3.4%	8.9%	19.2%	8.5%	60.0%
	2017	2.6%	8.2%	20.6%	7.1%	61.4%
	Change	**-0.8%**	**-0.7%**	**1.4%**	**-1.4%**	**1.4%**
Korea	2007	14.6%	10.9%	20.8%	6.9%	46.8%
	2017	13.7%	9.4%	19.8%	6.5%	50.5%
	Change	**-0.9%**	**-1.5%**	**-1.0%**	**-0.4%**	**3.7%**
US	2007	3.8%	7.4%	22.4%	5.9%	60.5%
	2017	3.3%	6.7%	22.8%	4.9%	62.4%
	Change	**-0.5%**	**-0.8%**	**0.4%**	**-1.0%**	**1.9%**

Notes: See Appendix 1 for sector definitions.
Source: OECD (2020). STAN Industrial Analysis database.

- In contrast with value added, **the distribution of employment across sectors is more even among the countries compared**.
- The largest shares of employment are observed in **other services** (e.g. wholesale and retail, real estate, public administration). This sector accounts for at least **60%** of employment across countries, with the exception of **Germany,** where it accounted for **57.7%** in 2017.
- Meanwhile, with the exception of **Germany**, **medium to high-tech manufacturing** accounts for less than 10% of the total employment.

Chart 1.9. Trade balance of the UK compared

Trade balance – total economy and broad sector groups, 2000–2018

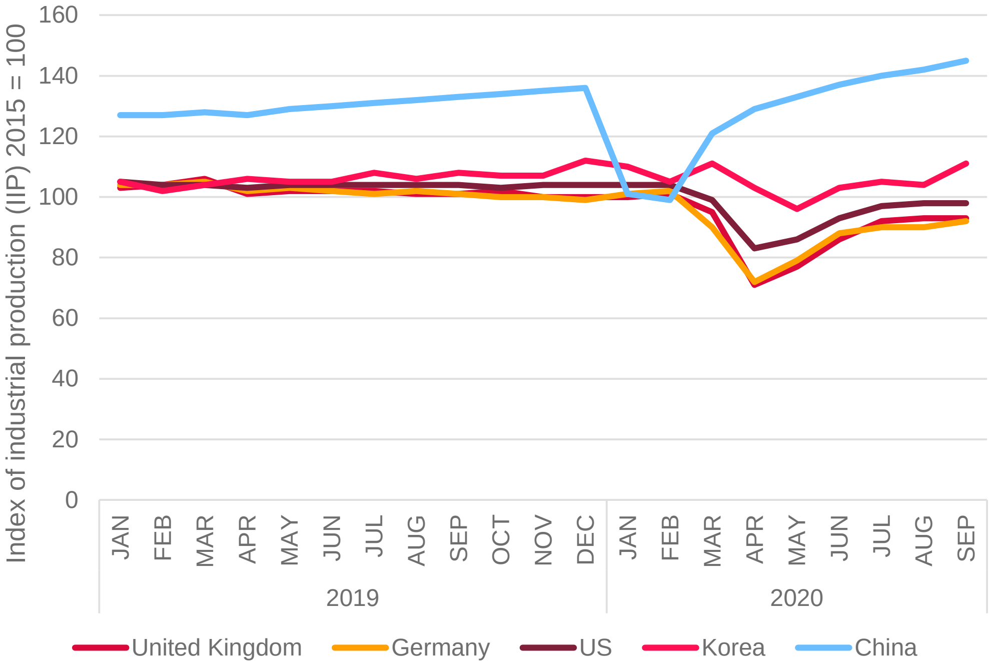


- **The UK, France** and **the US** recorded **trade deficits** in almost all years between 2000 and 2018.
- In these three countries **trade surpluses generated in services are more than outweighed by deficits in the trade in goods**, both manufactured and non-manufactured.
- The UK's trade deficit for the total economy was the highest in 2011, at ~US$159B, but it has since improved to ~US$46B, in 2018, with increased surpluses in the services trade and decreased deficits in goods trade. For France and the US, their trade deficits widened to ~US$67B and ~US$658B, respectively, by 2018.
- In contrast, **Germany and Korea** – which have significantly higher shares of medium/high-tech manufacturing – have consistently recorded trade surpluses in most years since 2000. Their **large surpluses in manufactured goods trade** more than offset the deficits in services and non-manufactured goods trade.

Note: Trade balance is based on gross exports and gross imports of all goods at HS 1992 2-Digit level and all EBOPS services (excluding services not allocated).
Source: UN Comtrade.

Chart 1.10. COVID-19 impact

Index of industrial production, selected countries



Source: UNIDO (2020). Monthly Index of Industrial Production.

- Mobility restrictions due to the **COVID-19** pandemic have disrupted global **supply chains**, **production activities** and **demand** across industries.
- Unlike **China** and **Korea**, countries such as **the UK**, **Germany** and **the US** have not yet managed to go back to pre-COVID production levels.
- In the UK some of the **manufacturing industries** most affected are: **automotive** (-52% average annual drop March–September 2020); **apparel** (-37%); and **machinery and equipment** (-28%).[2/]

[1/] The World Bank (2020). Global Economic Prospects.
[2/] UNIDO (2020). Monthly Index of Industrial Production.

Theme 2: Investment in Innovation

UK INNOVATION REPORT

Policy questions addressed in Theme 2

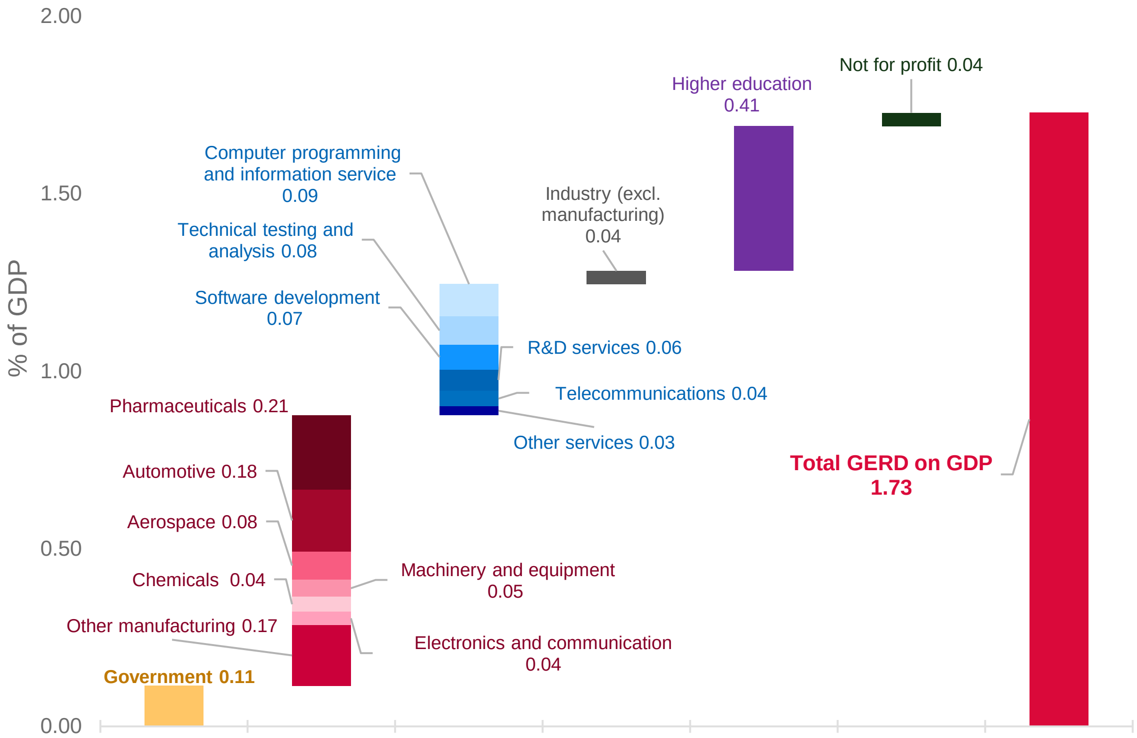
- Are the UK government and the private sector spending enough on R&D?
- How does this compare with the level of investment in other countries?
- How big is the gap to achieving the 2.4% R&D expenditure target?

What the data tells us

- The UK government has committed to boosting investment in R&D to **2.4% of GDP by 2027**. **Achieving this goal would require a step change in recent trends.**
- The UK gross domestic expenditure on R&D (GERD) as a percentage of GDP **has remained almost constant between 2000 and 2018**, increasing only from 1.6% to 1.7% during this period (Charts 2.1 to 2.3).
- The **business sector contributes less to the funding of R&D in the UK** (less than 55% of total expenditure) than in other countries, such as **Germany** (66%), **Korea** (76.6%) and **Japan** (79.1%) (Chart 2.5).
- **Manufacturing remains the largest contributor to R&D expenditure across industrialised economies**. In 2018 the **pharmaceutical**, **automotive** and **aerospace** industries accounted for around **40% of total business R&D expenditure** in the UK. This suggests that manufacturing industries have a key role to play in achieving the UK's 2.4% target (Chart 2.6).
- Business enterprise R&D expenditure (BERD) in the UK as a percentage of value added remains lower than comparator countries such as **France**, **the US**, **Japan**, **Germany**, **Korea** and **Sweden**, indicating that **UK businesses are not reinvesting in R&D as much as firms in those countries** (Chart 2.7, Chart 2.8).
- Between 2007 and 2019 the UK received **venture capital investments of a total of US$20.4B**, above other European nations. The UK venture capital market has been largely concentrated in London (Chart 2.11) and in sectors such as **ICT**, **biotech** and **health care** (Chart 2.12).

Chart 2.1. UK R&D expenditure by sector of performance

Gross domestic expenditure on R&D as % of GDP, 2018



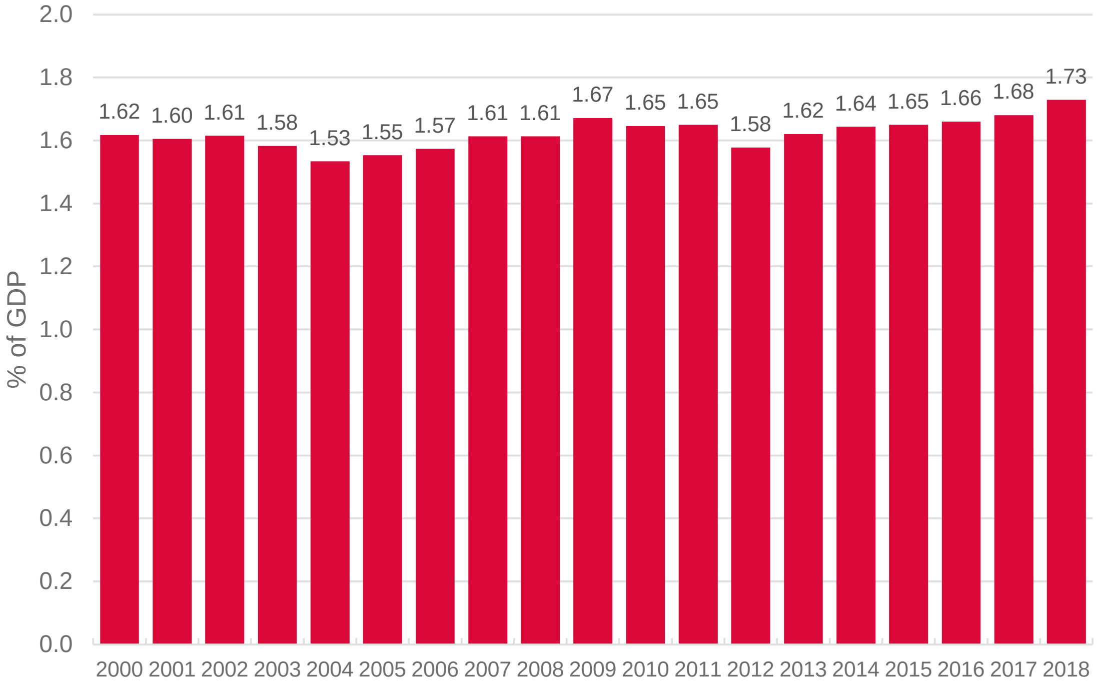
Note: Industries include: agriculture and fishing; extractive industries; electricity, gas and water; construction.
Source: ONS (2020). Research and Development in UK Businesses, 2018 Datasets; OECD (2020). Main Science and Technology Indicators.

- In 2018 the **UK gross domestic expenditure on R&D (GERD) as a percentage of GDP was 1.73%.**
- In terms of R&D expenditure by sector of performance (i.e. **use of funding**), the business enterprise sector performs the highest share of R&D, at 63%.
- **Manufacturing is the main driver of R&D expenditure, accounting for 42% of total GERD**, with pharmaceuticals, automotive and aerospace performing 26.8% of total GERD.
- Among businesses, **services perform 21.4% of total GERD**, mainly driven by ICT services, technical testing and analysis, software development, R&D services and telecommunications.
- The **UK's higher education sector** stands out from comparator countries, with a 23.6% share, above countries such as **Germany**, **France**, **Korea**, **Japan**, **China**, **India** and **the United States.**[a]
- Conversely, the **government sector** in the UK performs only 6.6% of R&D, below comparator countries, given the more prominent role played by UK's higher education sector

[a] OECD (2020). Main Science and Technology Indicators database.

Chart 2.2. UK R&D intensity

Gross domestic expenditure on R&D (GERD) as % of GDP, 2000–2018

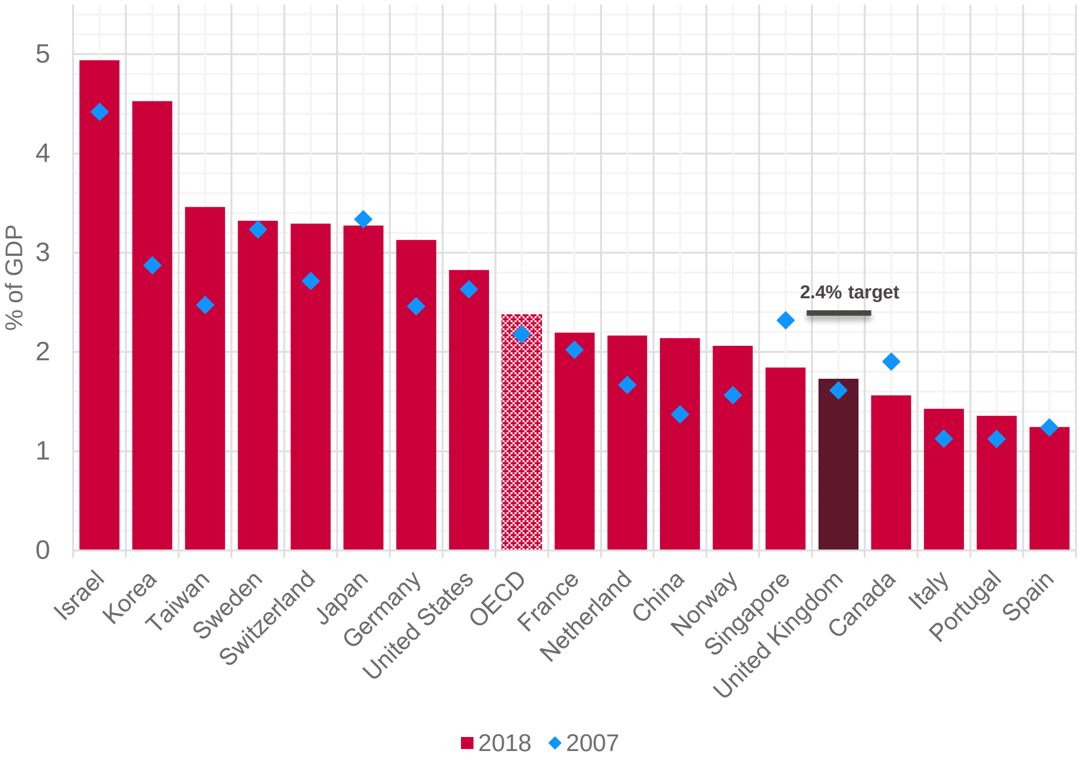


- The UK's **gross domestic expenditure on R&D (GERD)** as a share of GDP remained almost constant between 2000 and 2018, only increasing from 1.62% to 1.73%.
- The **UK government** has committed to boosting investment in R&D to **2.4% of GDP by 2027** and to increasing public funding for R&D to £22B per year by 2024.

Source: OECD (2020). Main Science and Technology Indicators.

Chart 2.3. R&D expenditure (1)

Gross domestic expenditure on R&D (GERD) as % of GDP, selected countries



- The UK's GERD remains **below the 2018 OECD average** of 2.4%.
- In this regard**, the UK ranks below key comparator countries** such as Israel, Korea, Sweden, Japan, Germany, the United States and France.

