University of Strathclyde Glasgow

Fraser of Allander Institute

The economic contribution of the Pharmaceuticals Sector in Scotland

February 2023

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The Fraser of Allander Institute

Disclaimer

The analysis in this report has been conducted by the Fraser of Allander Institute (FAI) at the University of Strathclyde. The FAI is a leading academic research centre focused on the Scottish economy.

The report was commissioned in September 2022 by The Association of the British Pharmaceutical Industry (ABPI) Scotland.

The analysis and writing-up of the results was undertaken independently by the FAI. The FAI is committed to providing the highest quality analytical advice and analysis. We are therefore happy to respond to requests for technical advice and analysis. Any technical errors or omissions are those of the FAI.

Executive Summary

The pharmaceuticals sector is a significant contributor to the Scottish economy and a key player in Scotland's life sciences sector.

In this report[1], we use our detailed model of the Scottish economy to quantify the economic impact and wider spill-over effects of Scotland's **Manufacturing of Pharmaceuticals sector**.

This report also includes analysis that considers a broader group of pharmaceutical contributors, which is most representative of ABPI members, that we call the '**Wider Pharmaceuticals sector**'.

Additionally, this report models the impact of the **Life Sciences sector** – a Scottish Government 'Growth Sector'.

This report goes beyond economic impact assessment, highlighting these sectors' wider impact on the Scottish economy.

To do so, this report evaluates the pharmaceuticals and life sciences sectors' contribution to the Scottish Government's National Strategy for Economic Transformation (NSET), setting out the evidence base of these sectors' economic and wider impact on the Scottish economy.

This report finds that, across the entire Scottish economy:

- The **Manufacturing of Pharmaceuticals** contributes just under £1.5bn in Gross Value Added (GVA)[2] to Scotland, supporting a total of 11,350 Full-time Equivalent (FTE)[3] Scottish jobs.
- The **Wider Pharmaceuticals** industry supports over £1.7bn in GVA and under 15,000 FTE jobs.
- The **Life Sciences** industry supports just under £3.4 billion in GVA and over 38,000 FTE jobs.

Additionally, this report sets out how these sectors contribute to the following five Scottish Government programmes of action:

1. Entrepreneurial people and culture

- Between 2017 and 2020, business survival rates in the life sciences sector stood at 67%, indicating that over two-thirds of life sciences enterprises that started in 2017 were still running by 2020. This rate exceeds all growth sectors and the overall survival rate across the Scottish economy.
- Pharmaceuticals have experienced significant growth in Scotland in recent years. Between 2019 and 2021, the total turnover of the pharmaceutical manufacturing sector rose from £690m to £1.65bn - down from the 2020 peak of more than £2bn. It is important that businesses are properly supported so that the increased jobs and growth they support continues post-pandemic.
- Scotland, particularly Edinburgh, performs well when it comes to life sciences innovations from Higher Education Institutions. However, scale-up is a barrier to success and Scotland loses spin-outs and talent to England.

1 It is important to note that this report is a follow-up to our 2017, 2018, and 2021 reports, and whilst comparisons of results can be made with regards to the impact figures for manufacturing of pharmaceuticals (comparisons allowed across all reports) and wider pharmaceuticals (comparisons allowed for 2018, 2021, and 2023 reports) outlined in Section 6, readers should not compare the publicly available data used in this report with that used in previous reports as this data is often revised and updated which previous reports will not reflect.

2 See Appendix 1 for definition.

3 See Appendix 1 for definition.

2. New market opportunities

- Although international exports increased by 9% in 2019, pharmaceutical manufacturing exports have contracted since 2018, down from £570m. This is due to a fall in exports to the rest of the UK (rUK) - down from £155m in 2018 to £50m in 2019. Given the recent performance of indicators such as turnover, we will likely see exports rise in 2020's data.
- Despite this, the manufacturing of pharmaceuticals sector's international export to GVA ratio of 42% is well above Scotland's overall - across all industries - target of a 25% ratio.
- Clinical trials play a key role in pharmaceutical export growth potential however, across the UK, patient access to industry research has fallen 44% since 2017/18, median wait time for regulatory approvals in trials rose by 25 days to 247 days in 2018 - 2020, and the number of clinical trials in the UK per year contracted by 41% between 2017 and 2021.

3. Productive businesses and regions

- The manufacturing of pharmaceuticals industry is Scotland's second largest contributor to business R&D, and these investments have significant long-term impacts on economic growth. This report estimates that the £164m invested in pharmaceutical R&D in Scotland in 2018 is expected to generate over £1.5bn in economic benefits for the Scottish economy over the next three decades.
- Despite this, pharmaceuticals is an extremely productive sector. GVA per head (of those employed) in pharmaceuticals manufacturing was almost £200,700 in 2020, almost double its nominal value in 2015, and significantly above the Scottish industry average of £60,000. Additionally, employment in the wider pharmaceutical sector is well-spread across Scotland, and supports productivity outside Scotland's cities, with the majority of employment in the Highlands and North Ayrshire.

4. Skilled workforce

- Relative to population size, Scotland has the highest number of higher education students enrolled in STEM-related subjects compared to the rest of the UK. However, ensuring there are enough graduates going into the pharmaceuticals industry is a challenge.
- The pharmaceutical manufacturing industry directly employs over 4,000 workers in Scotland, and for every 1 job supported in the manufacturing of pharmaceuticals industry, **1.7 jobs** are supported elsewhere in the economy. This part of the wider pharmaceuticals and life sciences sectors drives the greatest job creation elsewhere in the economy.
- Almost a third of Scotland's inactivity rate is driven by long-term sickness and this is a growing concern for the economy. Through reducing patient wait times and introducing innovative medicines, pharmaceuticals play a vital role in improving long-term health outcomes across the country.

5. A fairer and more equal society

- In 2022, hourly wages across all percentiles of the manufacturing of pharmaceuticals' wage distribution exceeded the real living wage in the UK. However, in Scotland, women earned 22% less than men working in the pharmaceuticals sector; in the UK, the gap was just 6%.
- Whilst the pharmaceutical manufacturing industry is still working to improve gender equality, the industry does support significant social outcomes. For example, North Ayrshire is one of Scotland's most deprived areas, with the second highest child poverty rate in the country, after Glasgow. The wider pharmaceuticals sector employs more people in North Ayrshire than anywhere else in Scotland - providing high-skilled, high-paid jobs to the area.

THE IMPACT OF THE PHARMACEUTICAL SECTOR

£1.7bn GVA & 15,000 FTE jobs

supported in the Scottish economy by the **Wider Pharmaceuticals** sector

The **Manufacturing of Pharmaceuticals** sector supports **£1.5bn in GVA** and **11,350 FTE jobs** across the Scottish economy in 2019

Manufacturing of Pharmaceuticals employment in Scotland is highest in **North Ayrshire** & **The Highlands**, supporting productive jobs outside Scotland's cities

Scotland's **Life Sciences** sector supports **£3.4bn in GVA** and **38,000 FTE jobs**

For every 1 job supported in the **Manufacturing of Pharmaceuticals** sector, **1.7 jobs** are supported elsewhere in the economy

Manufacturing of Pharmaceuticals GVA per job in 2020 was **£200,700**, more than 3 times the Scottish rate

Business survival rates in **Life Sciences** stood at **67%** between 2017 - 2020, exceeding all growth sectors and the Scottish average

£164m spent on **Manufacturing of Pharmaceuticals** R&D in 2018 is estimated to support **£1.5bn** in economic gains for Scotland over the next three decades

Clinical trials play a key role in the pharmaceutical sector's export growth potential however, **median wait times for regulatory approvals** in trials has **risen by 25 days to 247 days** in the UK

Introduction

The pharmaceuticals sector plays an important role in the Scottish economy, supporting economic activity and employment throughout Scotland.

In this report, we use our detailed model of the Scottish economy to quantify the economic impact and wider spill-over effects of Scotland's pharmaceuticals sector.

In National Accounts, the statistical classification of the pharmaceutical industry narrowly defines the sector as the Manufacturing of Pharmaceuticals. However, whilst manufacturing is an important part of the pharmaceutical sector, it is not the only component.

A more comprehensive definition, which we refer to as the 'Wider Pharmaceuticals sector', includes: the manufacturing of pharmaceuticals; pharmaceutical research and development; and other activities including medical sales, medical science liaison, management, etc. This definition is most representative of the Association of the British Pharmaceutical Industry (ABPI) Scotland members given that it is based on data provided by ABPI.

Pharmaceuticals are a crucial component of Scotland's 'Life Sciences sector', identified as a growth sector by the Scottish Government.

This report goes beyond economic impact assessment, highlighting the manufacturing of pharmaceuticals, wider pharmaceuticals, and life sciences wider impact on the Scottish economy. Central to this point, this report makes reference to the Scottish Government's National Strategy for Economic Transformation (NSET), which lays out their six steps of action to develop a well-being economy, i.e., an economy that thrives across economic, social and environmental indicators.

This report focuses on the first five 'transformational' programmes which include:

- Entrepreneurial people and culture
- New market opportunities
- Productive businesses and regions
- Skilled workforce
- A fairer and more equal society

Additionally, throughout this research, we engaged with ABPI Scotland and its members, who provided the institute with a range of industry insights and case studies[4] that demonstrate the contribution of the Scottish pharmaceutical sector to Scotland's economy.

This report is structured as follows:

- Section 1 to Section 5 evaluate the performance of the Scottish pharmaceutical sector - including the manufacturing of pharmaceuticals, wider pharmaceuticals, and life sciences sectors - across each of the five programmes of action highlighted in NSET, starting with the first programme of action, entrepreneurial people and culture, and ending with the fifth pillar of action, a fairer and more equal society.
- Section 6 summarises the results from modelling the Scottish pharmaceutical sector's - including the manufacturing of pharmaceuticals, wider pharmaceuticals, and life sciences sectors - economic contribution to the Scottish economy.
- The final chapter concludes this report.

4 Information and data included in these case studies are provided by ABPI and its members.

Section 1: Entrepreneurial people and culture

Fostering a culture of entrepreneurship and developing an entrepreneurial workforce is one of the central pillars of Scotland's National Strategy for Economic Transformation. This programme of action seeks to make Scotland a world leader in entrepreneurship, unlocking entrepreneurial activity across every sector of the economy.

The manufacturing of pharmaceuticals sector is an important source of entrepreneurial activity, supporting GVA and employment throughout Scotland.

Our modelling results outlined in Section 6 highlight that the manufacturing of pharmaceuticals is estimated to, once spill-over effects are accounted for, contribute £1.5bn in GVA to the Scottish economy, supporting around 11,350 Full-time Equivalent (FTE) jobs.

These impact figures rise to £1.7bn GVA and almost 15,000 FTE jobs once we add the contributions of sectors like pharmaceutical R&D, and other activities including medical sales - It is important to note that this definition gives the most realistic industrial mix of ABPI members.