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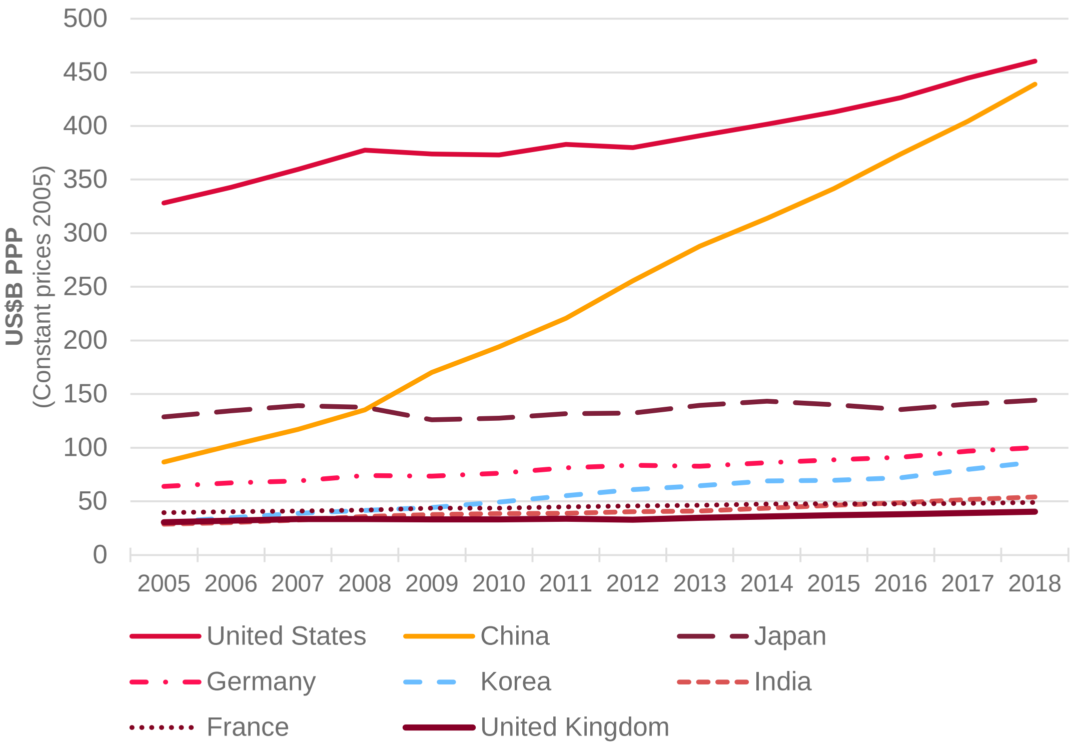
Note: 2007 data for Switzerland refers to 2008.
Source: OECD (2020). Main Science and Technology Indicators.

Chart 2.4. R&D expenditure (2)

Gross domestic expenditure on R&D (GERD), US$B PPP, selected countries

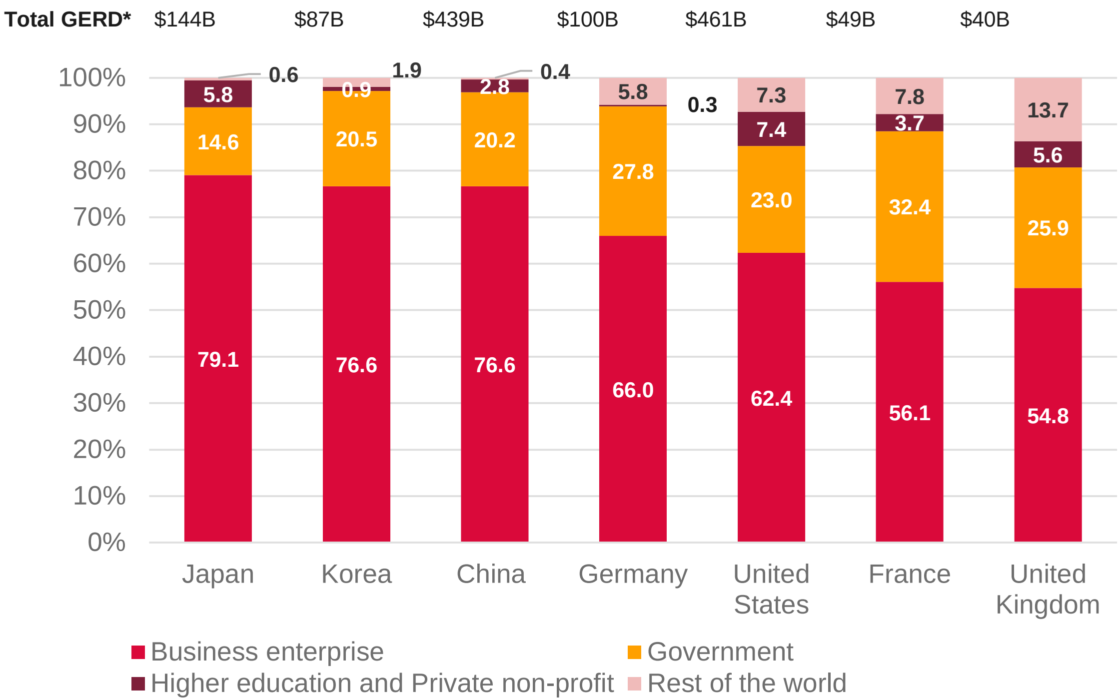


- Given their economic size, **the US** and **China** stand out from other nations, with **total expenditure** considerably higher than any other comparable countries.
- In 2018 the **UK** ranked **eighth in the world** for total expenditure on R&D, which stood at **US$40B** (in constant prices).
- The UK is, however, lagging behind countries such as **France**, **Germany**, **Korea** and **Japan**.
- In 2018 the UK's total expenditure on R&D was equivalent to:
  - 82% of **France's**
  - 46% of **Korea's**
  - 40% of **Germany's**
  - 28% of **Japan's**

Source: UNESCO-UIS (2020). UNESCO Institute for Statistics (UIS) database.

Chart 2.5. R&D expenditure by source of funding

% of gross domestic expenditure on R&D (GERD), selected countries, 2018

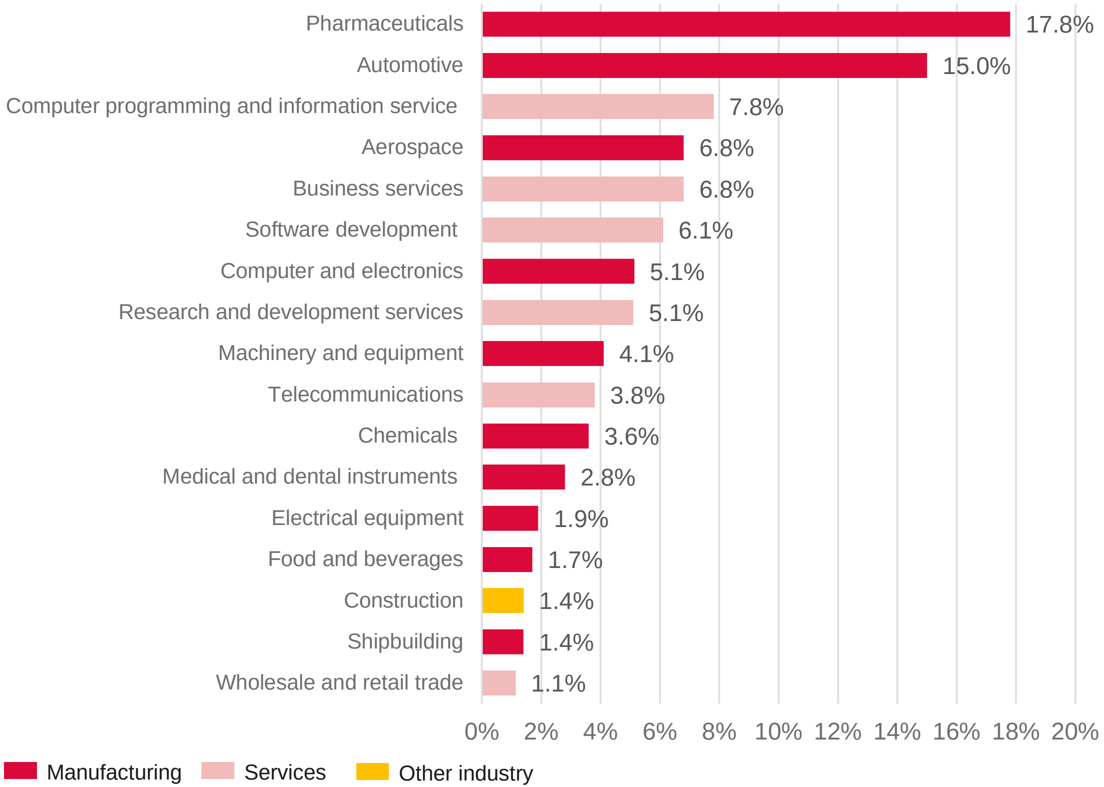


- The **business sector contributes less than 55%** to the funding of R&D in the UK.
- This contribution is below that of competitors such as **Germany** (66%), **Korea** (76.6%) and **Japan** (79.1%).
- The UK government (including national and regional governments, as well as their agencies) funds roughly **26% of total R&D expenditure**, which is higher than countries such as **Japan**, **Korea** and **China**.
- The UK has a relatively high share of R&D funded through the "**rest of the world**" category (13.7% in 2018). This includes, among other sources, research funding granted to UK-based universities from non-UK organisations.

Note: US$B PPP – constant prices 2005, data for France refers to 2017.
Source: OECD (2020). Main Science and Technology Indicators database.

Chart 2.6. Business R&D expenditure in the UK

% of total business enterprise R&D expenditure (BERD) by product, 2018



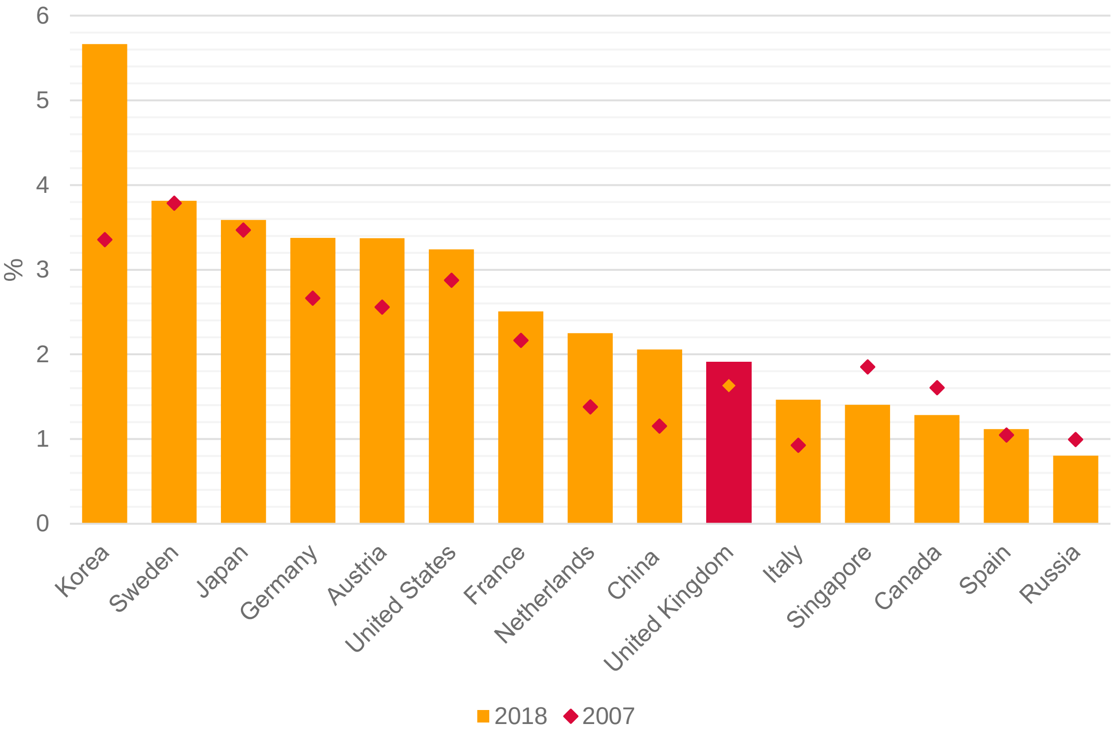
Source: ONS (2020). Business enterprise research and development.

- **Manufacturing industries remain the largest contributors to R&D expenditure across the world**[b] despite the sector's relative decline as a share of the economy in most industrialised countries in the last couple of decades.
- In 2018 **pharmaceuticals**, **automotive** and the **aerospace** industries accounted for around **40%** of total business R&D expenditure in the UK.
- Among services, **computer programming and information services**, **software development**, **business services** and **research and development services** accounted for around **26%** of total business R&D expenditure in 2018.

[b] OECD (2020). Business enterprise R&D expenditure by industry database.

Chart 2.7. R&D intensity in the business sector

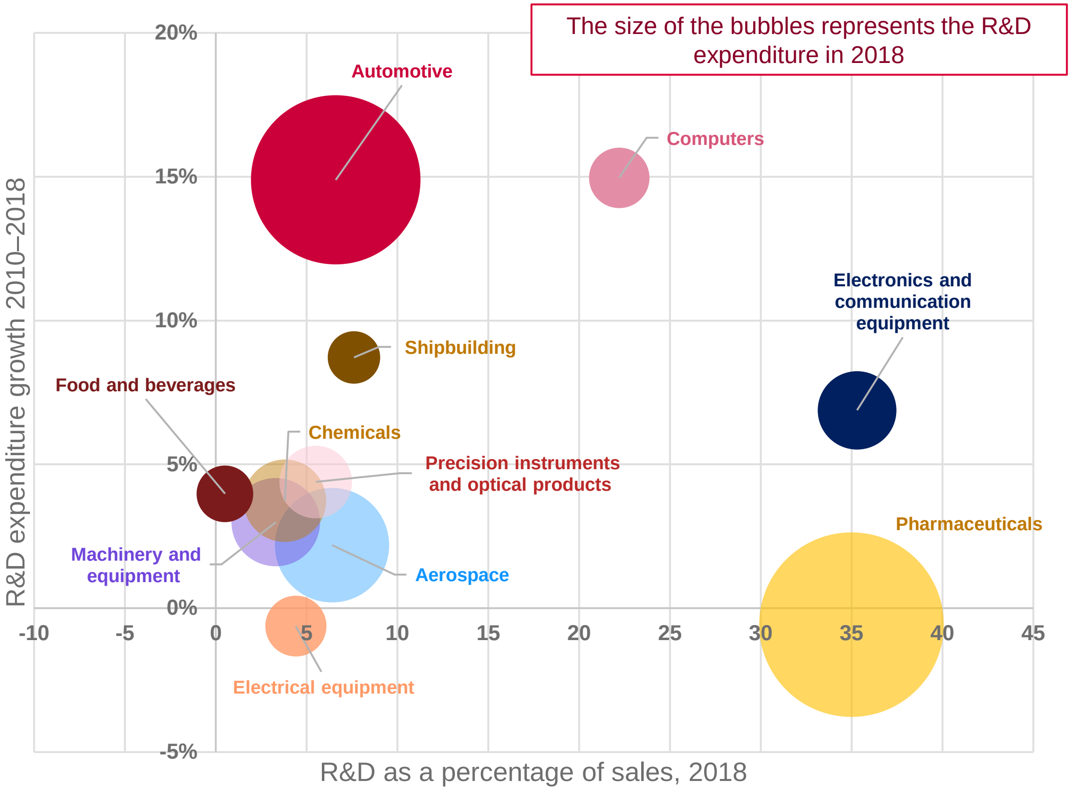
BERD as % of value added in industry, selected countries, 2007 and 2018



- Business enterprise R&D expenditure (BERD) in the **UK** as a percentage of value added in industry remains lower than comparator countries such as **France**, **the US**, **Japan**, **Germany**, **Korea** and **Sweden**.
- This indicates that UK businesses are not **reinvesting in R&D** as much as firms in those countries.

Note: Valued added in industry is calculated as the total gross value added (GVA), excluding "real-estate activities" and "community, social and personal service".
Source: OECD (2020). Main Science and Technology Indicators.

Chart 2.8. UK – R&D intensity in the manufacturing sector

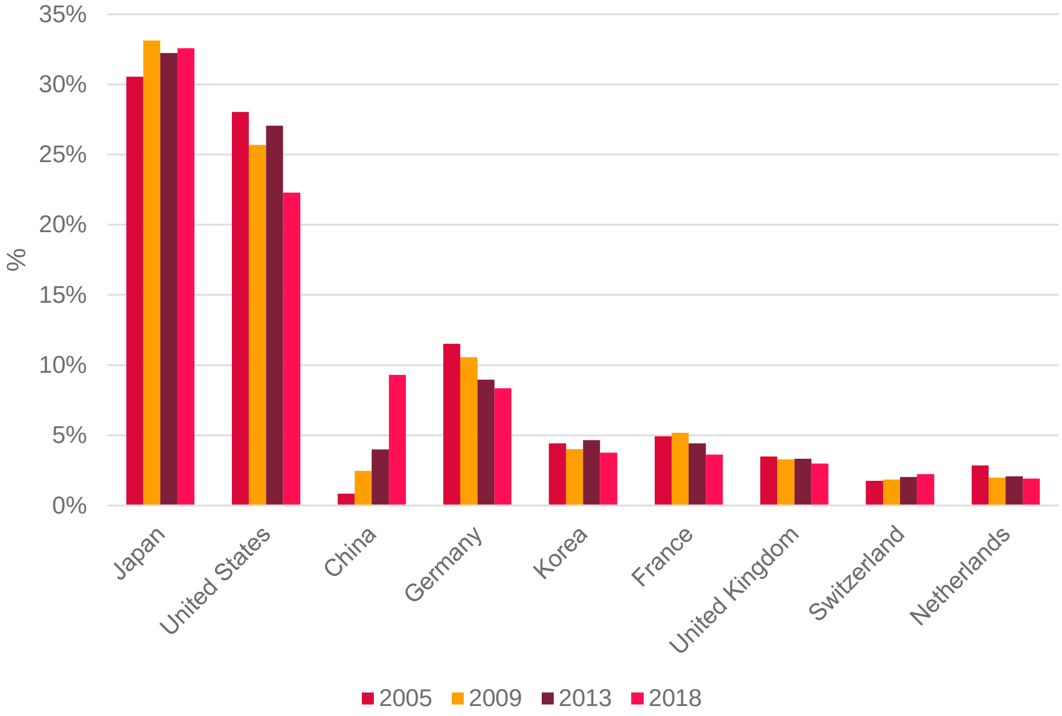


Source: ONS (2020) Research and Development in UK Businesses, 2018 - Datasets

- This chart reports **manufacturing sectors with the highest R&D intensity**, as measured by the sector expenditure on R&D as a percentage of sales.
- In 2018 pharmaceuticals, automotive, aerospace, and machinery and equipment accounted for 67% of total R&D expenditure in manufacturing.
- Differences exist among sectors. **Pharmaceuticals and electronics and communication equipment have the highest R&D intensity** (˜35%). However, for pharmaceuticals, the total expenditure on R&D decreased by 0.6% between 2010 and 2018. In the same period, R&D expenditure in electronics and communication equipment increased by 6.9%.
- **Automotive and aerospace show a similar R&D intensity, at 6.6% and 6.4%, respectively**. However, these sectors experienced a different performance in terms of R&D expenditure growth between 2010 and 2018, with automotive increasing by 14% against 2.2% in aerospace.

Chart 2.9. Share in the world's triadic patent families

%, top 10 countries in 2018, 2007–2018



- A triadic patent family is defined as a set of patents registered at the European Patent Office (EPO), the Japan Patent Office (JPO) and the United States Patent and Trademark Office (USPTO) to protect the same invention.
- In 2018 the UK was the seventh economy in terms of the share in the world's triadic patent families, with a share of 3%.
- Japan and the United States presented shares in the world's triadic patens well above comparator countries, at 32.6% and 22.3% respectively, in 2018.
- China has dramatically increased its shares, from 1% in 2005 to 4% in 2018.

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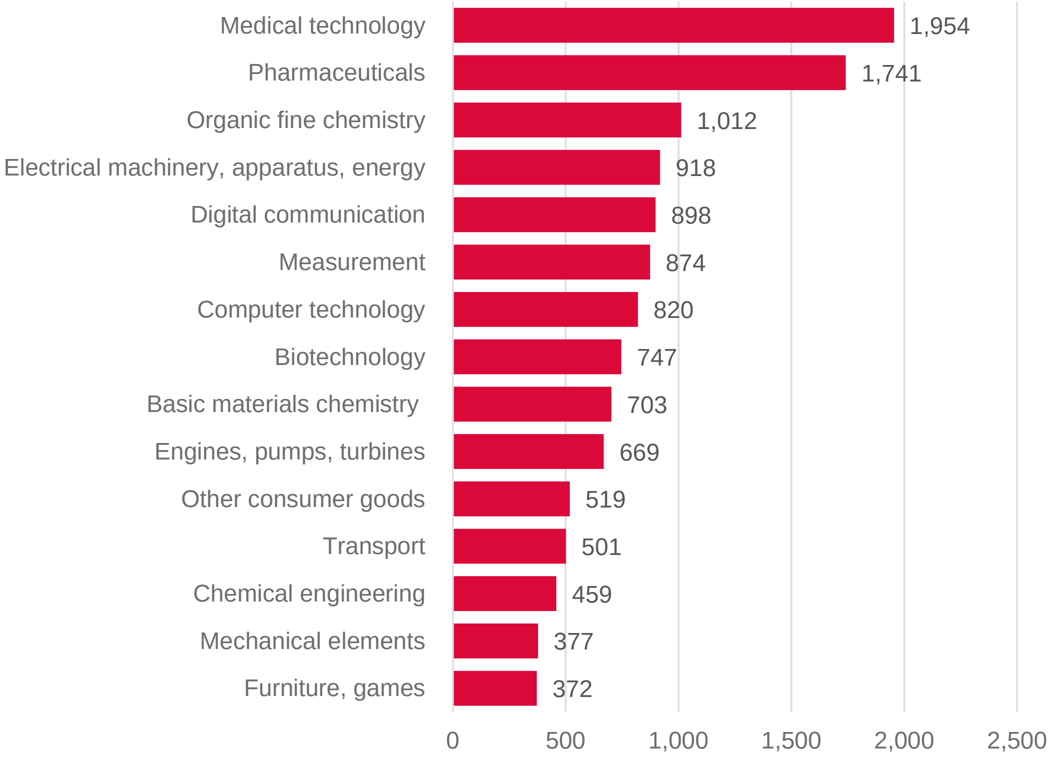
Source: OECD (2020). Triadic patent families (indicator).

Chart 2.10. UK – triadic patents by technology domain

Top 15, WIPO technology families, by inventor country of residence, 2007–2016

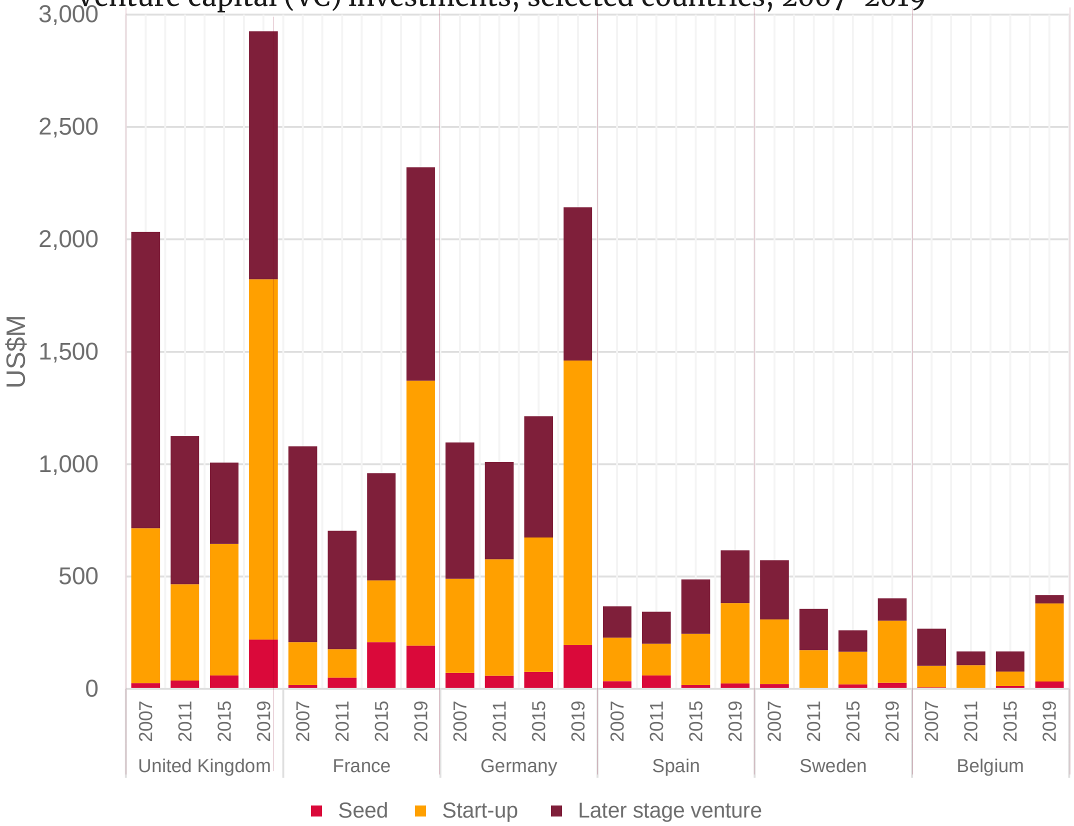


- In terms of patent technology families, as defined by the World Intellectual Property Organization (WIPO), **the United Kingdom presents a technology specialisation towards medical technology and pharmaceuticals.**
- Between 2007 and 2016 medical technology patents represented 11.6% of the total UK triadic patents, followed by 10.4% of pharmaceuticals and 6% of organic fine chemistry.

Source: OECD (2020). Science, Technology and Patents database.

Chart 2.11. VC investments by company development stage

Venture capital (VC) investments, selected countries, 2007-2019



- Venture capital represents a key instrument in investing in **innovative start-ups** and businesses that show high potential future growth.
- In Europe, countries such as **the UK**, **Germany** and **France** are the most attractive markets for venture capital investment.
- Between 2007 and 2019 the **UK** received venture capital investments to a total of US$20.4B, followed by **Germany** (US$15.7B) and **France** (US$13.9B).
- In 2019 the largest share of venture capital investments in the **UK** was directed towards **start-ups**, in line with comparator countries.

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Note: Original values in euros, converted at the annual average nominal exchange rate.
Source: Invest Europe (2020). Activity Report 2007-2019 – European Private Equity.

Chart 2.12. Top European venture capital regions

Top European regions by venture capital (VC) funding received, 2007–2019

Rank	Country	Region	Total received investment (US$ m)
1	UK	London	10,321
2	France	Ile-de-France	8,505
3	Germany	Berlin	5,199
4	Germany	Bavaria	3,709
5	UK	East of England	2,677
6	Sweden	Stockholm	2,568
7	Spain	Catalonia	2,113
8	UK	South East	2,220
9	Spain	Community of Madrid	1,639
10	Belgium	Flemish Region	1,547

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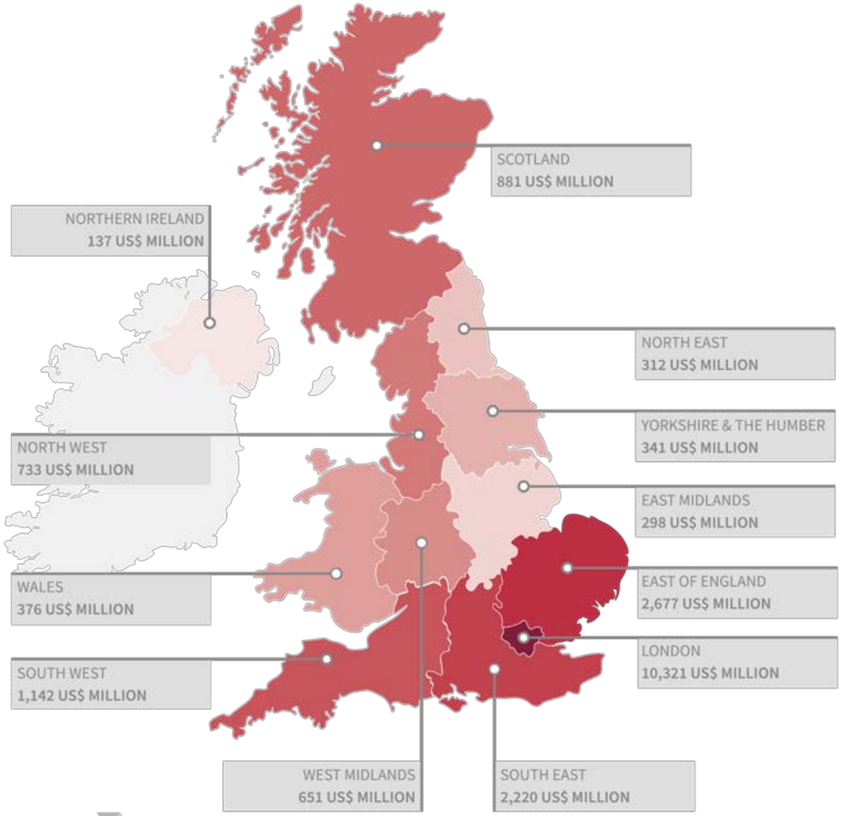
Note: Original values in euros, converted at the annual average nominal exchange rate.
Source: Invest Europe (2020). Activity Report 2007–2019 – European Private Equity.

- The **European venture capital market** is geographically **highly concentrated**.
- Between 2007 and 2019, 10 regions accounted for **more than 50% of the total venture capital investment** received in the EU-27[c] plus the UK, with the **UK** having **3 of the most dynamic regions in Europe** for VC investments (i.e. London, the East of England and the South East).

[b] Excluding the following countries, where data is not available: Croatia, Cyprus, Malta, Slovakia and Slovenia.

Chart 2.13. Venture capital investments in the UK (1)

UK regions by venture capital (VC) funding received, 2007–2019



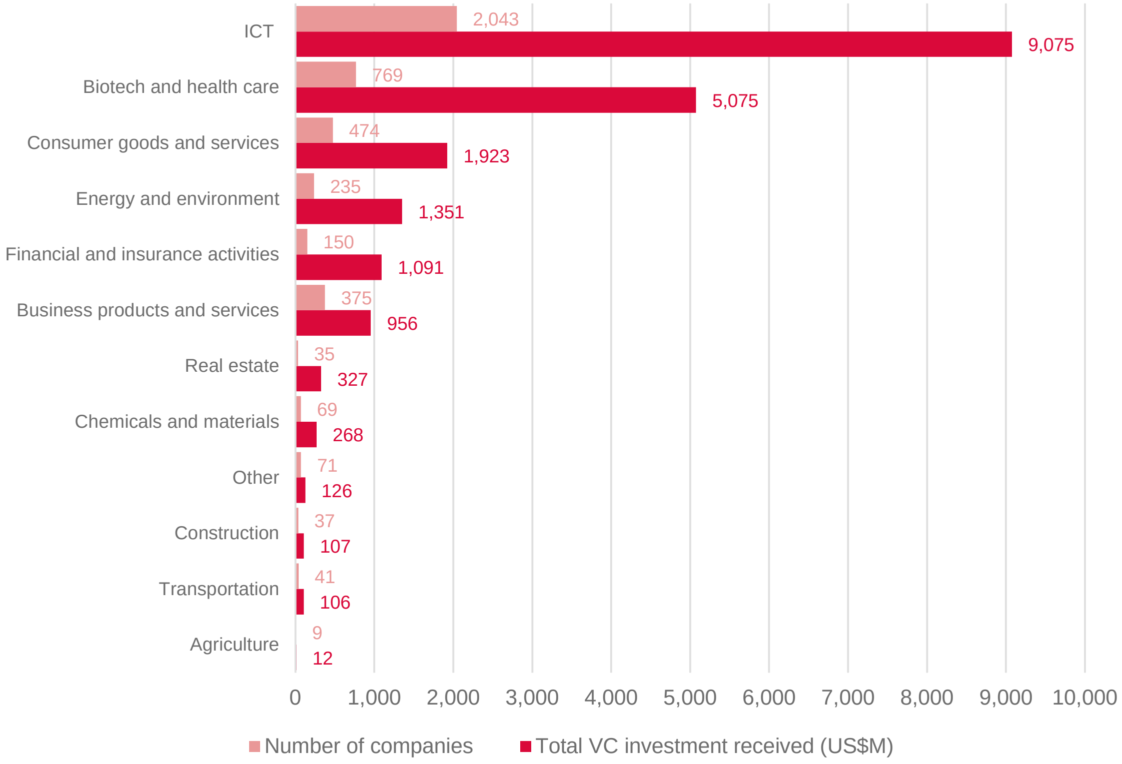
Note: Original values in euros, converted at the annual average nominal exchange rate; the figure does not include VC investment in British territories outside the UK, as well as unclassified investment. These investments amounted to 1.61% of total VC investment in the UK between 2007 and 2019.

Source: Invest Europe (2020) Activity Report 2007-2019 – European Private Equity.

- The **UK venture capital market is extremely concentrated in the "golden triangle"** of London, Cambridge and Oxford, which received 76% of the total venture capital investments between 2007 and 2019.
- In the same period, more than 50% of total VC investments were directed to London.

Chart 2.14. Venture capital investments in the UK (2)

Sectors by venture capital (VC) funding received, 2007–2019



- The **UK venture capital market is relatively concentrated in two key sectors**.
- Between 2007 and 2019 **ICT** (i.e. business-related software, computer and data services, Internet technologies, hardware, telecommunication services) and **biotech and health care** (i.e. biotech products and services, medical equipment and devices, pharmaceutical and drug delivery) received **US$14B** of VC capital investments, which **funded 2,812 companies**. This is equivalent to **70% of total venture capital investments and 65% of companies funded**.

Note: Original values in euros, converted at the annual average nominal exchange rate.
Source: Invest Europe (2020). Activity Report 2007–2019 – European Private Equity.

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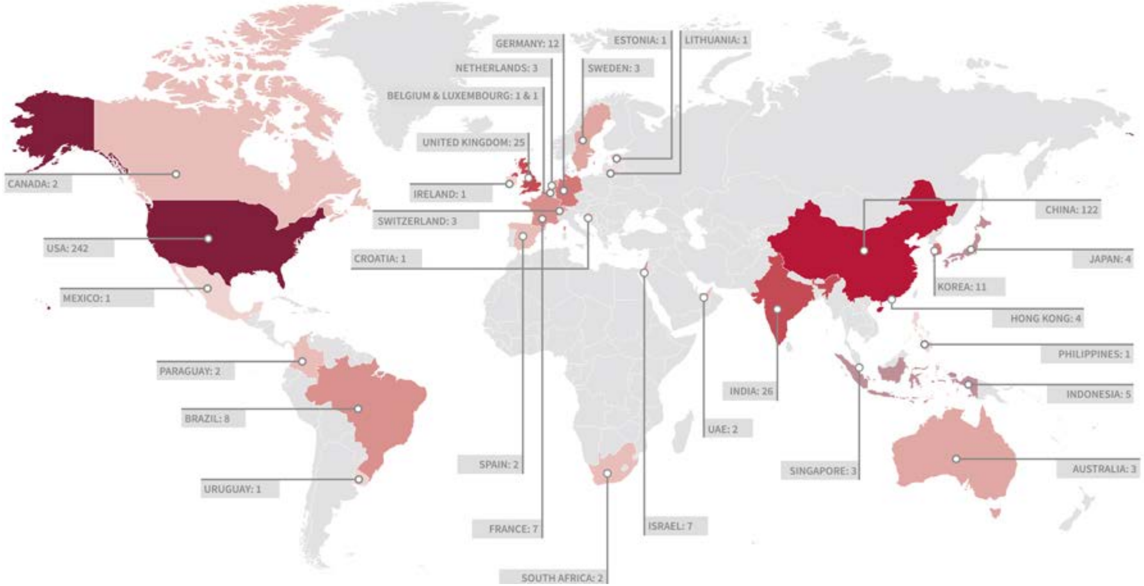
Chart 2.15. Unicorns