Over the past decade, enterprise and turnover growth suggest a strong track record of entrepreneurship in the pharmaceutical manufacturing sector.

The number of businesses manufacturing pharmaceuticals has increased by 40% since 2010.

Over the same period, the number of all Scottish private sector firms increased by just 13%.

The turnover of these enterprises has also grown significantly. Between 2019 and 2020, the total turnover of the pharmaceutical manufacturing sector rose from £690 million to more than £2bn – an increase of over 200%.

This sharp increase primarily arose due to the COVID-19 pandemic, where the manufacturing of pharmaceuticals played a vital role in the production of newly developed COVID-19 vaccines.

Turnover fell in 2022 to around £1.65bn, although remains very much above pre-pandemic levels. **See Chart 1**.

Given the unprecedented demand for the pharmaceuticals sector during the height of the pandemic, it is not surprising to see these numbers come down. However, It is important that businesses are properly supported so that the increased jobs and growth they support continues post-pandemic.

It remains to be seen how much of this growth in turnover will stick once the economy, not just in Scotland but globally, moves on from COVID-19.

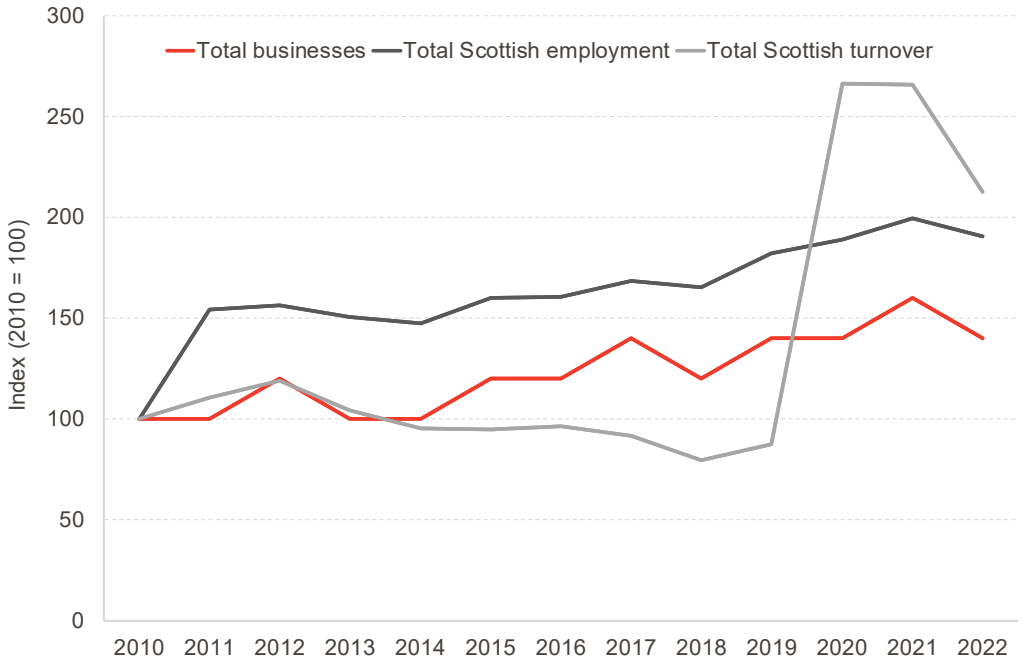
Within the larger life sciences community, of which the pharmaceuticals sector is an important player, entrepreneurship has been especially prominent.

Our modelling suggests that, once spill-over effects are accounted for, the life sciences industry in Scotland supports just under £3.4 billion in Scottish GVA and over 38,000 FTE jobs.

In 2015, the Scottish Government's Economic Strategy identified life sciences as a growth sector.

Growth sectors are defined as parts of the economy where Scottish firms have a distinct comparative advantage, i.e., sectors that Scottish firms can produce goods or services more efficiently than a country they trade with.

Chart 1: Manufacturing of pharmaceuticals industry index, total number of businesses, employment, and turnover, Scotland, 2010-2022



Source: *Scottish Government*

The six Scottish growth sectors include:

- Food and Drink
- Life Sciences
- Creative Industries
- Sustainable Tourism
- Energy
- Financial and Business Services

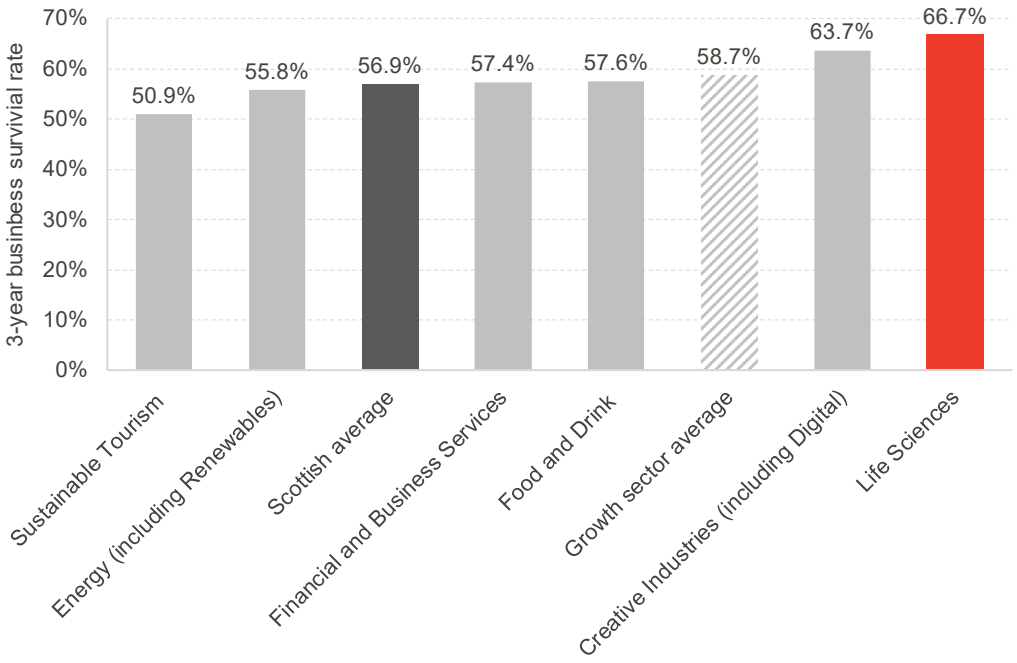
The life sciences growth sector is a significant contributor to the Scottish economy, and employment in this growth sector increased by over 11% in 2020 - the only growth sector to experience growth in employment in 2020.

GVA in life sciences was also up 4% on the year to 2020. Life sciences along with creative industries were the only growth sectors to experience growth in 2020.

Businesses in the life sciences industry also feature above-average business survival rates relative to the Scottish average, highlighting the entrepreneurial capabilities and adaptability of businesses operating within the sector.

Between 2017 and 2020, business survival rates in the life sciences sector stood at 67%, indicating that over two thirds of life sciences enterprises that started in 2017 were still running by 2020. This rate exceeds all growth sectors, and the overall survival rate across the Scottish economy. **See Chart 2.**

Chart 2: 3-Year Business Survival Rates, Growth Sectors and Scottish Average, 2017-2020



Source: *Scottish Government*

Several factors contribute to entrepreneurship in the pharmaceuticals sector and wider life sciences industry, such as Scotland's highly skilled workforce; which we discuss in detail in Section 4.

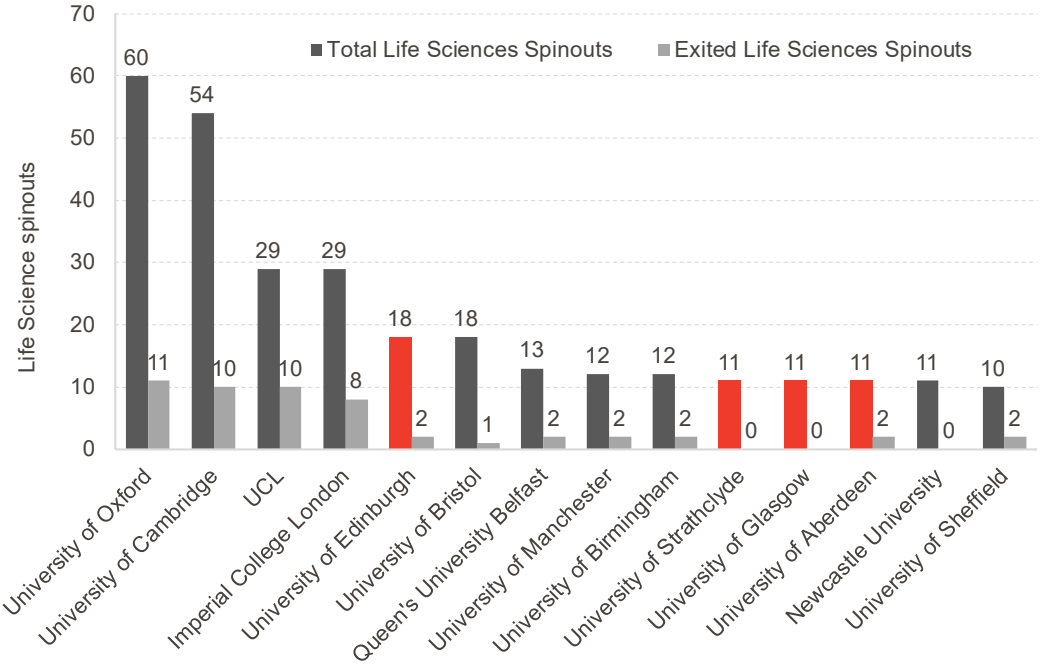
According to the latest Annual Population Survey estimates, in Scotland, half of the working age population had a degree or was enrolled at a higher education institution in 2021 – the highest of any country in the UK.

In the latest rankings, three of Scotland's universities were ranked in the world's top 100 universities. The quality of Scotland's higher education institutions could be a key driver of innovation, and the opportunities to commercialise the innovation of Scottish universities appear widespread, particularly in the life sciences sector. **See Chart 3.**

Additionally, government institutions appear important in the start-up success of Scottish life sciences companies, particularly at the initial funding stages.

The UK Life Sciences Start-Up report finds that Scottish Enterprise, a public body of the Scottish Government, invested in 14 life sciences start-ups between 2016 and 2020 – funding the 3rd highest number of UK life sciences spinouts. Overall, Scottish Enterprise played a role in funding half of the life sciences start-ups in Scotland between 2016 and 2020.

Chart 3: Top Universities for Life Sciences Spinouts, UK, 2011 – 2021



Source: *Beauhurst*

Overall, many leading start-ups - supported by knowledge exchange from world renowned universities and extensive government support - have made Scotland one of the largest life sciences clusters in Europe, made up of over 770 enterprises. However, the Campbell Report highlights that additional support is required across the industry, both to increase its global footprint and to develop a thriving ecosystem that supports enterprises at all levels of development.