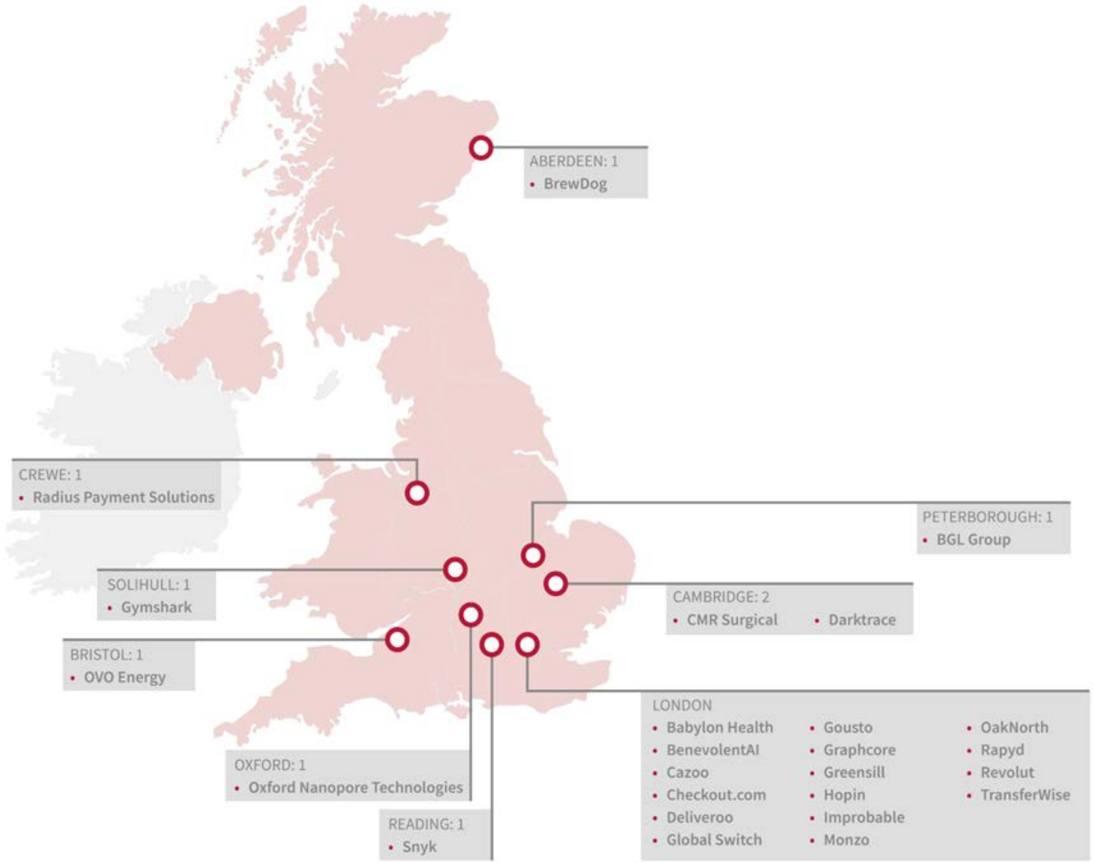
Number of unicorns in the world, 2020



- Unicorns are start-ups with a valuation over US$1B.
- **At the end of 2020 there are 507 unicorns around the world,** of which 26 are decacorns (valued at over US$10B) and 1 is a hectocorn (value at over US$100B).
- Th United States has 242 unicorns (47.7% of total world unicorns), followed by China, with 122 unicorns (24.1% of total), and India, with 26 unicorns (5.1% of total).
- **The UK is the fourth country in the world in terms of high-value start-ups, with 24 unicorns and 1 decacorn.**
- **Fintech, Internet software and services, e-commerce and direct-to-consumer, and artificial intelligence** account for almost 50% of sector activities of unicorns in the world.

Source: CBINSIGHTS (2021). Full List of Unicorns.

Chart 2.16. Unicorns in the United Kingdom



Source: CBINSIGHTS (2021). Full List of Unicorns.

- The United Kingdom presents a vibrant start-up ecosystem.
- Being the fourth country in the world, **the United Kingdom has 25 unicorns (including 1 decacorn) by the end of 2020.**
- The sectors with more unicorns are: **fintech** (9 companies), **artificial intelligence** (4 companies), **e-commerce**, and **logistics and delivery** (2 unicorns each).
- As per the venture capital investments in recent years, **most of the unicorns (16) are headquartered in London.**
- The UK's start-up ecosystem is also home of additional five "exited" unicorns (i.e. sold to larger corporates, or admitted to a public stock exchange). Two of them were eventually acquired by Chinese and US investors.[a]

[a] Beauhurst (2019). UK Unicorn companies – a free report on £1b businesses.

Theme 3: Industrial Performance

UK INNOVATION REPORT

Policy questions addressed in Theme 3

- **Are UK key industries becoming more or less competitive internationally?**
- **How are UK industries performing in terms of productivity, value added and employment?**
- **Are key industries in the UK investing enough in R&D compared to their international competitors?**

What the data tells us

- **Pharmaceuticals**, **automotive**, **aerospace** and **machinery and equipment** are key industries of the UK, accounting for 30.5% of the total manufacturing value added in 2018. Their **productivity levels lagged behind those of leading countries**.

- **Aerospace** and **machinery and equipment** became more productive on the basis that value added grew faster than employment (Chart 3.9, Chart 3.13) . **Automotive** became more productive as value added grew while employment shrank (Chart 3.5). In contrast, **productivity growth collapsed in pharmaceuticals** as value added contracted at a quicker rate than that of employment (Chart 3.1).

- **Trade analysis also suggests that the UK has become less competitive internationally in specific products**. It joins the bottom quartile of countries ranked by trade balance in **automotive** and **machinery and equipment** products (Chart 3.7, Chart 3.15), with widening deficits since 2009. From being the fifth largest net exporter of **pharmaceutical** products in 2009, the UK slipped rapidly into the third quartile of countries by 2018 (Chart 3.3). **Aerospace products is a bright spot** in which the UK has strengthened its position to become the fourth largest net exporter in 2018 (Chart 3.11).

- **Business R&D spending in the UK key industries is less than that of their international competitors** (unadjusted for economy and industry size). Business R&D spending has accelerated in **automotive** (highest growth rate among comparator countries) (Chart 3.8), **aerospace** and **machinery and equipment** (Chart 3.12, Chart 3.16). However, it has been on the decline for **pharmaceuticals** (Chart 3.4). Low R&D spending contributes to overall low investment spending in the UK and hampers the capital deepening needed for labour productivity growth.

Value added, employment and productivity analysis

This figure demonstrates the relationship between value added, employment and labour productivity. The horizontal axis measures the change in employment, and the vertical axis measures the change in value added, during the period of analysis.

The graph allows for more detailed country and sector comparison (than by considering overall productivity growth rates only) by explicitly showing the drivers of productivity growth or decline.

Positive productivity growth

Productivity growth is positive if the rate of growth of value added is ***higher*** than the rate of growth of employment. Productivity is also positive when value added decreases, but employment decreases ***faster*** (i.e. the decrease in employment is proportionally ***greater*** than the decrease in value added).

Negative productivity growth

Productivity growth is negative if the rate of growth of value added is ***lower*** than the rate of growth of employment. Productivity is also positive when value added decreases, but employment decreases ***slower*** (i.e. the decrease in employment is proportionally ***lower*** than the decrease in value added).

Zero productivity growth line

If the rate of change in value added and employment are the same (either positive or negative), productivity growth is zero.

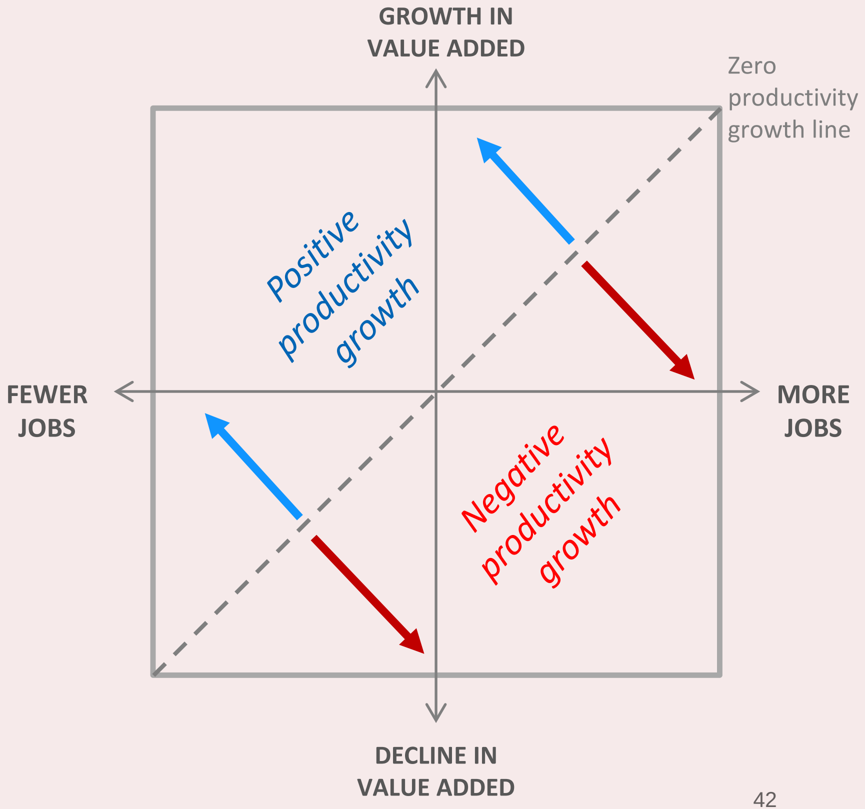


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Chart 3.1. Pharmaceuticals – value added and employment (a)

Value added, employment and labour productivity in pharmaceuticals and medicinal chemicals, selected countries

Rank	Country	Value added		Employment		Value added per employee	
		Billions US$, 2017	CAGR (2009–2017)	Thousand persons, 2017	CAGR (2009–2017)	Thousand US$, 2017	CAGR (2009–2017)
1	United States	165.7	2.1%	265.5	1.1%	624.1	0.9%
2	India*	49.0	8.0%	679.4	7.3%	72.2	0.6%
3	Germany	21.4	1.6%	121.3	0.7%	176.3	0.9%
4	Switzerland	20.5	8.0%	46.6	3.4%	439.6	4.5%
8	Korea	13.1	5.9%	41.3	6.0%	318.3	-0.1%
9	Singapore	10.7	0.1%	7.7	6.0%	1381.5	-5.5%
15	United Kingdom*	4.4	-12.3%	32.2	-3.0%	136.6	-9.5%

- The **UK** ranked **fifteenth** in the world in the production of pharmaceuticals in 2016–17 by value added in current PPP US$ terms.
- The **US** has sustained global leadership in the industry in the last decade, followed by **India**, **Germany**, **Switzerland** and **France**.
- With the exception of **Switzerland**, labour productivity growth has been weak among the top performers in the global industry.
- The productivity of the UK pharmaceuticals industry declined by almost 10% on a CAGR basis. At ~$137 in 2016–17, it was lower than the productivity levels of all comparators except India.

Note: Purchasing power parity (PPP) values computed using OECD PPP indices**.** *Because of data unavailability, 2016 values are used for India and the UK. CAGR: Compound annual growth rate.
Source: UNIDO, INDSTAT 4, ISIC Revision 4.

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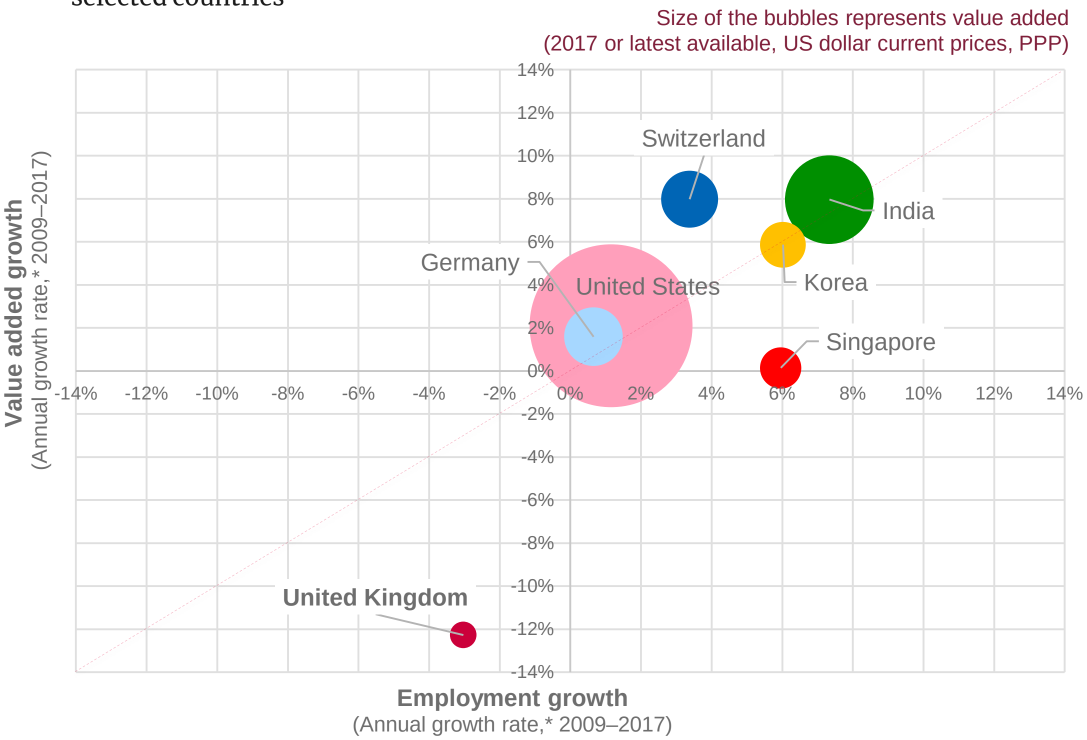
Chart 3.2. Pharmaceuticals – value added and employment (b)

Growth in value added and employment in pharmaceuticals and medicinal chemicals, selected countries



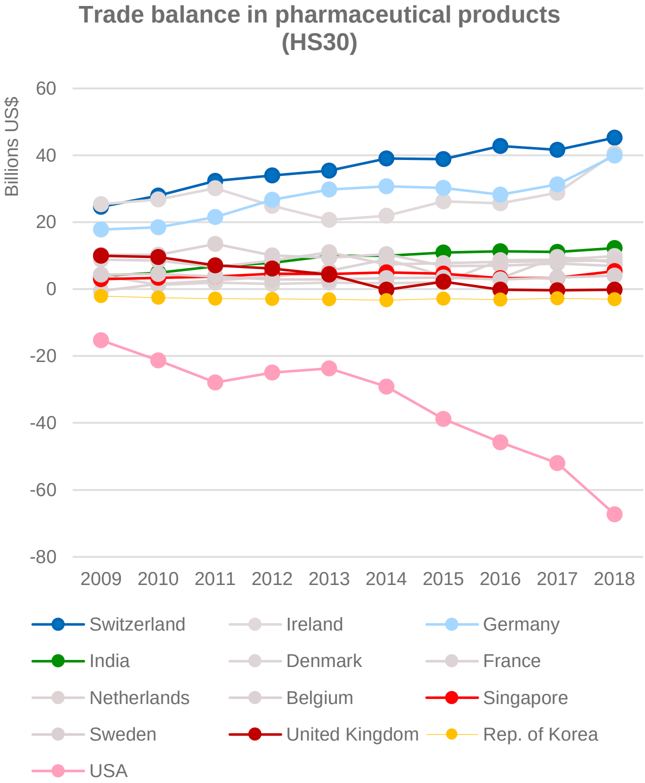
Note: Purchasing power parity (PPP) values computed using OECD PPP indices. Because of data unavailability, 2016 values are used for India and the UK. *Compound annual growth rate.
Source: UNIDO, INDSTAT 4, ISIC Revision 4.

- The **pharmaceutical industry** contributed to 7.5% of manufacturing gross value added in the UK in 2018.[1/]
- Unlike top-performing countries, **the UK has recorded negative growth rates in value added, employment and productivity.**
- **Korea** and **Singapore** are fast-growing nations with niche specialisation areas.
- The pharmaceutical industry has played a central role in responding to the **COVID-19** outbreak.[2/]

[1/] Office for National Statistics.
[2/] Life Sciences COVID-19 Response Group (2020). *Life Sciences Recovery Roadmap;* Kapoor et al (2020). Flexible Manufacturing: The Future State of Drug Product Development and Commercialization in the Pharmaceutical Industry. *J. Pharm. Innov*.

Chart 3.3. Pharmaceuticals – trade balance

Trade balance (exports minus imports) in pharmaceutical products by the UK and selected countries 2009–2018



Global ranking by trade balance in pharmaceutical products

2009		2018	
Rank	Country	Rank	Country
1	Ireland	1	Switzerland
2	Switzerland	2	Ireland
3	Germany	3	Germany
4	Belgium	4	India
5	UK	5	Denmark
6	France	6	France
7	Sweden	7	Netherlands
8	Denmark	8	Belgium
9	India	9	Singapore
10	Israel	10	Sweden
11	Singapore	11	Israel
12	Austria	12	Austria
13	Slovenia	13	Slovenia
14	Panama	14	Italy
15	Hungary	15	Hungary
16	Syria	16	Jordan
17	Jordan	17	Cyprus
18	Malta	18	Malta
19	Kuwait	19	Algeria
20	Qatar	106	UK
178	Rep. of Korea	183	Rep. of Korea
196	USA	196	USA

- The UK has suffered from a rapid loss in trade competitiveness in pharmaceutical products from the perspective of trade balance.
- **The UK was the fifth largest net exporter of pharmaceutical products in 2009,** with a surplus of ~$10B, placing it among the top quartile of countries according to trade balance.
- Since 2014 the UK has recorded deficits in pharmaceutical products trade in all years except 2015. Its trade deficit widened to ~$126M in 2018, placing it **among the third quartile of countries according to trade balance**.
- The wider deficits were a combination of a dip in exports between 2009 and 2018 (CAGR: -0.2%) and an increase in imports (CAGR: 4.3%).
- Top performers alongside the UK in 2009 – with the exception of Israel, which was overtaken by Singapore – **retained their spots among the top 10 by 2018**, notwithstanding the change in their ranking.

Note: Trade balance is based on gross exports and gross imports of goods at HS 1992 2-Digit level. Global ranking excludes Afghanistan, the Cayman Islands, Chad, the Cook Islands, FS Micronesia, Guinea-Bissau, Haiti, Iraq, Wallis and Futuna Islands, Mauritania, Libya, State of Palestinian and Tuvalu.
Source: UN Comtrade.