Despite this strong performance, Scotland lags behind other parts of the UK in generating life science spinouts, and the Logan Review highlighted that Scotland faces some challenging barriers when it comes to scaling up these innovations in Scotland.

CASE STUDY

Sir Mike Ferguson - Losing opportunities to down south

In recent years, Scotland has lost significant highly-invested, high-growth companies, such as the following University of Dundee spinouts:

- Amphista Therapeutics - company now 100% in Cambridge
- Exscientia – company now mostly in Oxford

Altogether well over 500 jobs are not in Scotland due to losing these 2 companies alone because of the lack of appropriate lab/office space close to the founding university.

Sir Mike Ferguson CBE FRS FRSE FMedSci, Regius Professor of Life Sciences at the University of Dundee.

CASE STUDY

Sir Mike Ferguson - Scottish pharma can prosper if work is joined up and supported

After World War II, legislation to decentralise production towards areas of declining traditional industry helped my home city of Dundee become a hub of high-tech manufacturing. There was a recognition that the jobs of yesterday were not the jobs of tomorrow. We face that same situation now that manufacturing jobs have all but disappeared. We can learn from this as we rebuild from COVID-19 alongside the UK Government's goal of levelling-up the economy.

Companies who flocked to Dundee from the 1940s were attracted by the skills honed by generations of jute workers even as that industry contracted. Once more, we have a bank of expertise to build the future on, this time because the University of Dundee is one of the country's premier centres of biomedical research. Let's level-up by letting innovation thrive where it is borne.

Higher-education institutes (HEIs) have a duty to deliver returns for the taxpayer. One of the best ways to do this is by turning discoveries into companies. Regions that have intellectual capital can attract investment to do this, so long as they can convert innovation into investable assets.

With 9% of the UK population, Scotland wins 14% of UK life and medical sciences research grants – amounting to some £500 million each year – but receives only about 6% of its commercialisation investment. Partly, this is because investors tend to fish within the 'Golden Triangle' of Oxford, Cambridge and London. We could level the field with more coordination.

I propose a pan-Scottish public-private fund that backs the best life sciences innovation ideas, hardening them into investable assets. If 1% of the Scottish HEI biomedical research budget went to such a fund it would allow the world-leading research being carried out in Scotland to realise its potential, creating jobs and prosperity in this country and healthcare benefits for people across the world.

Once investment is secured, anchoring new companies in the regions that created them is another challenge. Dundee has biomedical research excellence and scale by every metric, yet anchoring well-invested spin-out companies has been a struggle. Fortunately, much of this will be remedied thanks to the Tay Cities Deal, which recently provided £25million of funding that will enable us to accommodate high-growth spin-out companies rather than see them depart for regions with more advanced infrastructure support.

A final plea is for recognition for our role in attracting globally-mobile business R&D expenditure to Dundee and Scotland, and for assistance from the Government and its agencies to help us win more of it.

Overall, I am optimistic for the future. Scotland can prosper in the knowledge economy, but our success will depend upon working as a joined-up country that recognises the particular strengths of each region and supports its areas of genuinely world-leading excellence.

Sir Mike Ferguson CBE FRS FRSE FMedSci, Regius Professor of Life Sciences at the University of Dundee.

Note: this case study is an adaptation of an article written by Sir Mike Ferguson for The Times.

Section 2: New market opportunities

Exploring new market opportunities is the second phase of action identified in Scotland's National Strategy for Economic Transformation. This seeks to strengthen Scotland's position in new markets and industries, generating new, well-paid jobs from a just transition to net-zero.

Box 1: Scotland's Just Transition

Scotland's just transition is defined as the process of shifting away from fossil fuels towards a greater utilisation of green energy, ensuring the workers and communities affected by this transition are well-supported.

CASE STUDY

GSK Irvine - Renewable Energy

As part of GSK's commitment to have a net zero impact on climate by 2030, they have set a target to transition to 100% renewable electricity by 2025. In September 2021, they announced a major investment at their manufacturing site in Irvine, to secure renewable power generation. GSK Irvine accounts for approx. 40% of the CO_2 emissions of GSK's UK manufacturing facilities due to its large-scale fermentation and distillation operations.

GSK have entered into an agreement with a 3rd party organisation, Farm Energy Company, that includes building a 56 acre solar farm and two new wind turbines with a total generating capacity of 28 MW which will supply 85% of GSK Irvine's energy needs. This builds on a series of investments in wind, biomass and biogas, all designed to cut emissions by some 10,000 tonnes of CO_2 per year. It will also provide opportunities for biodiversity enhancement across the site.

NSET argues that Scotland's human and natural capital, technology, and research capabilities provide a good basis for comparative advantage, with the potential to build world-leading industries.

Countries have comparative advantage when they can produce goods or services more efficiently than a country they trade with, allowing trading partners to specialise in the production of different goods or services and benefit from international trade.

Scotland's life sciences sector is an industry where Scotland has a distinct comparative advantage. If it can realise its ambition of becoming a leading global hub for life sciences, it could be transformative for the health and wealth of Scotland.

According to the latest Export Statistics Scotland data, total exports of the manufacturing of pharmaceuticals sector amounted to £500m in 2019, made up of international exports reaching £450m, the majority of which to the EU, and exports to the rest of the UK totalling £50m.

Despite international exports increasing by 9% in 2019, pharmaceutical manufacturing exports have contracted since 2018, down from £570m. This is due to a fall in exports to the rest of the UK (rUK) - down from £155m in 2018 to £50m in 2019.

This appears to be a trend across manufacturing where exports to rUK fell 3% between 2018 and 2019. However, pharmaceuticals manufacturing appears the hardest hit with a contraction of 67%.

Also, It is important to note that the latest export statistics data cover 2019, meaning that we will likely see an increase in exports in the 2020 estimates given other measures such as turnover and employment also increased significantly during the height of COVID-19. This also means we will not see Brexit's impact on exports (expected to be seen in estimates of 2021) in Scotland until around late 2023/early 2024 - this will be important to look out for given pharmaceuticals reliance on EU trade.

Reliance on EU exports is a challenge for the pharmaceuticals sector; however, it also brings opportunities to increase trade with non-EU countries.

In the Scottish Government's A Trading Nation report, a target was set to increase the share of Scotland's international exports to 25% of GDP by 2029. Currently, this ratio stands at 21% across entire Scottish economy, indicating exports will have to significantly increase year-on-year across Scotland's key industries to achieve this target.

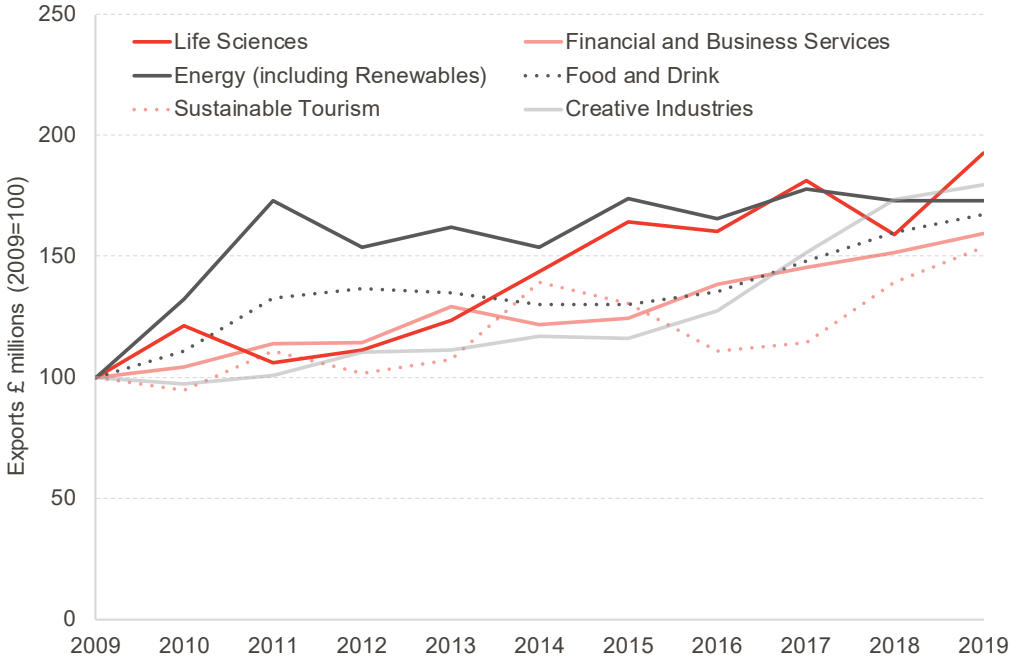
Some industries – like the pharmaceutical industry – already exceed this ratio.

National accounts data shows that the manufacturing of pharmaceuticals sector had a 42% international exports to GVA ratio in 2019, highlighting the international competitiveness of Scottish pharmaceutical firms.

Furthermore, across the broader life sciences sector, international exports totalled £1,570 million, or 4.8% of Scotland's international exports.

The life sciences growth sector has seen international exports almost double over the past decade, the most of any growth sector. **See Chart 4**.

Chart 4: Growth sector international exports (value) index, 2009 – 2019



Source: *Scottish Government*

In the Scottish Government's Export Performance Monitor, the top ten international export destinations for the Scottish life sciences sector were:

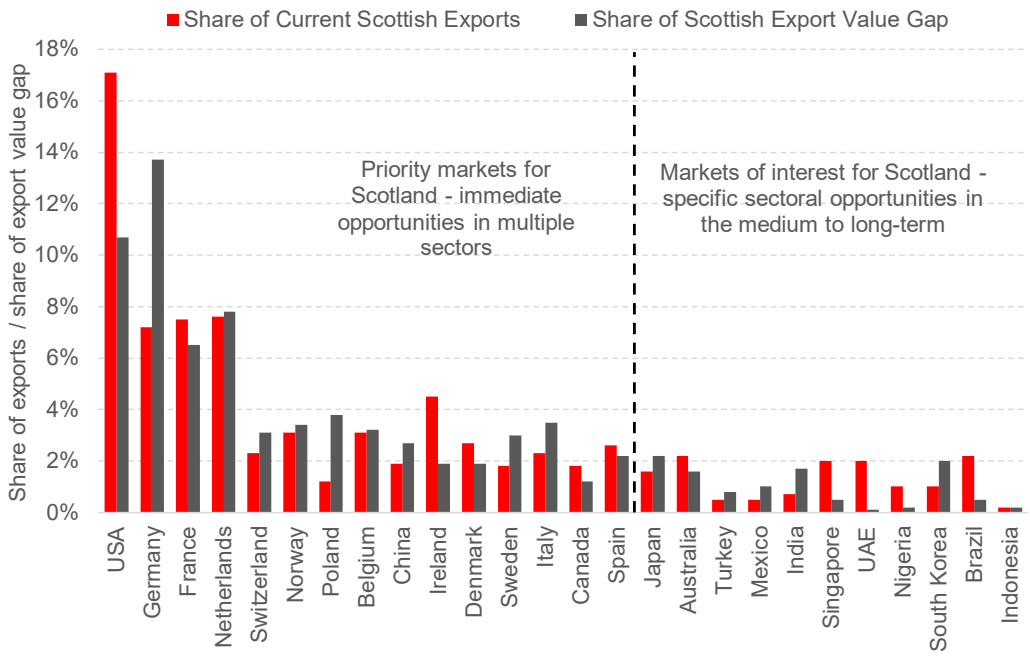
1. USA
2. Netherlands
3. Germany
4. France
5. Switzerland
6. Denmark
7. Sweden
8. Italy
9. Japan
10. Belgium

Each of these destinations, excluding Japan, were highlighted by the Scottish Government as priority markets - of which there are 15 - in the Trading Nation report.

Japan meanwhile was identified as a market of interest, i.e., markets where specific sectors could benefit from export opportunities over the medium to long-term.

Collectively, the Scottish Government estimates that 68% of opportunities to grow Scotland's total international exports will be within these 15 priority markets, predominantly made up of countries in North America and Europe. These 15 priority markets are displayed on the left-hand side of **Chart 5**.

Chart 5: Scotland's Top Priority Markets and Markets of Interest, 2021



Note: The Export Value Gap denotes the export performance of Scotland against competitor countries. A higher export gap indicates greater opportunities for Scottish export growth.

Source: *A Trading Nation*

Collectively for all Scottish exporters, the USA, Germany, and France were identified as the three top destinations with opportunities to increase international exports.

For the life sciences sector in particular, ageing populations in the USA, Japan, China, and Europe could increase demand for Scottish life sciences goods and services exports.

Furthermore, in Scotland's A Trading Nation report, stakeholder consultations highlighted sub-sectors of the life sciences industry that have high export-growth potential. These sub-sectors include:

- Precision medicine
- Regenerative medicine and tissue repair
- Preclinical drug development
- Clinical trials and preclinical services
- Biopharmaceutical safety testing
- Specialist and high value manufacturing
- Regulatory support

Developing comparative advantage in these sub-sectors could prove essential to realising the export growth potential of the life sciences sector and enable it to better compete on an international stage.

However, it is important to note that clinical trials, one of the key subsectors highlighted in the Trading Nations Report, has been struggling for a number of years in the UK.

A recent ABPI report found that –

- In the UK, patient access to industry research fell from over 50,000 in 2017/18 to just over 28,193 in 2021/22 – a 44% contraction.
- Between 2018 and 2020, median time between a clinical trial in the UK applying for regulatory approval and that trial delivering its first dose to a patient rose by 25 days to 247 days.
- The number of clinical trials initiated in the UK per year has fallen by 41% between 2017 and 2021.
    - Pharmaceutical companies are increasingly going elsewhere for trials (i.e. Spain and Australia).
    - The UK in 2021 ranked 10th in the world for Phase III industry trials, down from 4th place in 2017.

Alongside the development of new hubs for innovation comes the need to increase efficiency in the regulatory approval pipeline.

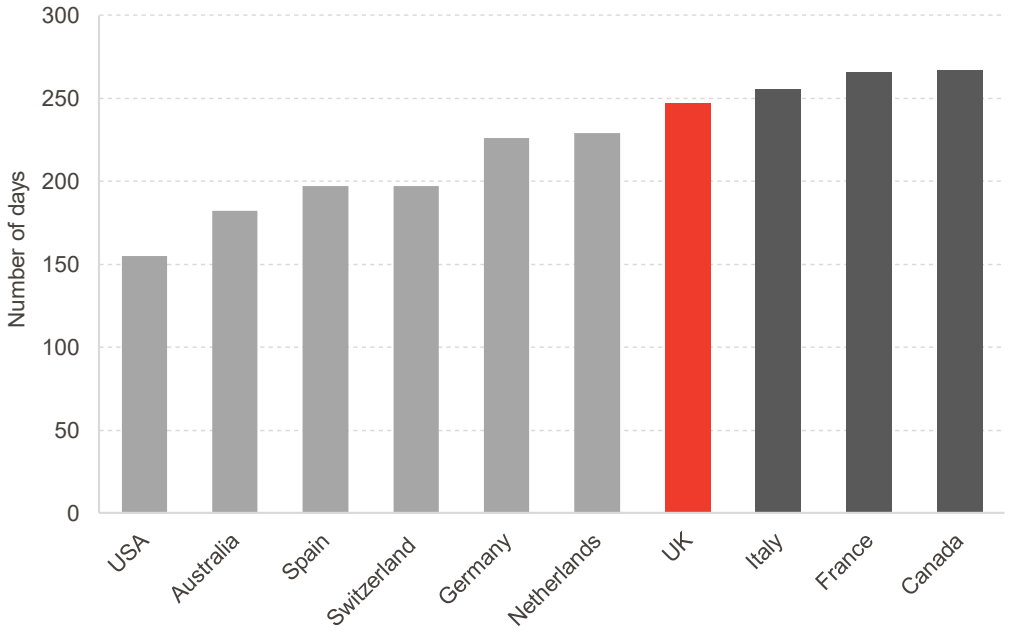
Chart 6 highlights the UK's lagging performance internationally with regard to how long it takes to move from clinical trial application to first patient receiving a dose.

While this process has increased in the number of days for most countries between 2018 and 2020, Italy, France and Canada have seen a larger increase in delays – moving the UK from 10th slowest to 7th place.

The UK saw a median time of 247 days between submitting a clinical trial application and administering the first dose to a patient in 2020. This marks an increase from the median time of 222 days in 2018.

There is a 92-day difference between the UK and the USA – which completes the process in only 155 days.

Chart 6: Median time from clinical trial application to a regulatory authority and the first patient receiving a first dose for a subset of commercial trials for novel medicines



Source: *UK Government*

Section 3: Productive businesses and regions

Enhancing the productivity and innovation of Scotland's businesses, industries, regions, communities, and public services is the third key pillar of the national strategy.

With world-leading expertise in drug discovery, precision medicine, medical technologies, and pharmaceutical services, Scotland's life sciences sector plays a vital role in the economy, most recently in tackling COVID-19.

Box 2: Innovative medicines

Innovative medicines play an important role in patient outcomes, and have wider impacts on the health and strength of the economy.

Recent research from PwC estimated the value of investing in innovative medicines to UK patients and to the UK economy, finding that not only does this investment have a significant impact on the health of individuals, but it also brings significant gains for productivity and economic growth, and billions in tax receipts for the exchequer.

Central to the strength and growth of the sector has been close links and partnership working between the private sector, NHS Scotland, and university research.

Box 3: Edinburgh BioQuarter

The Edinburgh BioQuarter is a leading location for medical research and life sciences innovation that is supported by four partners – City of Edinburgh Council, NHS Lothian, Scottish Enterprise and the University of Edinburgh – and brings together health and life sciences businesses and organisation into one hub.

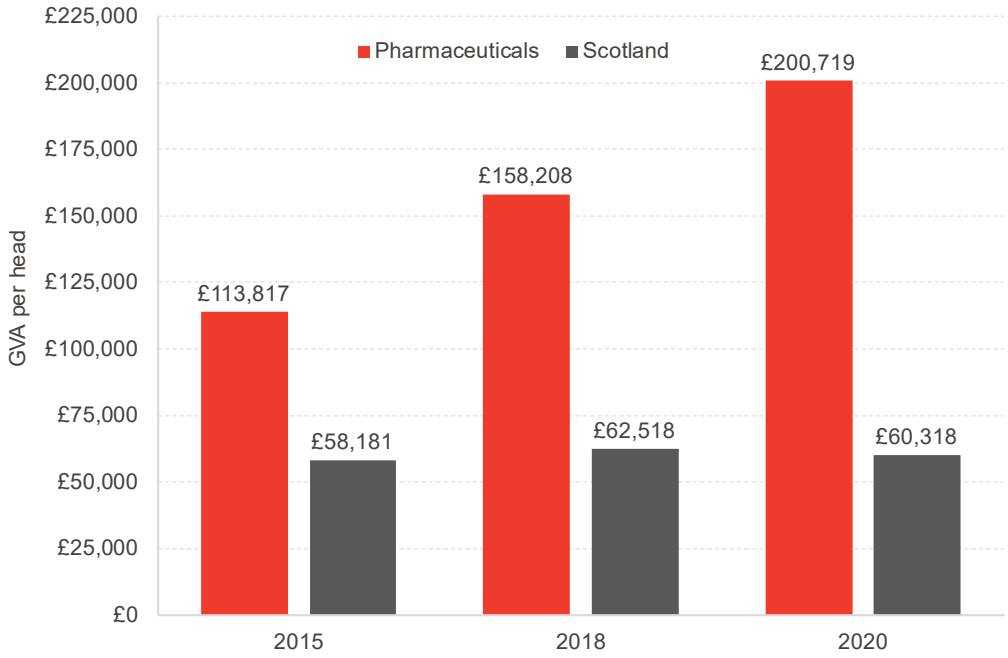
The BioQuarter hosts over 8,000 people across a 167-acre site, ranging from frontline health workers to academics. The aim of this collaborative cluster is to foster innovation opportunities to improve patient care and develop new medical treatments.

Building clusters of expertise in a dynamic sector such as life sciences offers an attractive opportunity to inward investors and has positive knock-on effects in the surrounding areas of clusters.

Moreover, wider benefits can also be felt across Scotland's economy, such as supply chain opportunities, and productivity improvements through innovation.

In our 2017 and 2021 reports, we found that productivity was a strength of the manufacturing of pharmaceuticals sector, and this remains the case. GVA per head was over £200,700 in 2020, almost double its nominal value just five years earlier. See **Chart 7.**

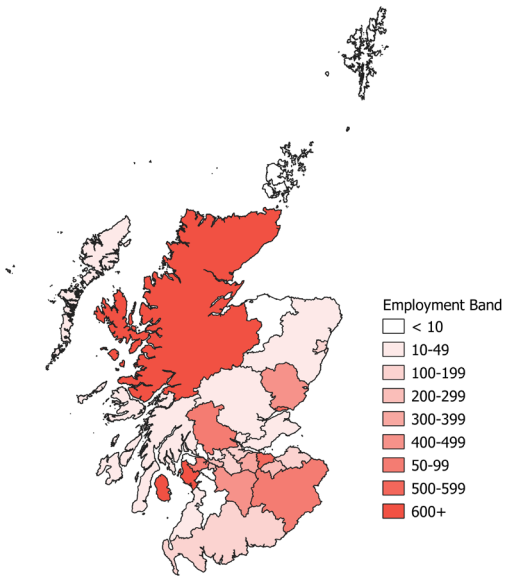
Chart 7: Nominal GVA per head (basic prices), pharmaceuticals (SIC 21) vs Scotland average, 2015 - 2020



Source: *Scottish Government*

Regionally, many of these productive jobs are widely spread across Scotland, not just within the cities but also in rural and island communities. **See Diagram 1.**

Diagram 1: Employment by local authority of the wider Scottish pharmaceutical industry, 2018



Source: *BRES and FAI calculations*

Research and development (R&D) is a key driver of productivity, and the pharmaceuticals sector is one of Scotland's key business R&D spenders. In 2018, business and enterprise research and development (BERD) investment totalled £164 million in the manufacturing of pharmaceuticals sector – equal to 12% of BERD spending across all industries.