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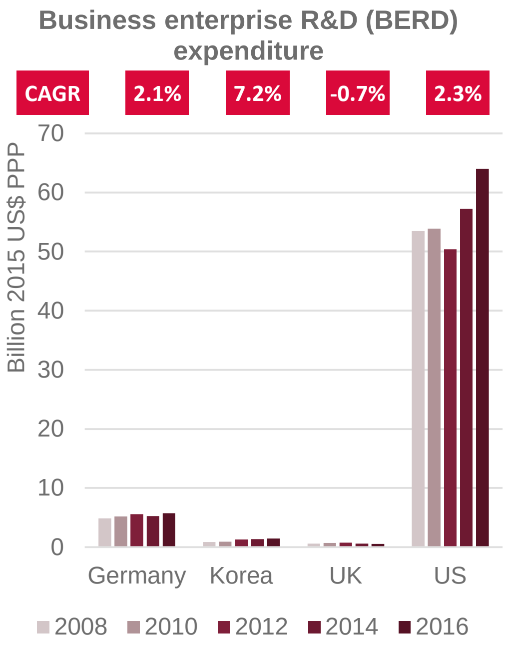
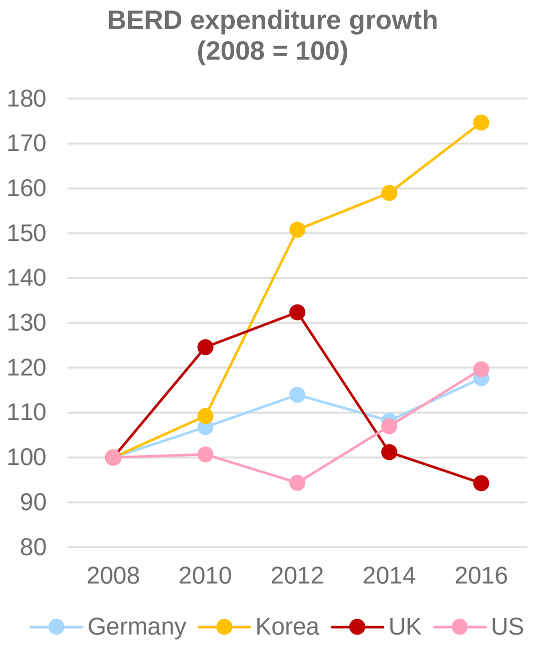
Chart 3.4. Pharmaceuticals – business spending on R&D

Business enterprise R&D (BERD) expenditure in basic pharmaceutical products and pharmaceutical preparations, selected countries





Note: Compound annual growth rates for countries are based on data for the first and last available years within the 2008–2016 range.
Source: OECD Research and Development Statistics; Make UK Sector Bulletin: Pharma.

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- In 2018 the **pharmaceutical industry** accounted for almost 17.8% of overall business R&D expenditure in the UK.[1/]
- However, the same decline experienced by the sector in terms of GVA and productivity also affected **R&D expenditure**.
- The sector spent **3% less** in 2018 than it did in 2008.[1/]
- **Research and development** is fundamental to pharmaceutical companies that rely on the discovery of new drugs to achieve growth.
- It takes on average between 12 and 15 years and £1B for a new medicine to go through the necessary procedures before it can be prescribed by doctors.
- **Patents** play a key role in the **pharmaceutical** industry: the expiration of patents, while good for consumers, can result in weaker industry performance when firms experience sharp declines in revenue. This phenomenon is known as the "**patent cliff**".

[1/] Office for National Statistics.

Chart 3.5. Automotive – value added and employment (a)

Value added, employment and labour productivity in the automotive industry, selected countries

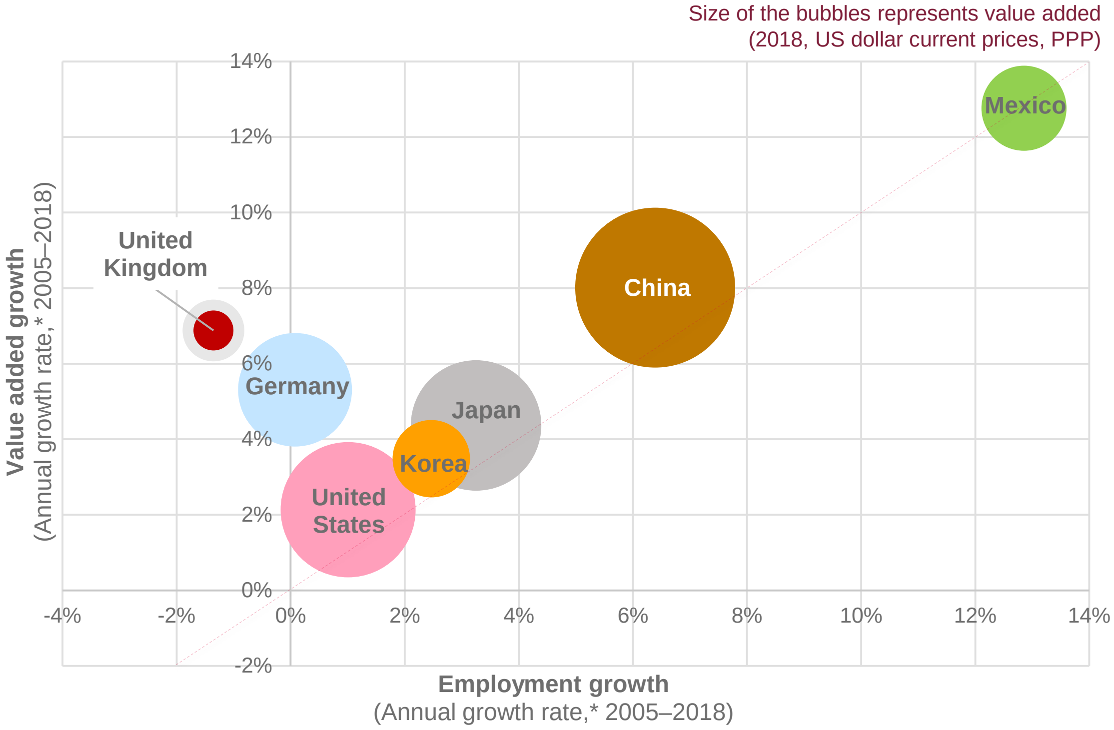
Rank	Country	Value added		Employment		Value added per employee	
		Billions US$, 2018	CAGR (2005–2018)	Thousand persons, 2018	CAGR (2005–2018)	Thousand US$, 2018	CAGR (2005–2018)
1	China	270.6	8.0%	4588	6.4%	59.0	1.5%
2	United States	193.0	2.1%	955.9	1.0%	201.9	1.1%
3	Japan	180.2	4.4%	1,101.6	3.3%	163.6	1.1%
4	Germany	136.8	5.3%	873.7	0.1%	156.6	5.2%
5	Mexico	76.8	12.8%	832.9	12.9%	92.2	-0.1%
6	Korea	63.4	3.5%	325.2	2.5%	195.0	1.0%
7	United Kingdom	27.5	6.9%	160.3	-1.4%	171.3	8.3%

- In 2018 the **UK** ranked seventh in the world automotive industry in value added terms.
- **China** has become the global leader in the automotive industry in terms of value added, surpassing **the US**, **Japan** and **Germany**. However, **employment** levels have reduced (at an annual rate of 1.4%).
- From 2005 to 2018 **UK automotive productivity** has grown at higher rates than among other world leaders (8% annually).
- The productivity of the UK automotive industry grew by 8.3% – outpacing the sixth largest countries in automotive production – on a CAGR basis. With value added per employee of $171 in 2018, the UK was the third most productive – after the US and Korea – and more productive than Japan and Germany.

Note: Purchasing power parity (PPP) values computed using OECD PPP indices. Data refers to ISIC 34 motor vehicles, trailers, semitrailers. CAGR: Compound annual growth rate.
Source: UNIDO, INDSTAT 2 2020, ISIC Revision 3.

Chart 3.6. Automotive – value added and employment (b)

Growth in value added and employment in the automotive industry, selected countries



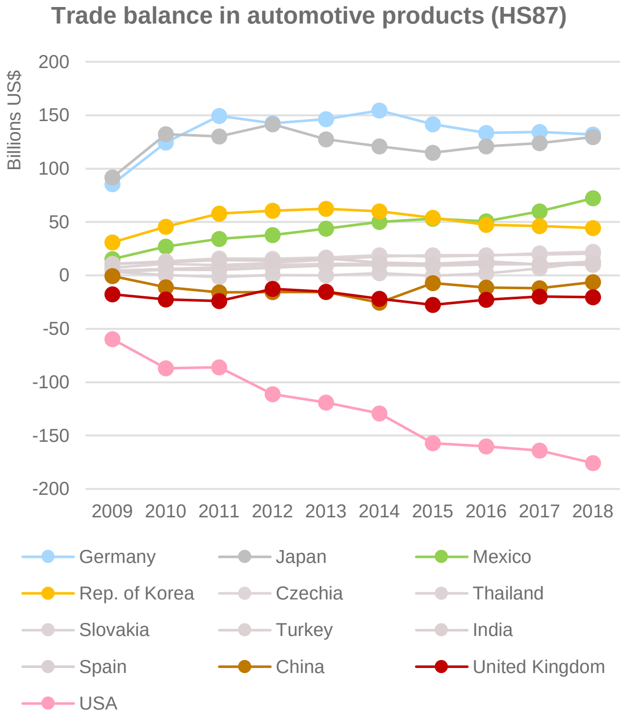
- The **automotive** industry contributed to 8.8% of the manufacturing gross value added in the UK in 2018.[1/]
- The **UK** automotive industry has recorded a strong performance in recent decades, with **value added** growing at around 7% annually from 2005 to 2018.
- The automotive sector has been one of the most affected by the **COVID-19** pandemic. Policy packages have been established around the world, including **France**, **Germany**, **Korea** and **the UK** to support the industry while promoting the production of energy-efficient vehicles.[2/]

Note: Purchasing power parity (PPP) values computed using OECD PPP indices. Data refers to ISIC 34 motor vehicles, trailers, semitrailers.
*Compound annual growth rate.
Source: UNIDO, INDSTAT 2 2020, ISIC Revision 3.

[1/] Office for National Statistics.
[2/] Policy Links (2020). *How manufacturing can emerge stronger*.

Chart 3.7. Automotive – trade balance

Trade balance (exports minus imports) in vehicles other than railway and tramway by the UK and selected countries 2009–2018



Global ranking by trade balance in automotive products

2009		2018	
Rank	Country	Rank	Country
1	Japan	1	Germany
2	Germany	2	Japan
3	Rep. of Korea	3	Mexico
4	Mexico	4	Rep. of Korea
5	Czechia	5	Czechia
6	Spain	6	Thailand
7	Poland	7	Slovakia
8	Thailand	8	Turkey
9	Slovakia	9	India
10	Turkey	10	Spain
11	Hungary	11	Hungary
12	Oth. Asia, nes	12	Sweden
13	India	13	Romania
14	Romania	14	South Africa
15	Slovenia	15	Poland
16	Kuwait	16	Oth. Asia, nes
17	South Africa	17	Slovenia
18	Belarus	18	Belarus
19	Qatar	19	Algeria
20	Sweden	20	Anguilla
128	China	184	China
195	UK	193	UK
196	USA	196	USA

- The UK's **terms of trade in automotive products have improved**. The ratio of exports to imports increased from $0.61 in exports for every $1 in imports in 2009 to $0.73 in exports for every $1 in imports in 2018.
- **The UK's international ranking by net exports has also improved**. However, it consistently belongs to the bottom quartile of countries ranked by net exports in automotive products.
- Its deficit in automotive products trade widened by 1.7% per year (CAGR), from ~$18B in 2009 to ~20B in 2018.
- **Germany, Japan, Mexico, Korea, the Czech Republic, Thailand, Slovakia, Turkey and Spain** were among **the top 10 countries in both 2009 and 2018**, notwithstanding the change in their respective ranking.
- Poland fell out of the top 10 in 2018, and its spot was taken by India.

Note: Trade balance is based on gross exports and gross imports of goods at HS 1992 2-Digit level. Global ranking excludes Afghanistan, the Cayman Islands, Chad, the Cook Islands, FS Micronesia, Guinea-Bissau, Haiti, Iraq, Wallis and Futuna Islands, Mauritania, Libya, State of Palestinian and Tuvalu.
Source: UN Comtrade.

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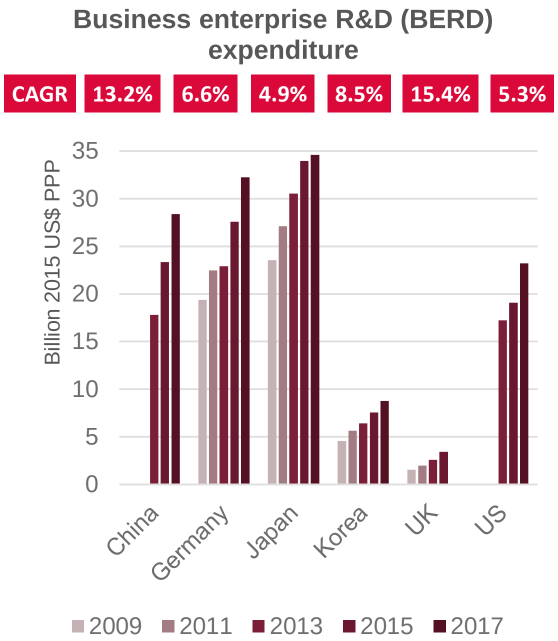
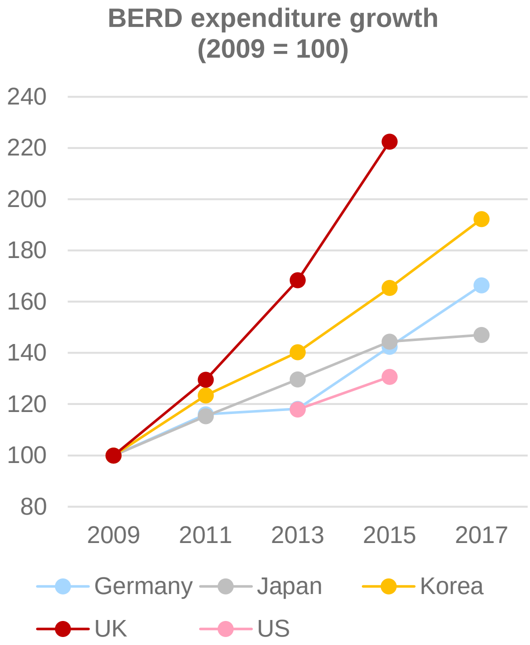
Chart 3.8. Automotive – business spending on R&D

Business enterprise R&D (BERD) expenditure in motor vehicles, trailers and semi-trailers, selected countries





Note: Compound annual growth rates for countries are based on data for the first and last available years within the 2009–2017 range. For BERD expenditure growth, the base year for the US is 2008.
Source: OECD Research and Development Statistics; Make UK Sector Bulletin: Automotive.

- In 2018 the **automotive industry** accounted for almost 15% of overall business R&D expenditure in the UK, second only to the pharmaceutical industry.[1/]
- UK automotive R&D grew by 15.4% (CAGR) between 2009 and 2015.
- The automotive industry has been one of the most productive UK manufacturing industries over the last 20 years; its **productivity growth** of 61% since the 2008 financial crisis has been the strongest of any industry.
- Over 6% of automotive firms – both original equipment manufacturers (OEMs) and those in the supply chains – are **foreign-owned**, over double the average for the UK manufacturing sector as a whole.
- The biggest foreign investors in the UK automotive industry are **the US** (31% of foreign-owned companies), followed by **Japan** (15%) and **Germany** (14%).

Chart 3.9. Aerospace – value added and employment (a)

Value added, employment and labour productivity in air and spacecraft and related machinery, selected countries

Rank	Country	Value added		Employment		Value added per employee	
		Billions US$, 2017	CAGR (2005–2017)	Thousand persons, 2017	CAGR (2005–2018)	Millions US$, 2017	CAGR (2005–2017)
1	United States	130.3	5.2%	401.2	0.4%	324.7	4.7%
2	France	22.6	9.4%	141.6	3.8%	159.6	4.9%
3	Germany	16.5	6.0%	77.9	0.5%	211.8	9.9%
4	United Kingdom*	12.9	2.5%	108.3	0.7%	119.4	1.7%
5	Canada	8.1	4.5%	51.3	2.5%	157.3	1.2%
6	Italy	6.5	9.4%	45.6	4.1%	142.9	5.6%
7	Korea	2.4	8.5%	16.8	7.7%	143.1	-2.0%

- The **US** has sustained its leadership in the aerospace industry over the last decade. It is followed by **France, Germany, the UK, Canada** and **Italy**.
- Of the top six performing countries, **France**, **Italy** and **Korea** experienced the largest increases in value added and employment, between 2005 and 2017.
- In terms of value added per employee, **Germany** and **Italy** have observed the highest growth rates.
- The productivity of the UK aerospace industry grew by 1.7% – lagging behind most countries, except Canada and Korea – on a CAGR basis. With value added per employee of ~$120 in 2017, the UK was the least productive compared to all other countries.

Note: Purchasing power parity (PPP) values computed using OECD PPP indices. Data refers to ISIC 3030: Air and spacecraft and related machinery. *Due to data unavailability 2016 values are used in the 2017 series for the UK. CAGR: Compound annual growth rate.
Source: UNIDO, INDSTAT 4, ISIC Revision 4.