Box 4: The long-term impact of R&D Investment

A UK-wide PWC report, commissioned by ABPI, found that the "stream of benefits" to the UK of £4.7bn invested in private pharmaceutical R&D in 2019 to be worth £45bn in future economic benefits for the UK economy over a 30-year period.

Replicating this analysis, the institute finds that the £164m invested in pharmaceutical R&D in Scotland in 2018 is estimated to generate over £1.5bn in economic benefits for the Scottish economy over a 30-year period (from 2018 – 2048).

Methodology

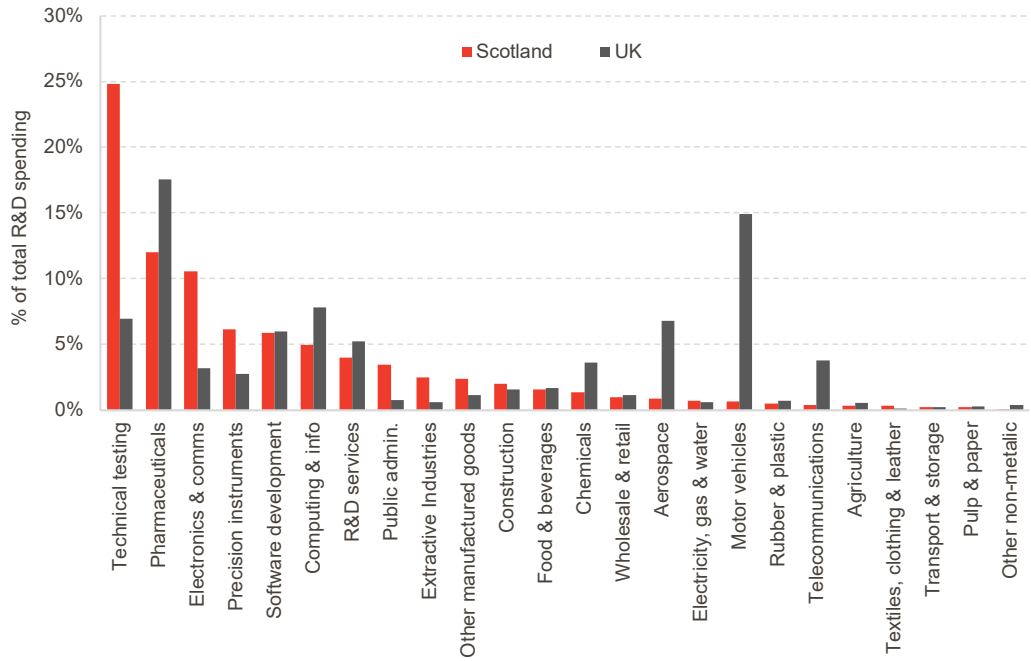
The Institute reviewed the literature outlined in the report "Medical Research: What's it Worth?", finding that reputable pieces of economic literature have aimed to estimate the social return to private R&D, and found a range to typically fall at around 50%. This means that for every £1 invested in R&D, £0.5 is generated in benefits thereafter.

It is worth noting that a lot of the research carried out here is international. For example, looking at the impact of R&D spend in the US. Scotland and the UK typically perform poorly on the international stage when it comes to measures of productivity, and in comparison to countries like the US, the social return to R&D may be poorer.

Nonetheless, using the latest BERD statistics for pharmaceutical R&D (2018) and Green Book guidance on health discounting and adjustments for inflation, the institute projected the present value of economic benefits of investing £164m in pharmaceuticals in 2018.

In comparison to other product groups, Scotland's pharmaceutical manufacturing sector had the second largest spend on R&D in 2018, after the technical testing and analysis services sector. Both Scotland and the UK spend a significant share on R&D through their technical testing and pharmaceutical sectors. However, the manufacturing of pharmaceuticals BERD per head is £30 in Scotland compared to just over £65 in the UK. **See Chart 8.**

Chart 8: BERD Expenditure in Scotland and the UK, by sector, 2018



Note: Due to censoring, not all industries are included in the chart or analysis. Therefore, weightings may not sum to 100.

Source: *Scottish Government*

CASE STUDY

Roche

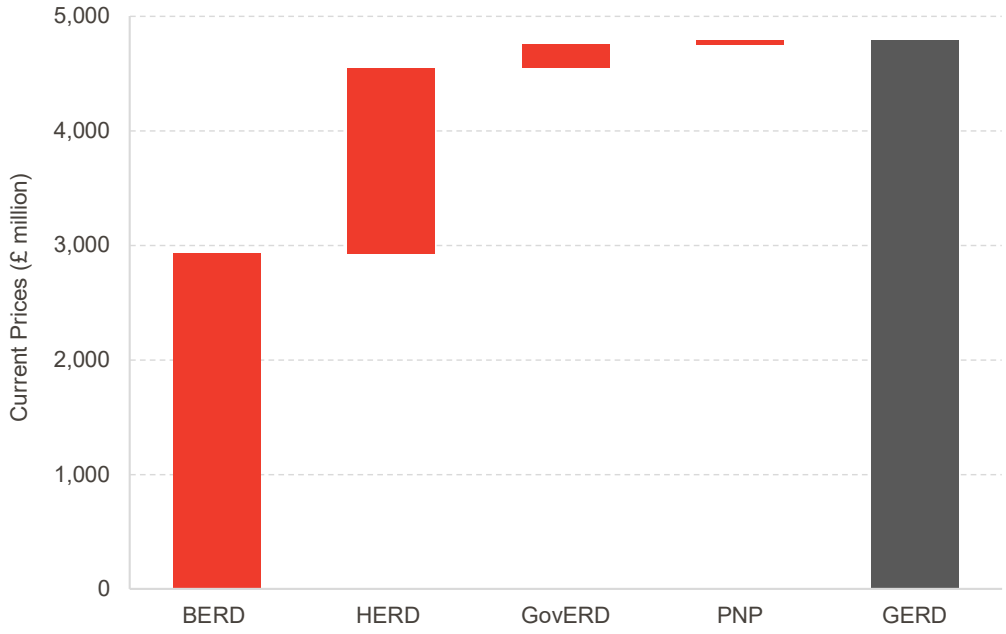
As a research-intensive healthcare company, Roche UK discovers and develops diagnostics and medicines for a wide range of chronic and life-threatening health conditions that continue to improve healthcare.

The UK is important to Roche's Global R&D programme.

- In 2020, Roche Global invested £10bn in R&D, leading the global pharmaceutical industry and ranking in the top 10 of all companies globally.
- Over £400m was invested in UK R&D in 2020, equating to 8.5% of the total UK government health R&D spend of £3.4bn.
- 117 medicines are in development by Roche around the world.

Industry and Higher Education Institutions are key drivers of R&D in Scotland. **See Chart 9.**

Chart 9: Gross expenditure on research and development in Scotland, 2018-2020.



Source: *GERD*

Business enterprise research and development (BERD) accounted for approximately 61% of gross expenditure on research and development (GERD) in 2020 – while Higher Education R&D (HERD) accounted for 34% and Government expenditure on R&D (GovERD) accounted for 4%.

However, whilst businesses and higher education institutions drive the majority of innovation in the economy, collaboration between government, academia, and industry is crucial in driving productivity and longer-term economic growth.

Additionally, collaborations, such as the Medicines Manufacturing Innovation Centre (MMIC) discussed overleaf, play an important role in providing skilled jobs to areas lacking employment opportunities.

For example, Renfrewshire experiences high levels of employment deprivation and income deprivation (SIMD 2020 statistics) and there is potential that the addition of the MMIC will provide more opportunities for skilled employment in the Renfrewshire region both within the pharmaceutical industry and also within the sectors that support it.

CASE STUDY

Medical Manufacturing Innovation Centre

The Medicines Manufacturing Innovation Centre – located at the Advance Innovation District in Renfrewshire - opened in late 2022. The £88 million facility is a collaborative venture involving the CPI, University of Strathclyde, UK Research & Innovation, Scottish Enterprise and industry partners, AstraZeneca and GSK.

The purpose of the centre is to develop new manufacturing techniques and technologies, as well as improve existing processes and systems. Its goal is to bring new and innovative medicines to market more quickly and efficiently, while also reducing the cost of manufacturing medicines.

Dave Tudor, Managing Director of Medicines Manufacturing Innovation Centre said:

"The facility we have built here in Renfrewshire is the first example of a consistent and concerted effort from the pharma industry to collaborate. This will be crucial to unlocking the challenges we've faced so far to translate research into tangible benefits that will help address unmet health needs"

CASE STUDY

Novartis Pharmaceuticals UK - Collaborating with Scottish researchers to solve the healthcare challenges of tomorrow

Novartis Pharmaceuticals UK is proud to play an important part in the Scottish life sciences ecosystem as we work to re-imagine medicine to meet the evolving needs of patients and the NHS. Innovative medicine can enable patients to live longer and more productive lives, and its speedier adoption can help the NHS, and the economy to build back stronger from the COVID-19 pandemic.

Collaboration is central to bringing innovation to patients and in 2015 Novartis was ranked as the seventh most cited company in the UK when assessing collaborations with universities. In the period from 2014 to October 2019, Novartis collaborated with 288 institutions to produce 869 publications. Scottish academics are a leading source of Novartis collaboration and 141 of our publications since 2014 have been produced jointly with researchers in Scotland, with the University of Glasgow ranking as a top 5 UK institution for Novartis.

A fully functioning Triple Helix which brings together academia, industry and the NHS has the potential to deliver solutions to patients more quickly. Novartis is working across a number of therapy areas to meet the healthcare challenges faced by patients in the UK and Scotland and we believe that Scotland's thriving academic sector can play a vital role in ensuring our collective health and wealth can improve.

CASE STUDY

Pfizer - partnering to accelerate transformations in medicines development and manufacturing

Industry implementation

Medicines Manufacturing Innovation Centre (MMIC)

In 2021 Pfizer partnered with the Medicines Manufacturing Innovation Centre, a collaboration between CPI (Centre for Process Innovation) and the University of Strathclyde, along with other industry partners, GSK and AstraZeneca. The Centre aims to advance emergent and disruptive technologies through a series of flagship 'Grand Challenge' projects to increase productivity and patient outcomes in the pharmaceutical industry.

The partnership with Pfizer will focus on Grand Challenge 1, which aims to develop an innovative continuous direct compression (CDC) platform enabling oral solid dosage medicines to be formulated more robustly and efficiently. The CDC platform will feature a digital twin and data predictor model to allow for the modelling of processes in a digital space. This capability will improve efficiency and significantly cut down the quantity of starting materials needed to optimise formulations with the aim of enabling companies to ultimately develop formulations faster and at reduced cost.

Research & Innovation

Continuous Manufacturing and Advanced Crystallisation (CMAC)

Pfizer has partnered in this consortium alongside seven industry partners, actively engaging on a number of technical projects including advanced process modelling, advanced materials characterisation and technology translation of continuous manufacturing tools. Since the start of its CMAC membership, Pfizer has recruited two FTEs from the CMAC centre into its R&D facility in England, and have set-up a knowledge transfer partnership with CMAC to translate know-how from research projects into the business.

Pfizer Proprietary Research & Innovation Projects

Pfizer have partnered with the University of Strathclyde on strategic proprietary research and innovation projects via PhD and Postdoctoral research. Focus areas for these projects have included development of novel computational / predictive strategies to accelerate i) analytical measurement methodology development and ii) understanding of product shelf-life stability.

Translational Research & Innovation

Centre for Process Analytics and Control Technology (CPACT)

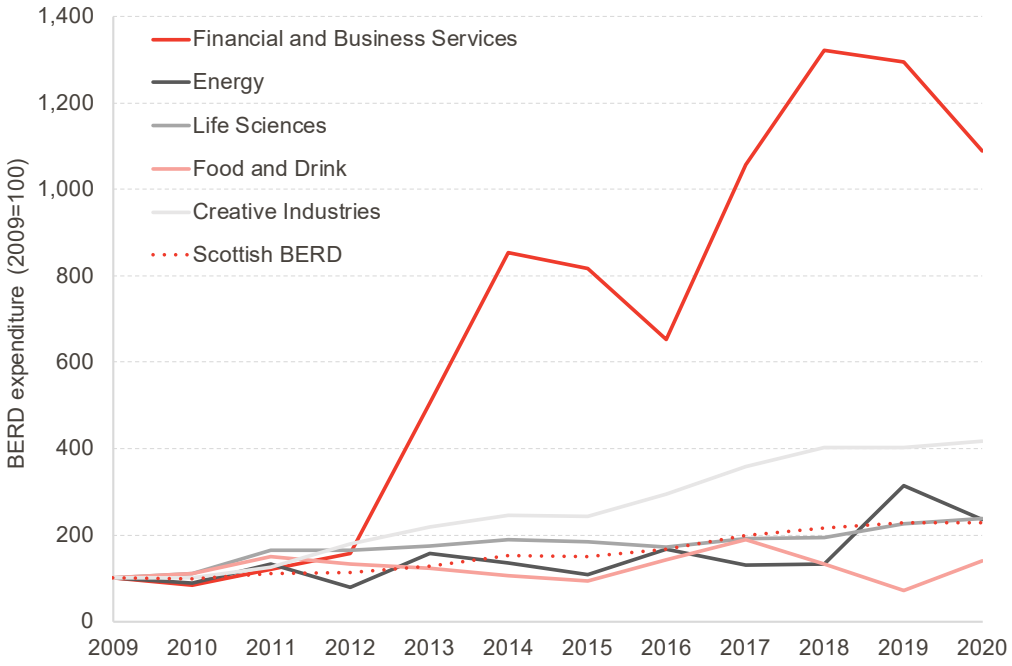
Pfizer is a partner in CPACT through an annual grant. The focus of this large industry/academic consortia concerns innovations in technologies for process optimisation, monitoring and control. The consortia seeks to improve access to knowledge and best practice sharing.

Total investment since 2017: £1.6m (not including planned 2023 investments)

The life sciences sector is a key driver of R&D in the Scottish economy.

In 2020, Business Enterprise Research and Development (BERD) expenditure in life sciences reached £366m, the most of any growth sector. Over the past decade, BERD expenditure has more than doubled in the life sciences industry, similar to Scotland BERD overall growth. **See Chart 10**.

Chart 10: Growth sectors BERD expenditure, 2009 -2020.



Source: *Scottish Government*

However, Creative Industries and Financial & Business Services have experienced the greatest BERD growth over the past decade, totalling £238m and £207m respectively in 2020.

Closely linked to R&D, foreign direct investment (FDI) can play an important role in enabling companies to exploit new market opportunities. Not only does it increase the capital available to industries, but it can also support higher levels of economic output and job creation.

In total, the UK life sciences sector attracted just under £900 million in FDI capital expenditure in 2020. If the UK could attract inward FDI investment rivalling Ireland – a comparable country – then PwC estimate an additional £1.2 billion could be generated for the UK economy, as well as creating or safeguarding an additional 7,230 jobs.

As noted in the PwC report, Ireland's ability to attract foreign direct investment is supported by its regulatory environment, government support, track record in clinical and academic R&D, and its commitment to growth of its knowledge economy through initiatives such as the national network of technical training institutes brought about in the 1970s.

Further investment into the UK and Scotland's life sciences sectors is not guaranteed and international competitiveness around issues like clinical trial wait times will be important in securing future FDI.

However, the benefits of attracting life sciences investment could be significant in further driving Scotland's inwards investment trajectory.

As highlighted in EY's Attractiveness Survey, in 2021, Scotland secured a 14% rise in inward investment across all industries relative to the previous year – a rate exceeding both Europe and the UK. Furthermore, in this year's survey, Scotland was ranked as the second most attractive region in the UK for FDI investment after London, with 16% of those surveyed selecting Scotland.

Section 4: Skilled Workforce

The fourth pillar of the National Strategy recognises the importance of a skilled workforce to business productivity and economic prosperity in Scotland.

The pharmaceuticals and life sciences sectors support employment across the whole Scottish economy. Our modelling results outlined in section 6 estimate that:

- For every 1 job supported in the manufacturing of pharmaceuticals sector, **1.7** jobs are supported elsewhere in the economy.
- For every 1 job supported in the wider pharmaceuticals sector, **1.5** jobs are supported elsewhere in the economy.
- For every 1 job supported in the life sciences sector, **1.3** jobs are supported elsewhere in the economy.

The manufacturing of pharmaceuticals industry within the wider pharmaceuticals and life sciences sector clearly drives the greatest job creation elsewhere in the economy.

Supporting employment is important to Scotland's economy. Scotland and the UK have historically low levels of unemployment, but economic inactivity is a growing concern.

Economic inactivity occurs when someone is not seeking employment. There are some inactivity drivers which are considered 'bad' – for example, being long-term sick or discouraged from being in work. There are also 'good' reasons for being economically inactive; for example, those that take an early retirement or leave employment to study fall into this category.

Just under 23% of Scotland's working age population are economically inactive – below Wales' rate of 24% and Northern Ireland's rate of 27%. Both England and the UK's inactivity rate stood at around 21% in 2022 (Oct 2021 - Sep 2022).

Almost a third of Scotland's inactivity rate is driven by long-term sickness, compared to a quarter across the UK.

Firstly, these are concerning statistics for the health and wellness of our economy, but they are also worrying for longer-term economic growth when we consider the detrimental impact long-term sickness could have on productivity and public finances.

Recent research from PwC found that 1.2 million patients in the UK are missing out on innovative treatments. A lack of access to these cutting edge treatments and medicines coupled with long NHS wait times could result in health conditions worsening, pushing further people into long-term sickness.

Both the Scottish Fiscal Commission and Office for Budget Responsibility have noted an increase in benefits uptake related to poor health and disability, and the expectation of higher levels of uptake in the future.

Overall, it is important to consider the overall health of the economy before discussing the skills level of the workforce as poor health is a serious concern for our labour market, and as highlighted throughout this report, pharmaceuticals plays a vital role in tackling this growing issue.

CASE STUDY

Lilly UK

Following the addition of a new chemotherapy to the treatment standards for patients with soft tissue sarcoma (STS), The Beatson West of Scotland Cancer Centre worked with Lilly UK to halve the amount of time patients spent in hospital and free up consultant time which improved the efficiency of their chemotherapy clinic.

Under a Joint Working Agreement with Lilly UK, the project took a Lean Six Sigma approach to identify areas for improvement, which would implement a new nurse-led service to reduce the length of time patients spent in clinic.

The aim of the project was to identify where delays were occurring. Data was collected from key points in the care pathway, and this helped map out the minimum possible process time so that this could be used as a baseline target. Following this, the project set up a new Systemic Anti-Cancer Therapy (SACT) service for patients, removing them from the general clinic, therefore freeing up capacity in the general clinic and reducing patients time in hospital. The project also measured patient satisfaction with the new service, as well as efficiencies made in having a new nurse led service as opposed to one led by consultants.

The programme resulted in a series of positive changes for the SACT service. Total patient time in hospital was reduced by more than half from 8 hours 31 minutes on average, to 3 hours 57 minutes. This is a reduction of 4 hours 34 minutes, and equates to a reduction of 53.6%. For patients whose treatment was authorised the day prior to attending for treatment, the time in hospital was reduced further, to 3 hours 18 minutes. This is a reduction of 61.3% on pre project time in hospital. Surveys completed by 12 patients also showed a high rate of satisfaction with the new service.

The project highlighted that the use of process mapping was an effective tool in improving clinical efficiencies, that could be benefit in reducing patient numbers in line with new ways of working following the COVID-19 pandemic. It also demonstrated the critical role that industry can play in sharing skills to ultimately improve patient care and their experience in the NHS.

Better for patients:

- Total patient time in hospital was reduced by more than a half - from 8 hours 31 minutes on average, to 3 hours 57 minutes.
- For patients whose treatment was authorised the day prior to attending for treatment the time in hospital was reduced further, to 3 hours 18 minutes.

Better for the NHS:

- The resultant reduction in hospital waiting times and transition to a Nurse led service, helped free up capacity for consultants for other NHS care.

As discussed in Section 1, Scotland has a highly educated workforce, and it is widely recognised that STEM education is linked with good quality, well-paid jobs.