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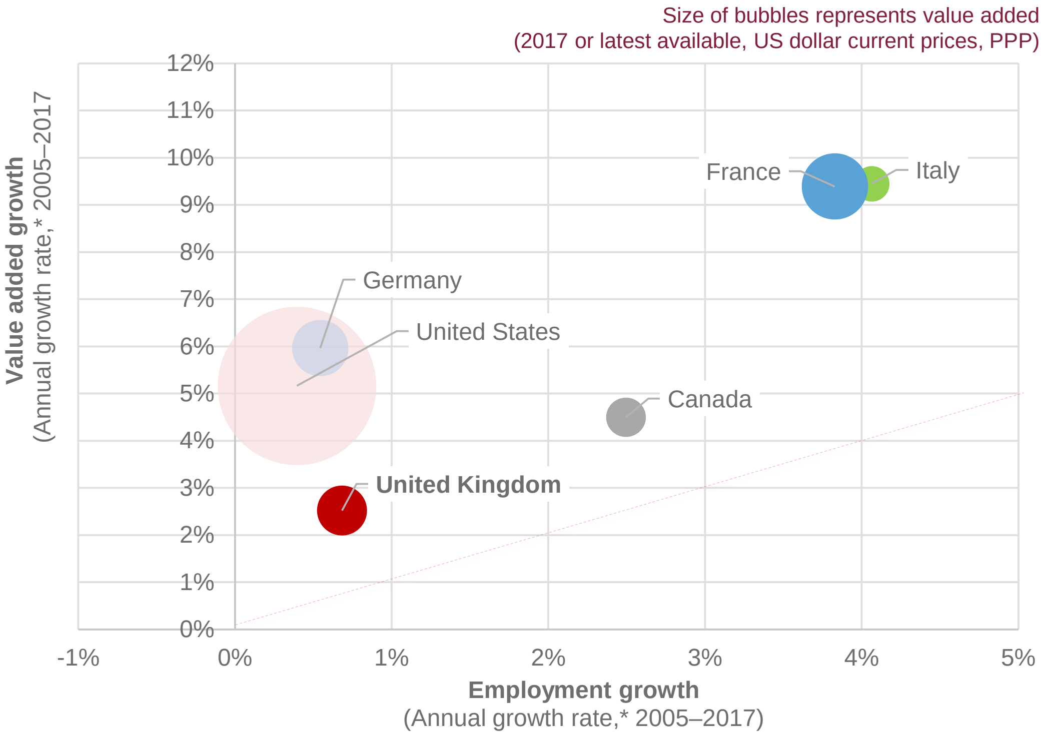
[1/] Policy Links (2020). *How manufacturing can emerge stronger*.

Chart 3.10. Aerospace – value added and employment (b)

Growth in value added and employment in air and spacecraft and related machinery, selected countries



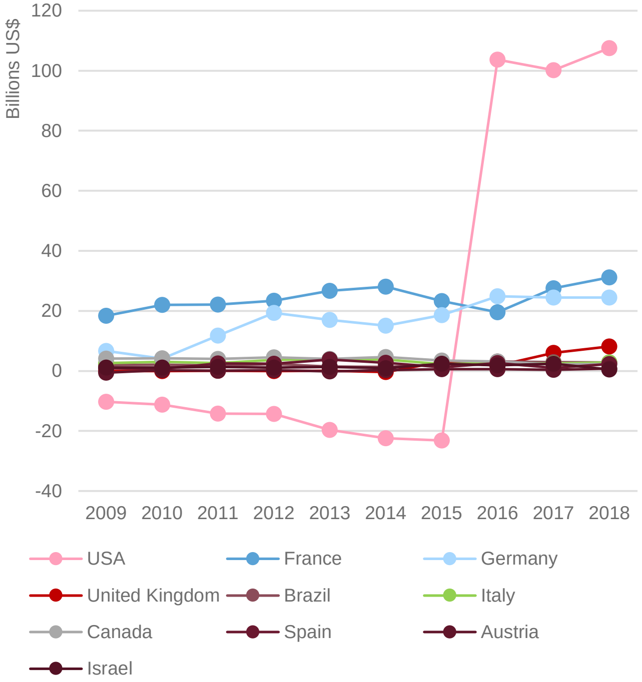
Note: Purchasing power parity (PPP) values computed using OECD PPP indices. Data refers to ISIC 3030: Air and spacecraft and related machinery. Because of data unavailability, 2016 values are used in the 2017 series for the UK. *Compound annual growth rate.
Source: UNIDO, INDSTAT 4, ISIC Revision 4.

- The **aerospace** industry contributed to 5.9% of the manufacturing gross value added in the UK in 2018.[1/]
- The UK ranks in fourth position in the world in the manufacturing of **air and spacecraft and related machinery,** in value added terms.
- However, the **UK's share of global value added halved** between 2006 and 2016 (from 14% to 7%).
- As well as **automotive**, the **aerospace** industry has been highly impacted by the COVID-19 pandemic. Strategies to support national industries have been announced in countries including **France** and **Germany**, with a particular emphasis on improving the sustainability of the sector.[2/]

[1/] Office for National Statistics (other transport equipment).
[2/] Policy Links (2020). *How manufacturing can emerge stronger*.

Chart 3.11. Aerospace – trade balance

Trade balance (exports minus imports) in aircraft, spacecraft and parts thereof by the UK and selected countries 2009–2018



Global ranking by trade balance in aerospace products

2009		2018	
Rank	Country	Rank	Country
1	France	1	USA
2	Germany	2	France
3	Canada	3	Germany
4	Italy	4	UK
5	Brazil	5	Brazil
6	Israel	6	Italy
7	Spain	7	Canada
8	Thailand	8	Spain
9	Australia	9	Austria
10	Kuwait	10	Israel
11	Czechia	11	Mexico
12	Switzerland	12	India
13	Mexico	13	Belgium
14	Ukraine	14	Tunisia
15	Belgium	15	Oman
16	Qatar	16	Cyprus
17	Senegal	17	Myanmar
18	Iceland	18	Romania
19	Côte d'Ivoire	19	Seychelles
20	Bosnia Herz.	20	Ecuador
23	UK	21	Senegal
196	USA	22	Togo

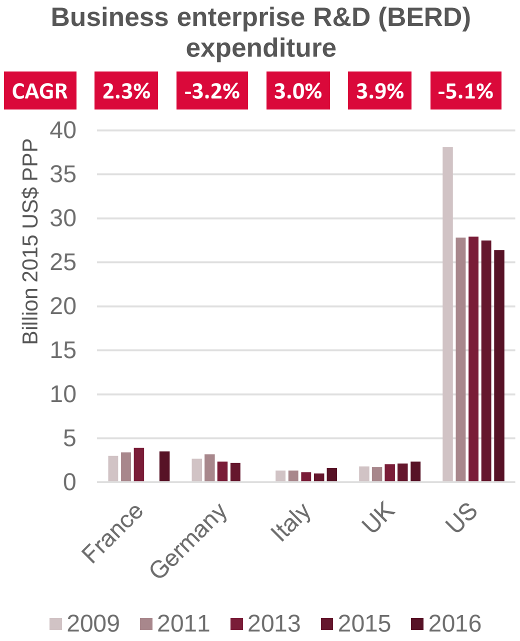
- The UK has become increasingly competitive in aerospace products trade from the perspective of trade balance. Its position improved from being the **twenty-third largest net exporter in 2009 to the fourth largest in 2018, with the surplus widening by 100.9% per year from ~$15M to ~$8B**.
- The UK achieved growth rates of 111% in exports of aerospace products and 122% in imports, respectively, the highest among comparator countries.
- France, Germany, Brazil, Italy, Canada, Spain and Israel were among the top 10 countries by net exports in aerospace products for both 2009 and 2018, despite the change in their respective ranking.
- **The US was the largest net exporter, with a surplus of ~$108B in 2018**, in sharp contrast to its ranking at 196th with a deficit of ~10B in 2009. This was achieved on the back of strong growth in exports (2009–18 CAGR 37%)[1], with modest growth in imports (6%).

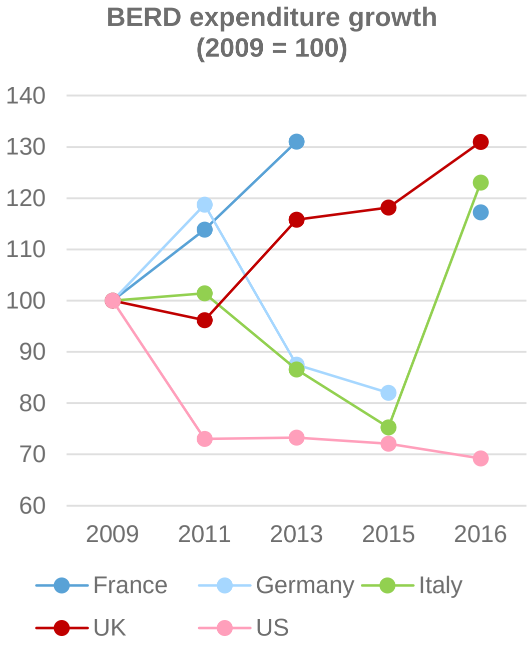
[1] This was particularly strong in the exports of commercial aerospace products to China, which accounted for 12% of total industry exports in 2017 (*SpaceNews*, 11 July 2018).

Note: Trade balance is based on gross exports and gross imports of goods at HS 1992 2-Digit level. Global ranking excludes Afghanistan, The Cayman Islands, Chad, the Cook Islands, FS Micronesia, Guinea-Bissau, Haiti, Iraq, Wallis and Futuna Islands, Mauritania, Libya, State of Palestinian and Tuvalu.
Source: UN Comtrade.

Chart 3.12. Aerospace – business spending on R&D

Business enterprise R&D (BERD) expenditure in air and spacecraft and related machinery, selected countries





- In 2018 the **aerospace** industry accounted for 6.8% of **overall business R&D in the UK**.
- It is the fourth largest contributor to business R&D after **pharmaceuticals**, **automotive** and **computer programming and information service activities**.
- UK aerospace R&D grew by 3.9% (CAGR) between 2009 and 2016, outpacing growth rates in **Italy** and **France**.
- Business spending on R&D underpins most of the technological advances in the UK aerospace industry.

Note: Compound annual growth rates for countries are based on data for the first and last available years within the 2009–2016 range.
Source: OECD Research and Development Statistics; Make UK Sector Bulletin: Aerospace.

Chart 3.13. Machinery and equipment – value added and employment (a)

Value added, employment and labour productivity in machinery and equipment, selected countries

Rank	Country	Value added		Employment		Value added per employee	
		Billions US$, 2018	CAGR (2005–2018)	Thousand persons, 2018	CAGR (2005–2018)	Thousand US$, 2018	CAGR (2005–2018)
1	China	441.6	7.5%	7,035.0	1.9%	62.8	5.6%
2	United States	184.3	0.8%	1,031.9	-1.3%	178.6	2.0%
3	Germany	144.1	5.1%	1,373.2	2.2%	104.9	2.9%
4	Japan	110.6	0.9%	945.1	0.0%	117.1	0.8%
5	Italy	66.4	5.2%	578.2	1.1%	114.8	4.0%
6	Korea	55.5	3.7%	353.0	0.9%	157.3	2.8%
7	France	36.1	5.1%	371.6	1.5%	97.1	3.6%
8	United Kingdom	31.8	4.9%	305.2	0.7%	104.3	4.3%

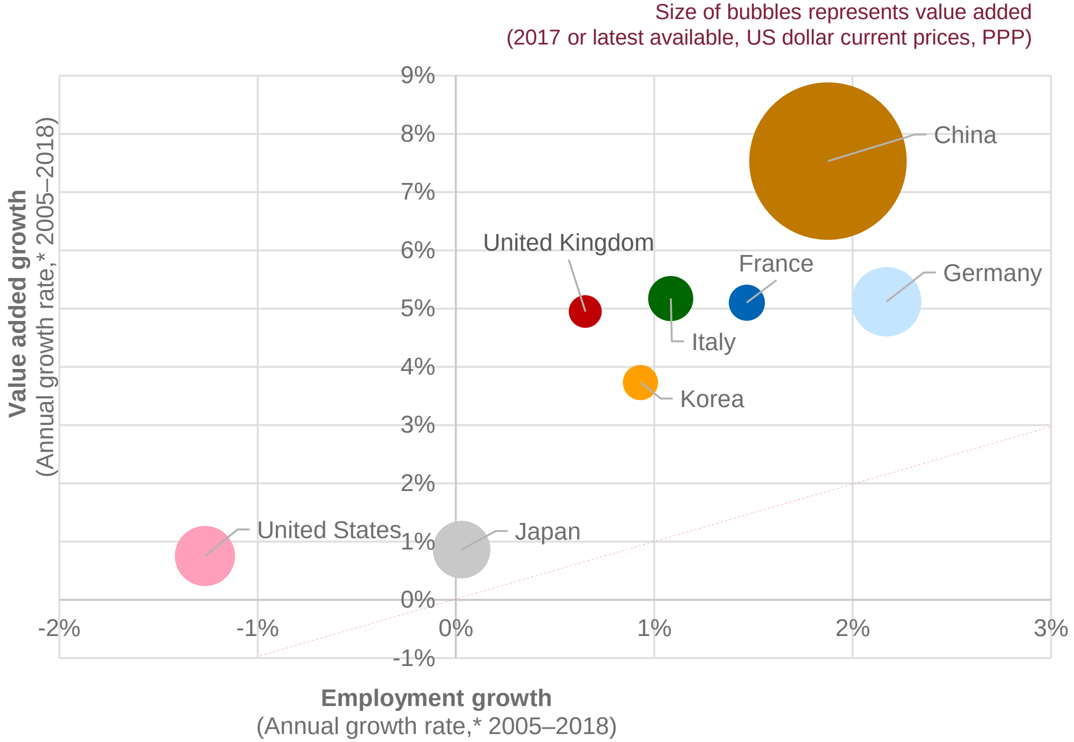
- The **UK** ranks eighth in the world in the production of machinery and equipment in value added terms.
- **China** has become a world leader in the production of machinery and equipment, showing the largest increase in **value added** from 2005 to 2018.
- **Germany** showed the largest growth in **employment** in the same period.
- **China**, **the UK** and **Italy** have observed the largest increases in value added per employee.
- The productivity of the UK machinery and equipment industry grew by 4.3% – the second highest after China – on a CAGR basis. With value added per employee of ~$104 in 2018, the UK was less productive than the US, Korea, Japan, Germany and Italy.

Note: Purchasing power parity (PPP) values computed using OECD PPP indices. CAGR: Compound annual growth rate.
Source: UNIDO, INDSTAT 2 2020, ISIC Revision 3.

Note: Manufacture of machinery and equipment includes: manufacture of machinery, pumps, compressors, lifting and handling equipment, machine tools and domestic appliances, among others.

Chart 3.14. Machinery and equipment – industrial performance (b)

Growth in value added and employment in machinery and equipment, selected countries



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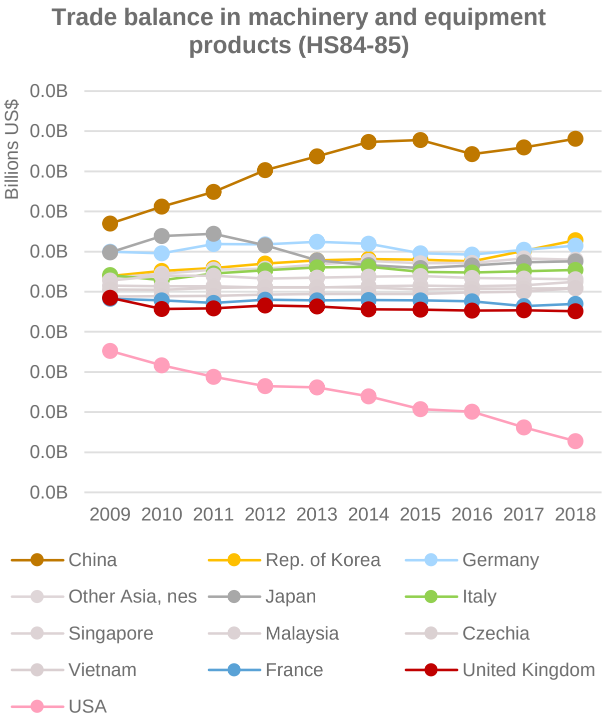
Note: Purchasing power parity (PPP) values computed using OECD PPP indices. *Compound annual growth rate.
Source: UNIDO, INDSTAT 2 2020, ISIC Revision 3.

- The **machinery and equipment** industry contributes to 8.3% of the manufacturing gross value added in the UK.[1/]
- **The value added and employment** of **the UK** machinery and equipment industry has grown at rates similar to those observed in top performing countries.
- The strong linkages between this industry and the automotive and aerospace industries have meant that production has also contracted amid the **COVID-19** outbreak.[2/] **Sustainability** is also a strong trend in the machinery and equipment industry.[3/]

[1/] Office for National Statistics.
[2/] The Manufacturing Technologies Association, MTA (2020). *Forecast for Manufacturing Technology.*
[3/] MTA (2020). *Decarbonisation: Future Growth for Manufacturing*.
Note: Manufacture of machinery and equipment includes: manufacture of machinery, pumps, compressors, lifting and handling equipment, machine tools and domestic appliances, among others.

Chart 3.15. Machinery and equipment – trade balance

Trade balance (exports minus imports) in, for example, nuclear reactors, boilers and machinery, and electrical and electronic equipment by the UK and selected countries 2009–2018



Global ranking by trade balance in machinery and equipment products

2009		2018	
Rank	Country	Rank	Country
1	China	1	China
2	Germany	2	Rep. of Korea
3	Japan	3	Germany
4	Italy	4	Oth. Asia, nes
5	Rep. of Korea	5	Japan
6	Oth. Asia, nes	6	Italy
7	Singapore	7	Singapore
8	Malaysia	8	Malaysia
9	Netherlands	9	Czechia
10	Hungary	10	Vietnam
11	Sweden	11	Hungary
12	Austria	12	Austria
13	Ireland	13	Thailand
14	Finland	14	Switzerland
15	Czechia	15	Denmark
16	Philippines	16	Ireland
17	Thailand	17	Philippines
18	Switzerland	18	Slovenia
19	Slovakia	19	N.Macedonia
20	Denmark	20	Algeria
186	France	189	France
187	UK	191	UK
196	USA	196	USA

- The UK has not been competitive (and increasingly so) in machinery and equipment products trade. It is consistently in the bottom quartile of countries according to trade balance, with the deficit widening by 14.1% per year from ~$15B in 2009 to ~49B in 2018.
- The terms of trade have also deteriorated, from $0.82 in exports for every $1 in imports in 2009 to $0.67 in exports for every $1 in imports in 2018.
- **China, Korea, Germany, Taiwan, Japan, Italy, Singapore and Malaysia** were among the top 10 countries according to net exports of machine and equipment products for both 2009 and 2018.
- They were joined by the Czech Republic and Vietnam in 2018, while the Netherlands and Hungary fell out of the top 10.