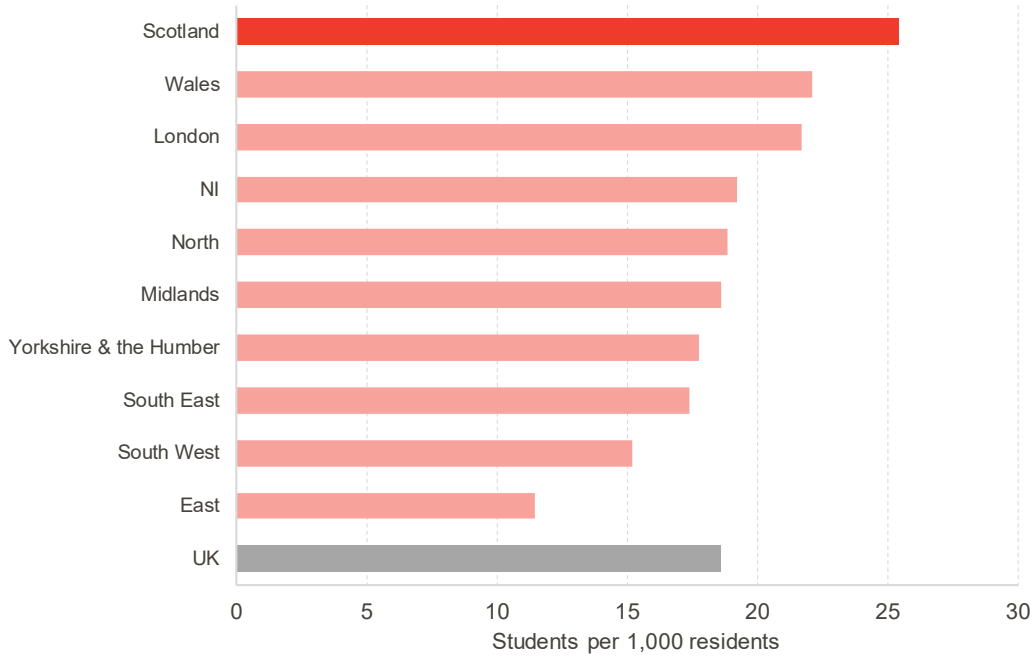
Box 5: ABPI – STEM Education

ABPI has made a number of commitments to support STEM education. Most recently, it launched an updated, dedicated platform of free, high quality, up-to-date STEM resources supporting all key stages for UK curricula. These seek to help develop the foundational STEM skills of young people, support long-term attainment, drive achievement, and provide support for teachers.

Note: all resources have been awarded the 'Green Tick' by the Association for Science Education.

Relative to population size, Scotland has the highest number of higher education students enrolled in STEM-related subjects when compared to the rest of the UK. **See Chart 11.**

Chart 11: Higher education students in STEM-related subjects, 2020/2021



Methodology note: Data gathered from HESA on the number of student enrolments in the academic year of 2020/21 by the subject of study at the most detailed level available. STEM-related subjects are defined in accordance with HESA. Data are then presented per 1,000 residents using ONS mid-year population estimates.

Source: *HESA, ONS*

However, it is important to note that this high rate of students in STEM does not guarantee a sufficient supply of labour. In its recent report, Bridging the skills gap in the biopharmaceutical industry, ABPI discuss that this skills shortage is driven by quantity, not quality, and in some areas such as engineering, these skills are highly demanded by other sectors so it is difficult to pair the demand and supply of labour in this sector.

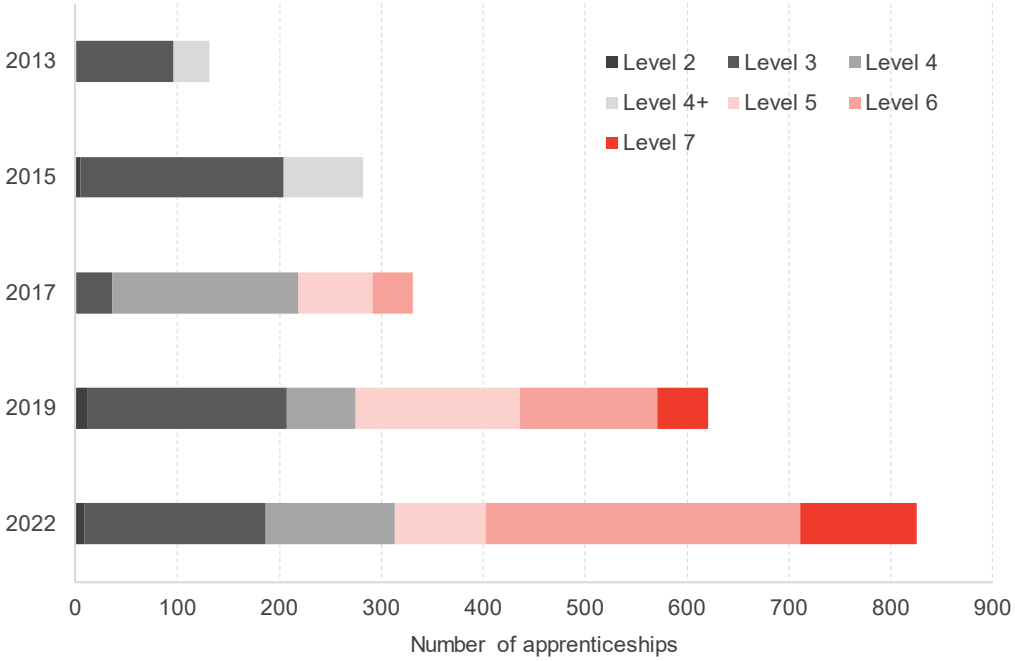
Obviously, higher education is not the only route into the pharmaceuticals sector, and apprenticeships play a key role in filling pharmaceutical jobs.

Additionally, apprenticeships are recognised as a key way for people to work, learn, and earn, no matter their background.

The life sciences sector has seen strong apprenticeship growth over the past decade with the number of apprenticeships at a record high in 2022, increasing by 33% since 2019.

Additionally, there has been a significant increase in people pursuing higher apprentice qualifications, with level 6 and 7 equivalent to a bachelor's and master's degree, respectively. **See Chart 12**.

Chart 12: Apprenticeships hosted by the pharmaceuticals manufacturing industry, by level, UK, 2013-2022



Note: 2022 data are compiled from the responses of a sample of 14 pharmaceutical firms.

Source: *ABPI*

CASE STUDY

University of Strathclyde and GSK MPhil/PhD

The University of Strathclyde and global pharmaceutical company GlaxoSmithKline (GSK) have established new models of industry/university partnership that drive significant benefits for both organisations and the wider economy.

The collaborative MPhil and PhD programme, established in 2009, was the first of its kind in the UK pharmaceutical industry. It provides an innovative framework for personal advancement, enabling GSK employees – registered as students with Strathclyde – to work towards higher research degrees through their work-based projects.

GSK wanted to provide their employees with an environment of continuous professional development to better equip them with the skills to develop greater scientific excellence. The standards achieved by GSK students are of the highest level and are at least equal to those achieved by postgraduate students in full-time studies.

Since launching 14 years ago, the research partnership has supported both GSK employees and new graduates towards higher research degrees. The collaboration has included over 200 research students to date, and has seen over 125 research papers published in a series of contributions towards the research outputs of both organisations and all associated with the UK health sector.

The partnership is now recognised as a landmark programme within GSK for the development of early talent and is central to GSK strategy and policy within associated research areas.

CASE STUDY

ENTHUSE Partnership with GSK and STEM Learning

When ENTHUSE Partnerships were launched in 2018, GlaxoSmithKline sponsored six fully funded partnerships with STEM Learning.

ENTHUSE Partnerships have been developed to empower schools, colleges and employers to share, practice, and work collaboratively with the aim to achieve:

- Increased attainment in STEM subjects: narrowing the gap for disadvantaged students
- Increased interest in STEM careers: more students interested in working in STEM industries
- Increased understanding of STEM careers: more students aware of the qualifications and routes to progress in STEM

ENTHUSE Partnerships have supported 32 schools across the UK, six of which have been funded by GSK.

Monifieth High School in Angus, Scotland, was one of the first schools selected to lead the GSK ENTHUSE Partnerships in 2018. The alliance has enabled schools and colleges in the local area to work together to build a sustainable model of collaborative support, increasing access to high-quality learning opportunities and providing pupils with a different experience of STEM.

For employers, the partnerships provide invaluable opportunities in terms of developing the skills of its current workforce, identifying and nurturing future talent, and working with STEM Learning to set the agenda in terms of STEM education in the UK.

Section 5: A fairer and more equal society

Encouraging a fairer, more equal society is the final priority area highlighted in Scotland's National Strategy for Economic Transformation.

This pillar seeks to reorientate Scotland's economy towards one of well-being and fair work; that delivers low unemployment and high wage growth; reduced structural poverty, in particular child poverty; and improved health, cultural and social outcomes for disadvantaged families and communities.

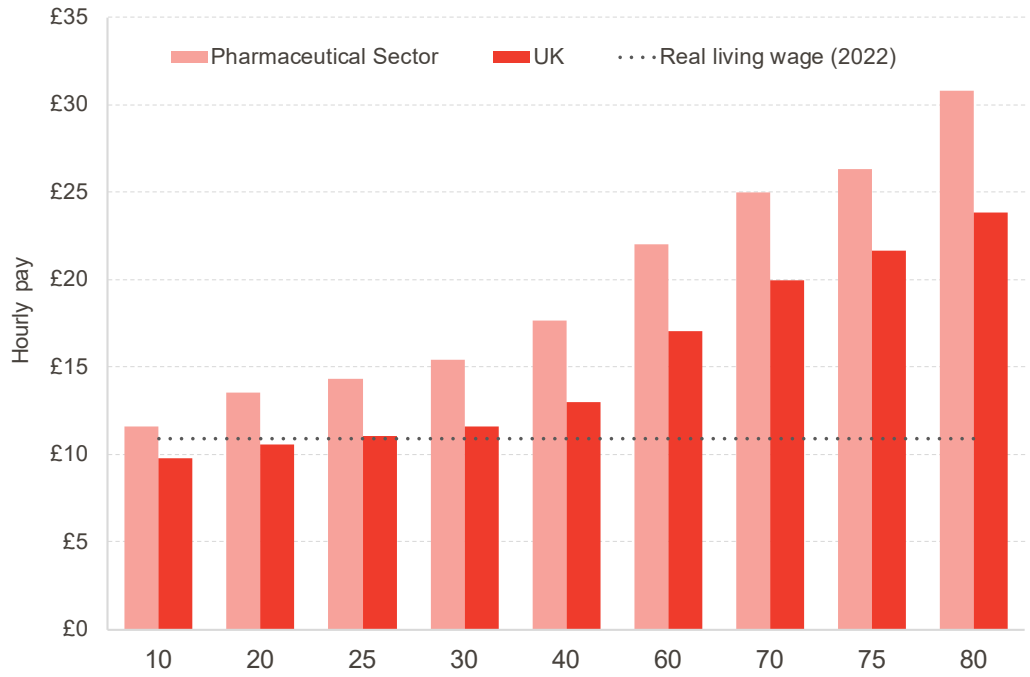
The impact of the pharmaceutical sector on the health of communities is clearly demonstrated throughout this report, and our previous reports for ABPI therefore, this section focuses on how the sector contributes to tackling inequalities and improving social outcomes.

The manufacturing of pharmaceuticals sector (SIC21) is an important source of highly skilled, well-paying jobs across the UK, with median wages reaching £20.01 in 2022 – a value significantly above the real living wage of £10.90.