Note: Trade balance is based on gross exports and gross imports of goods at HS 1992 2-Digit level. Global ranking excludes Afghanistan, the Cayman Islands, Chad, the Cook Islands, FS Micronesia, Guinea-Bissau, Haiti, Iraq, Wallis and Futuna Islands, Mauritania, Libya, State of Palestinian and Tuvalu.
Source: UN Comtrade.

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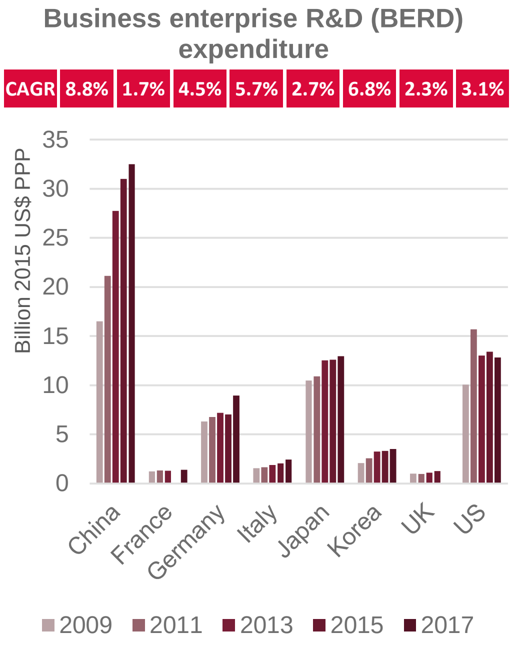
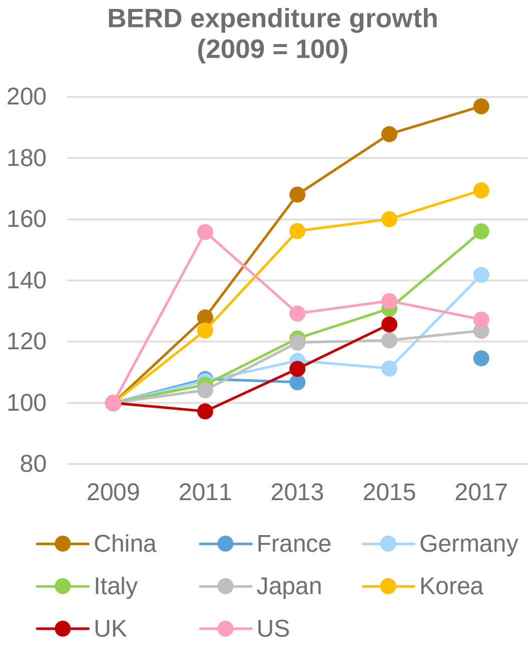
Chart 3.16. Machinery and equipment – business spending on R&D

Business enterprise R&D (BERD) expenditure in machinery and equipment n.e.c., selected countries





Note: Compound annual growth rates for countries are based on data for the first and last available years within the 2009–2017 range.
Source: OECD Research and Development Statistics; Make UK Sector Bulletin: Mechanical Equipment.

- In 2018 the **machinery industry** accounted for 4.1% of overall business R&D in the UK.
- UK machinery R&D grew by 2.3% (CAGR) between 2009 and 2017, trailing all countries except **France**.
- The **machinery industry** tends to be bigger than the manufacturing average, in terms of both turnover and employment.
- With size comes opportunities for **scale, greater diversification and (at least the perception of) stability** – all of which have supported the machinery industry through its cyclical fluctuations.
- 43% of the demand for products made by the machinery industry came from overseas consumers and their investments – making the industry one of the most **export-intensive** in UK manufacturing.
- In 2014, 7.4% of mechanical equipment firms in the UK were foreign-owned – higher than the UK total manufacturing average, at just 3%.
- **Foreign-owned firms** were 37% more productive than domestic firms, and they helped to contribute to the industry's considerable R&D expenditure.

Theme 4: Science and Engineering Workforce

UK INNOVATION REPORT

Policy questions addressed in Theme 4

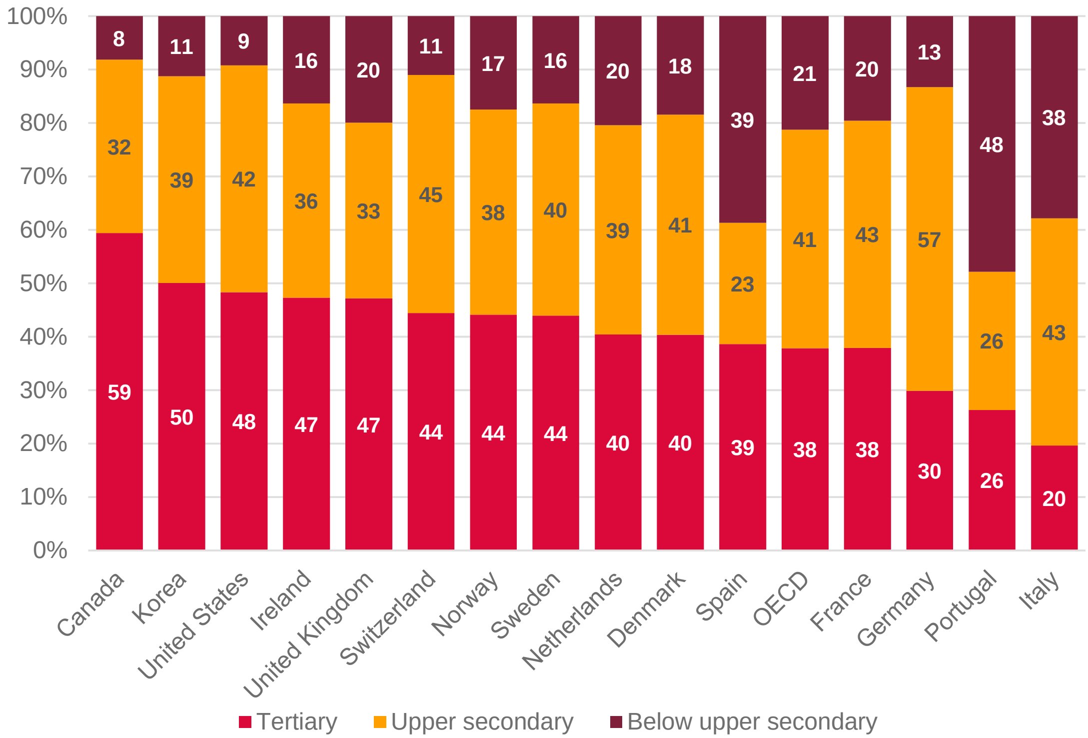
- Is the UK producing enough scientists and engineers?
- Is the UK government investing enough in technical and vocational education?
- How does this compare with other countries?

What the data tells us

- **The UK presents a level of tertiary education attainment well above the OECD average**, but it is still below countries such as Canada and Korea (Chart 4.1).
- **Undergraduate enrolment in STEM disciplines has increased steadily in the UK in recent years** (Chart 4.2). In 2018 graduates in STEM disciplines accounted for 44.2% of total graduates in the UK, above comparator countries such as **France** (37%), **the United States** (36.8%) and **Canada** (35%) (Chart 4.3).
- **The number of R&D personnel (i.e. researchers, technicians and other supporting staff) in the UK remains below that of comparator countries** such as Korea, France and Germany (Chart 4.4). **In the UK most of the researchers are employed in the government and higher education sector**, as opposed to some comparator countries, where researchers are mainly employed in business enterprises (Chart 4.5).
- **Women are underrepresented within the "researchers" segment of R&D personnel,** although the share of women researchers in the UK is above the world average, and it is well above comparator countries such as Japan, Korea, Germany and France (Chart 4.6).
- **The UK education system is marked by a "missing middle" of higher technical education** (i.e. enrolment in post-secondary education courses, below the standard three-year Bachelor's degree) that is usually designed to provide students with technical skills to enter the job market (Chart 4.7).
- **The UK has few science and engineering technicians,** compared to countries of a comparable size, such as France and Italy (Chart 4.8). **Science and engineering technicians are employed in every sector of the economy**, dealing with, for example, operating technical equipment, power plants, aircrafts and ships, among other tasks (Chart 4.9).

Chart 4.1. Educational attainment

%, population 25–64 years old, selected countries, 2019



- **The UK presents a level of tertiary education attainment (47%) that is well above the OECD average (38%)** and countries such as Italy (20%), Germany (30%) and France (38%).
- Although showing a similar value to the United States (48%), the UK is still below the level of the tertiary educational attainments of Canada (59%) and Korea (48%).

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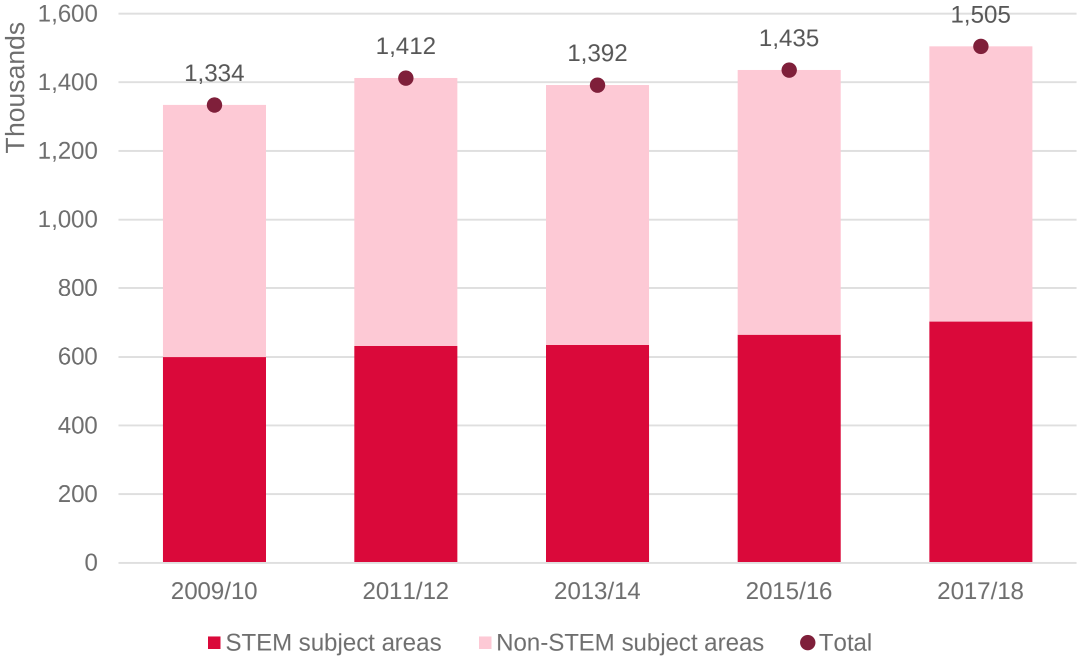
Source: OECD (2021), Adult education level (indicator)

Chart 4.2. UK STEM graduates

Full-time student enrolments on undergraduate courses, various years



Note: STEM disciplines include: Medicine and Dentistry; subjects allied to Medicine; Biological Sciences; Veterinary Science; Agriculture and related subjects; Physical Sciences; Mathematical Sciences; Computer Science; Engineering and Technology; Architecture, Building and Planning.

Source: Gatsby Charitable Foundation (2020). Key Indicators in STEM education.

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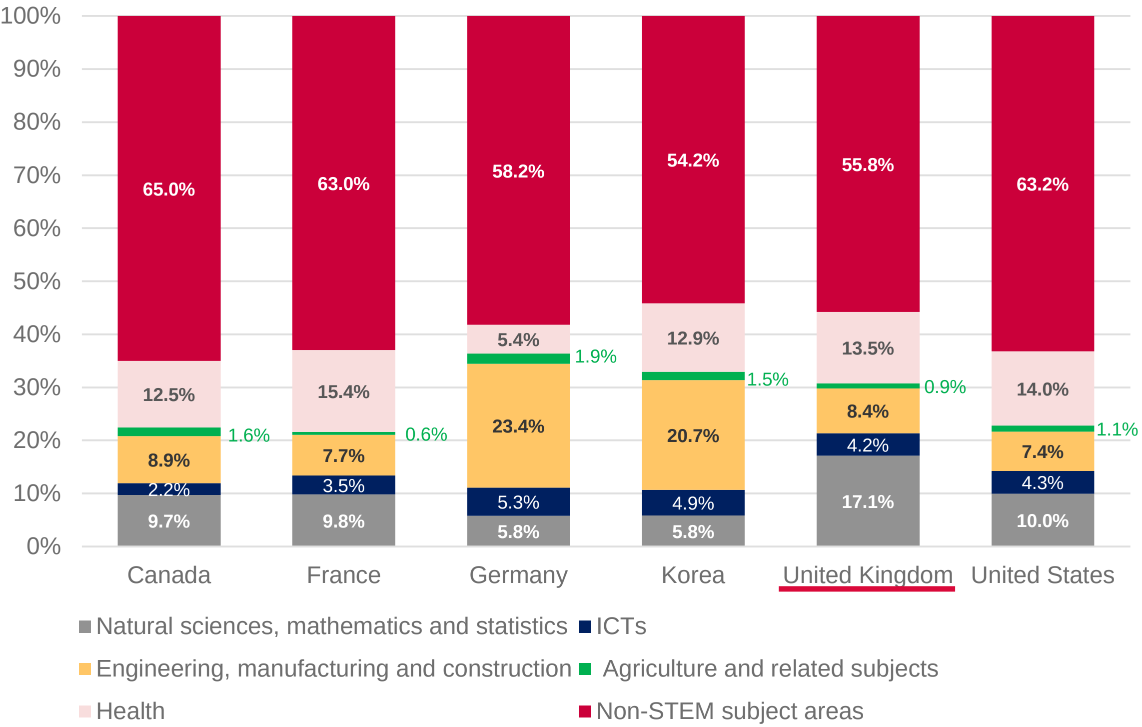
- Although innovation encompasses several disciplines, graduates in STEM disciplines (**Science, Technology, Engineering and Mathematics**) are of particular importance to innovation activities.
- Tackling the **shortage of STEM skills** is one of the objectives of the *UK Government Industrial Strategy.*
- Between 2009/10 and 2017/18 **the total number of students enrolled in STEM undergraduate courses in the UK increased by 17.6%,** more than the increase in non-STEM subject areas (9%).
- In 2017/18 **students who had enrolled in STEM undergraduate courses accounted for 46.7% of total students**, representing an increase from 44.9% in the 2009/10 academic year.
- In 2019 **STEM graduates represented only 18% of the total UK workforce**, with a prevalence of engineering and technology disciplines.[a]

Source: [a] British Science Association (2020). The State of the Sector: Diversity and Representation in STEM Industries in the UK.

Chart 4.3. Graduates by subject areas

Bachelor degrees or equivalent, selected countries, 2018



Note: Non-STEM subject areas include: Arts and humanities; Social sciences, journalism and information; Business, administration and law; Education; Generic programmes and qualification; field unknown
Source: OECD (2020). Education at a Glance database.

- In 2018, 418,704 students obtained a Bachelor degree from UK's Higher Education Institutions.
- **Graduates in STEM disciplines accounted for 44.2% of total graduates in the UK in 2018**. This value is above comparator countries such as France (37%), the United States (36.8%), and Canada (35%).
- **The share of graduates in Engineering, Manufacturing and Construction remains relatively low in the UK, at 8.4%,** especially when compared to countries such as Germany (23.4%), and Korea (20.7%).

Chart 4.4. R&D personnel

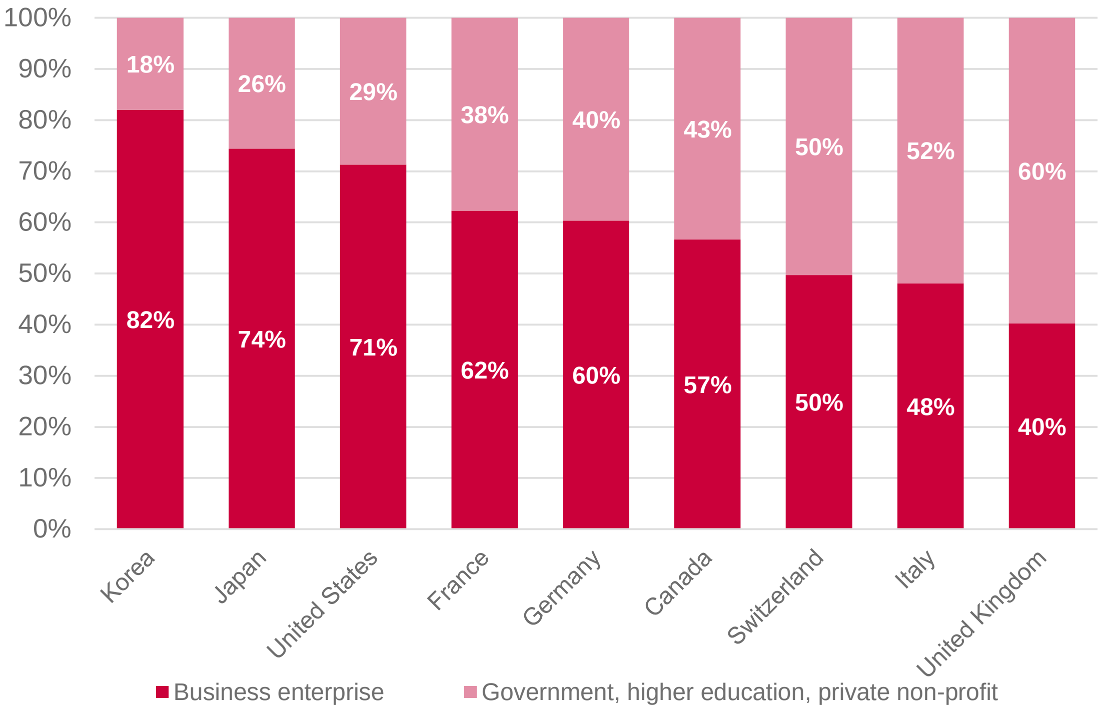
Per thousand employment, selected countries, 2018

Note: For the USA, Switzerland and the OECD, the last data that is available for researchers is from 2017; other R&D personnel data for the USA and OECD is not available.
Source: OECD (2020). Main Science and Technology Indicators database.

- The OECD classifies R&D personnel as **researchers, technicians** and **other supporting staff**.
- In **the UK** the number of R&D personnel per 1,000 employment (14.3) remains below that of **Korea** (18.8), **Switzerland** (16.3), **France** (16.1) and **Germany** (15.8).
- While having a number of researchers per 1,000 employed (9.4) that is above the OECD average (8.6) and **the United States** (9.2), **the UK** still has comparatively fewer researchers employed than countries such as **Korea** (15.3), **France** (10.9), **Japan** (9.9) and **Germany** (9.7).

Chart 4.5. Researchers by sector of employment

% of total researchers, FTE, selected countries, 2018



Note: For the USA, Switzerland and Canada data, refer to 2017.
Source: OECD (2020). R&D personnel by sector and function database.

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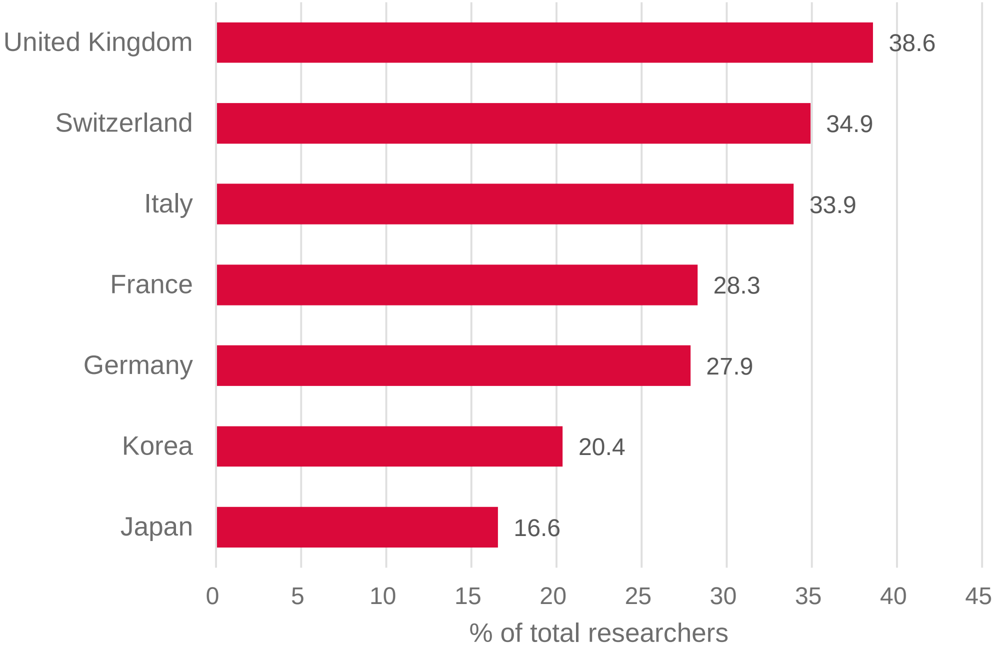
- The OECD *Frascati Manual* defines **researchers** as "***professionals engaged in the conception or creation of new knowledge****. They conduct research and improve or develop concepts, theories, models, techniques instrumentation, software or operational methods."*
- In **the UK** most of the researchers (60%) are employed in the **government and higher education sector**. This may be related to the low attractiveness of the business sector for UK-based researchers and/or the lack of R&D job opportunities in business enterprises.
- Conversely, more than 70% of researchers in countries such as **Korea**, **Japan** and **the United States** are employed in business enterprises.

Chart 4.6. Women researchers

% of total researchers, headcount, selected countries, 2018



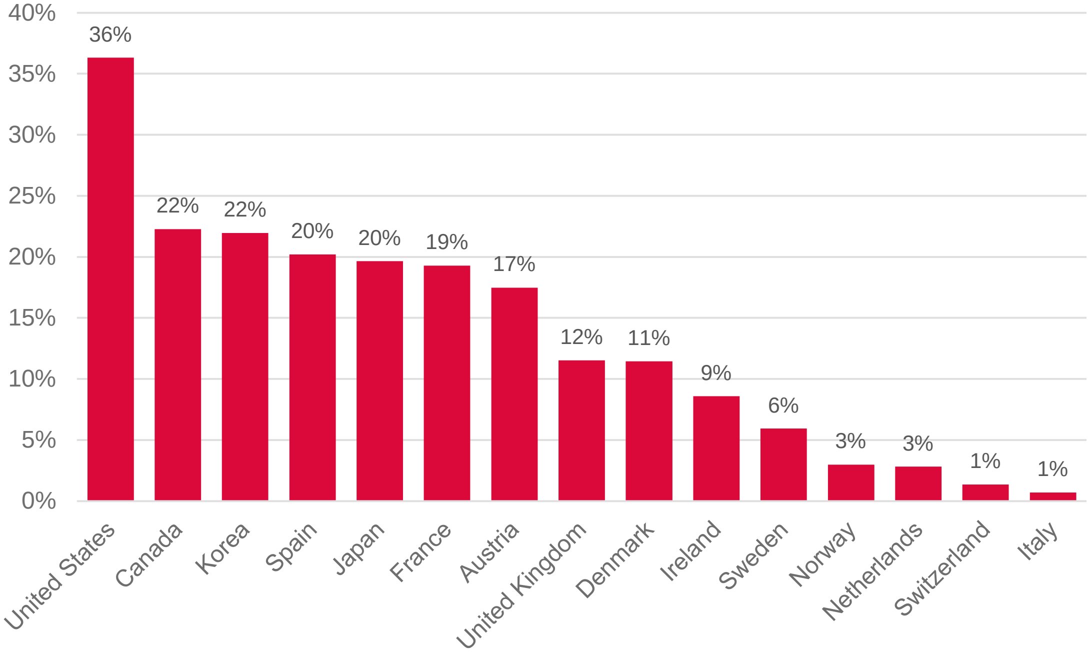
Note: For the Switzerland, Germany and France data, refer to 2017. USA data is not available.
Source: OECD (2020). Main Science and Technology Indicators database.

- As indicated by UNESCO,[a] **only around 30% of the world's researchers are women**, despite the fact that in recent decades the number of women enrolling in tertiary education has increased.
- There are, however, differences among regions. The regional averages for the share of female researchers are as follows:
    - 48.2% for Central Asia
    - 45.1% for Latin America and the Caribbean
    - 41.5% for the Arab States
    - 39.3% for Central and Eastern Europe
    - 32.7% for North America and Western Europe
    - 31.8% for Sub-Saharan Africa
    - **29.3% for the world**
    - 23.9% for East Asia and the Pacific
    - 18.5% for South and West Asia
- In **the UK** the share of women researchers is above the world average, as well as the North America and Western Europe average, and it is well above comparator countries such as **Japan**, **Korea**, **Germany** and **France**.

Source: [a]UNESCO (2019). Institute for Statistics (UIS) Fact Sheet no 55.

Chart 4.7. Higher technical education

Enrolment in short-cycle tertiary education, % of total tertiary education, 2018



Note: Tertiary education includes: short-cycle tertiary education; Bachelor degrees; Master degrees; PhD degrees.
Source: OECD (2020). Education at a Glance database.

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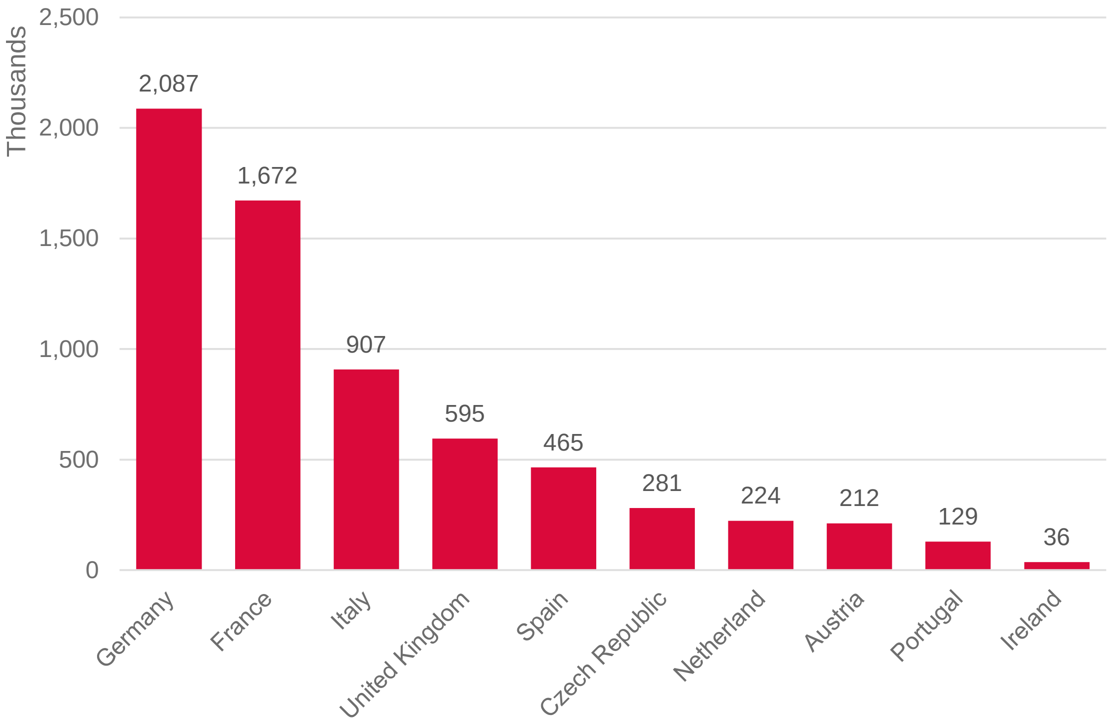
- Recent analyses argue that the **UK education system is marked by a "missing middle" of higher technical education (HTE)**: enrolment in post-secondary education; and short-cycle tertiary education.[a]
- For example, in 2018 students who were enrolled in short-cycle tertiary education in the UK made up 12% of the total tertiary education, compared to 36% for the USA and 22% for Canada and Korea.
- **HTE corresponds to Level 4 and Level 5 of the UNESCO International Standard Classification of Education (2011):** post-secondary, non-tertiary education (Level 4) is post-secondary education, not sufficiently complex to be tertiary education, which prepares students to enter the job market (or pursue tertiary education); short-cycle tertiary education (Level 5) courses are often practically based, preparing students to enter the labour market.*
- The lack of HTE skills may have implications for the competitiveness of the economy, as the job market requires a variety of skills that are not always provided by standard three-year Bachelor degrees.
- **The evidence suggests that the lack of HTE enrolment in the UK is due to the bias of public funding towards higher tertiary education** (i.e. Bachelor degree and above).[b]

Note: * In the *Frameworks for Higher Education Qualifications of UK Degree-Awarding Bodies*, HTE corresponds to Level 4 and Level 5, both corresponding to UNESCO ISCED Level 5.
Source: [a] Field S. (2018). The Missing Middle: Higher Technical Education in England. *Gatsby Charitable Foundation;* [b] Mason G. (2019). Higher Education, Initial Vocational Education, and Training and Continuing Education and Training: Where Should the Balance Lie? *LLAKES Research Paper 66.*

Chart 4.8. Science and engineering technicians

Selected countries, 2019



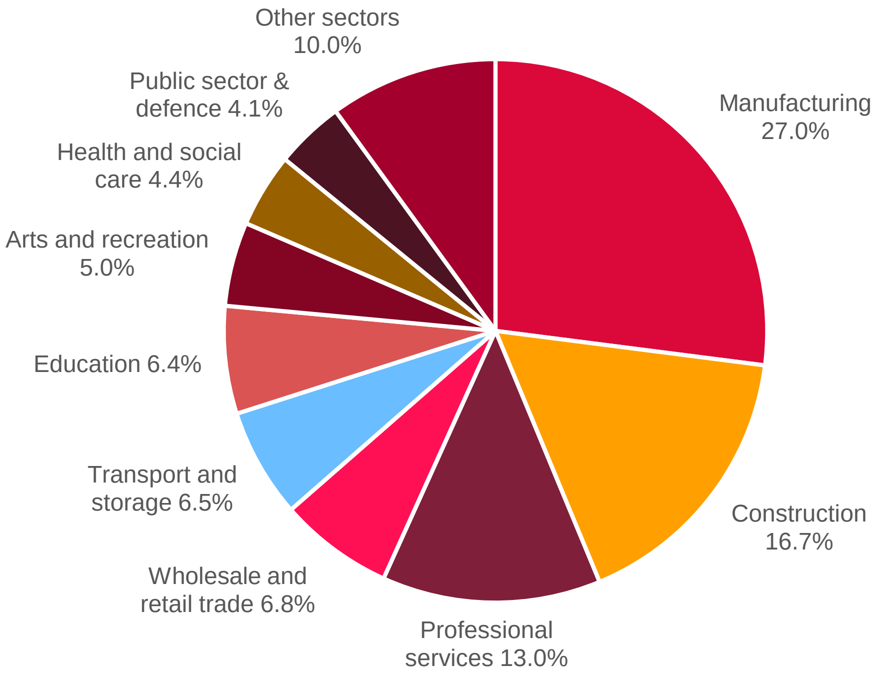
Source: Skills Panorama (2021). Science and engineering technicians.

- **Science and engineering technicians** are physical and engineering science technicians, mining, manufacturing and construction supervisors, process control technicians, life-science technicians or ship and aircraft controllers and technicians, among other sectors.
- **The UK has few science and engineering technicians** compared to countries of a comparable size, such as France and Italy.
- Analyses conducted by the UK National Audit Office also suggest that "*there is an acute shortage of technician-level STEM skills*" in the United Kingdom.

Source: [a] National Audit Office (2018). Delivering STEM (science, technology, engineering and mathematics) skills for the economy.

Chart 4.9. UK Science and engineering technicians

By sector of employment, 2019



Note: Other sectors include: energy supply services; ICT services; other business services; other primary sector and utilities; water and waste treatment.
Source: Skills Panorama (2021). Science and engineering technicians.

- In the UK **science and engineering technicians are mainly employed in manufacturing (27%), construction (16.7%) and professional services (13%),** where they are involved with operations, operating technical equipment, power plants, aircrafts and ships.
- The UK Government Industrial Strategy recognises that **in the past technical education was given insufficient attention;** its aim is to reform the system to improve the technical education outcome.
- In this respect, from September 2020 **T Level qualifications were introduced in England as a 2-year post-16 course** qualification that "*bring[s] classroom learning and an extended industry placement together on a course designed with businesses and employers*".

Source: [a] HM Government (2020). About T Levels.

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Appendix 1

Sectors and statistical codes

ISIC Rev 4*

	Section	Division	Description
Low/medium-tech manufacturing	C	10–12	Food products, beverages and tobacco
	C	13–15	Textiles, wearing apparel, leather and related products
	C	16–18	Wood and paper products, and printing
	C	22–23	Rubber and plastics products, and other non-metallic mineral products
	C	24–25	Basic metals and fabricated metal products, except machinery and equipment
	C	31–33	Furniture; other manufacturing; repair and installation of machinery and equipment
Medium/high-tech manufacturing	C	19	Coke and refined petroleum products
	C	20	Chemicals and chemical products
	C	21	Basic pharmaceutical products and pharmaceutical preparations
	C	26	Computer, electronic and optical products
	C	27	Electrical equipment
	C	28	Machinery and equipment n.e.c.
	C	29	Motor vehicles, trailers and semi-trailers
	C	30	Other transport equipment
Other production	A	01–03	Agriculture, hunting, forestry and fishing
	B	05–09	Mining and quarrying
	D	35	Electricity, gas, steam and air conditioning supply
	E	36–39	Water supply; sewerage, waste management and remediation activities
	F	41–43	Construction

	Section	Division	Description
Knowledge services	J	58–63	Information and communication
	K	64–66	Financial and insurance activities
	M	69–82	Professional, scientific and technical activities
	P	85	Education
Other services	G	45–47	Wholesale and retail trade, repair of motor vehicles and motorcycles
	H	49–53	Transportation and storage
	I	55–56	Accommodation and food service activities
	L	68	Real-estate activities
	N	77–82	Administrative and support service activities
	O	84	Public administration and defence; compulsory social security
	Q	86–88	Human health and social-work activities
	R	90–93	Arts, entertainment and recreation
	S	94–96	Other service activities
	T	97–98	Activities of households as employers; undifferentiated activities of households for own use

As per International Standard Industrial Classification of All Economic Activities, Revision 4.

Technical notes

1. The data used in the report has been gathered from dynamic databases, which are regularly updated throughout the year. In some cases, the most recent values may be provisional, while earlier data may have been revised as a result of initiatives to expand data completeness and coverage.
2. Data sources aggregate information from a large number of disparate primary sources, and, as such, missing values and discrepancies in the data are to be expected. Data sources might also use different industry classifications and sector groupings.
3. Key data sources include: Office for National Statistics (UK); UNIDO's Industrial Statistics Database (INDSTAT); OECD Science, Technology and Industry Scoreboard; United Nations Commodity Trade Statistics Database (UN Comtrade); UIS Statistics (UNESCO); IP Statistics Data Center (WIPO); National Science Foundation Science and Engineering Indicators; and World Bank Education Statistics.
4. For most indicators, the latest available year is 2018. As such, the effects of the COVID-19 pandemic are not reflected in most of the charts in the report.
5. A flexible approach has been adopted to the selection of countries for international comparison, accounting for factors such as industrial specialisation and data availability. Country rankings can be influenced by the units chosen for comparison and the data source.

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Cambridge Industrial Innovation Policy (CIIP) brings together the Centre for Science, Technology & Innovation Policy at the Institute for Manufacturing, the Policy Links Unit from IfM ECS and the Babbage Policy Forum. Our work is based around what we call industrial innovation policy, a policy domain that focuses on the interplay between technology, innovation and industrial competitiveness.

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