Although the distribution of wages in SIC21 are censored due to sample size issues for Scotland in the Annual Survey of Hours and Earnings (ASHE), estimates are available for the UK.

In the UK, wages across all 10 percentiles of the manufacturing of pharmaceuticals' wage distribution exceeded the real living wage in 2022. This means that all workers employed by SIC21, including the lowest 10% of earners, were still paid, on average, a wage above the real living wage. See **Chart 13**.

Chart 13: Wage Percentiles of the manufacturing of pharmaceuticals sector (SIC21), Hourly Pay, UK, 2022



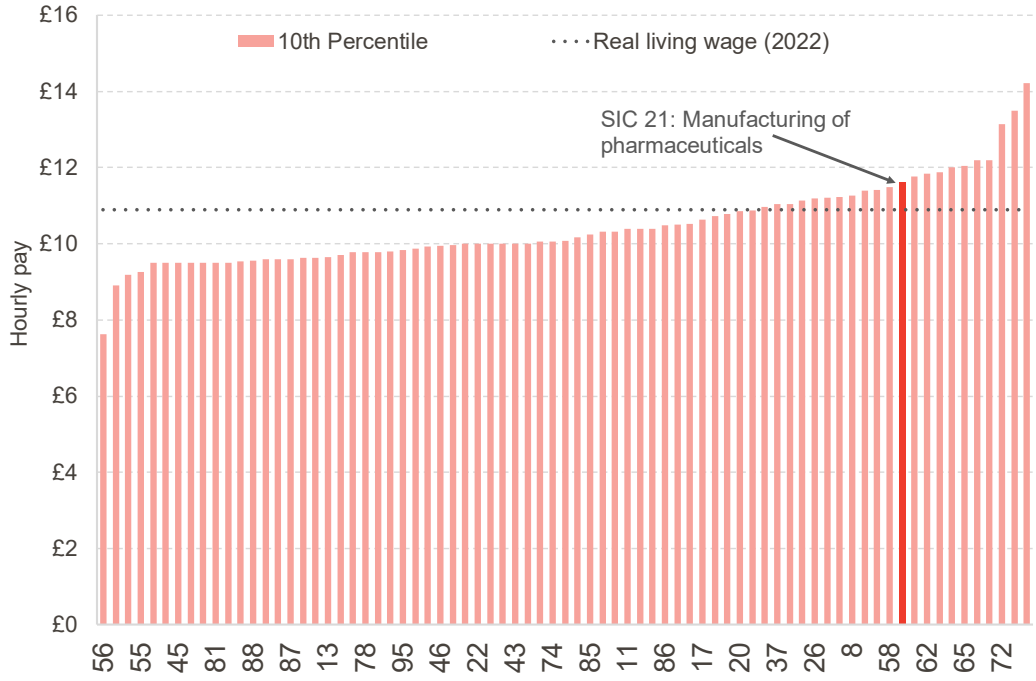
Note: The 90th wage percentile of the UK manufacturing of pharmaceuticals sector was censored in the Annual Survey of Hours and Earnings, therefore data is not included in the chart or analysis.

Source: *Annual Survey of Hours and Earnings*

Focusing on the lowest paid 10% of workers in the manufacturing of pharmaceuticals sector, workers were paid an average hourly wage that exceeded the real living wage by over £2 in 2021 – the fourth highest amount of any sector.

In 2022, however, this difference had fallen to just £0.69 above the new living wage, with the sector placed eleventh among the highest-paying sectors. **See Chart 14**.

Chart 14: Average hourly wage of the lowest 10% of earners by sector, UK, 2022



Note: Due to censoring in the ASHE, not all sectors are included in the chart or analysis.

Source: *Annual Survey of Hours and Earnings*

In terms of gender diversity, the manufacturing of pharmaceuticals sector performs less well.

In Scotland, men in the manufacturing of pharmaceuticals sector were paid a median hourly wage of £23.45 in 2021, while women were paid £18.25. In contrast, the median hourly wages of men and women in the sector across the UK were £19.97 and £18.81, respectively.

This means in Scotland, women earned 22% less than men working in the sector, compared to just 6% less at UK level. Across all sectors, however, the gender pay gap stood at 12% in Scotland and 16% in the UK.

Undoubtedly, there remains a lot of work to be done to integrate women fairly and equally into more well-paid roles within the Scottish pharmaceuticals industry.

However, the modelling carried out in Section 6 suggests that the wider pharmaceuticals sector supports a more equal proportion of men and women across the supply chain than the sector itself.

This means that women are more likely to occupy roles in sectors across the wider economy that benefit from the output of the pharmaceuticals sector. This may include roles that utilise medicines or equipment provided to the human health and social care sector, or, employees of retail premises, selling pharmaceutical products and medicines. **See Chart 15**.

Whilst the pharmaceutical manufacturing industry is still working to improve gender equality, the industry does support significant social outcomes.

As noted in the previous section, Scotland, like the rest of the UK, is facing a significant challenge with its levels of economic inactivity. North Ayrshire council has one of the highest inactivity rates in the UK at over 30% and more than 43% of this inactivity is due to long-term sickness (compared to 32% in Scotland).

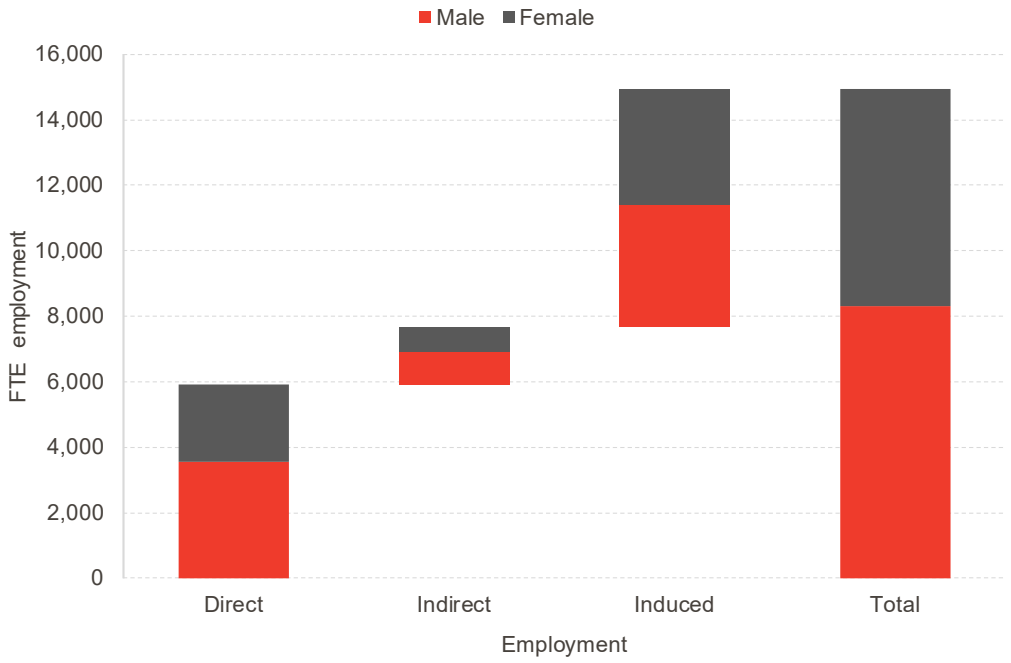
As previously reported, the pharmaceutical industry is a major employer in North Ayrshire and is contributing significantly to the local economy. In 2021, 800 people in North Ayrshire were employed by the manufacturing of pharmaceuticals sector – the most of any Scottish local authority.

As discussed in our 2021 report, North Ayrshire is the fifth most deprived area in Scotland, with its deprivation primarily driven by income and employment deprivation.

Additionally, as of 2021, 21% of children in North Ayrshire were living in a relative low income family - the second highest of Scotland's 32 local authorities, after Glasgow (25%)

Employing people from these deprived areas on secure, high-skilled, high-paid jobs not only contributes to building a skilled workforce but also to tackling inequalities and child poverty.

Chart 15: Direct and spill-over (indirect and induced) employment impacts of the wider pharmaceutical industry in Scotland by gender



Source: *FAI calculations*

CASE STUDY

Roche UK

As a research-intensive healthcare company, Roche UK discovers and develops diagnostics and medicines for a wide range of chronic and life-threatening health conditions that continue to improve healthcare.

Roche also holds itself to the highest standards when it comes to its people and true inclusion.

As of 2022, Roche employs far more women in management positions than typical UK firms:

- 57% of full-time UK employees at Roche are women, considerably higher than the UK average of 43%;
- 57% of UK managerial positions at Roche are held by women, significantly higher than the UK average of 37%; and,
- 6.7% average UK gender pay gap at Roche, less than half of the UK average of 13.9%.

Sources: People and culture team at Roche UK and Human Resources team at Roche Group; ONS/NOMIS Annual Population Survey.

CASE STUDY

GSK and NHS Optimisation in Greater Glasgow and Clyde

NHS Greater Glasgow and Clyde and GSK are undertaking a Joint Working project running from May 2022 to April 2023. The project involves the balance of contributions from both parties with the pooling of skills, experience and resources.

The intended benefits of the project include, for patients:

- Full COPD review in line with local guidelines based on risk stratification, potentially increasing volume of those receiving a review, leading to better outcomes
- Fewer COPD-related interventions, including hospital admissions
- Better informed about COPD management and treatment options

For the NHS:

- Realisation of value-based healthcare objectives of improved patient outcomes with reduced costs
- Guideline implementation resulting in consistent prescribing and non-prescribing recommendations and promoting learning for sustainability
- Insight into COPD population at practice and local healthcare economy level to allow sharing of best practice and evaluation of care provision to support clinical governance and support equity of care
- Opportunity to upskill primary care doctors and nurses
- An environment to support the delivery of improved health outcomes for the COPD patient population
- Build network of respiratory interested health care professionals
- Prescribing in-line with national sustainability aspirations where clinically appropriate for patients

For GSK:

- Broadening of the professional network
- Demonstrate partnership working
- Increase in the appropriate use of medicines licensed for COPD aligned to local guidance, will likely increase the prescribing of GSK products as well as those of other pharmaceutical companies.
- Better understanding of the challenges faced by the NHS in delivering high-quality patient services and care
- Helps GSK to live its value of being a patient focused company

Section 6: Modelling the contribution of the pharmaceuticals sector to the Scottish economy

In this section we model the economic contribution of the pharmaceutical industry to the Scottish economy using our Hypothetical Extraction Model (HEM). Specifically, we estimate the total economic impact of the manufacturing of pharmaceuticals sector, wider pharmaceuticals sector, and life sciences sector on the Scottish economy.

It is important to note that this modelling uses 2018 national accounts data and therefore does not account for the various challenges, highlighted in this report, that are currently facing the sector.

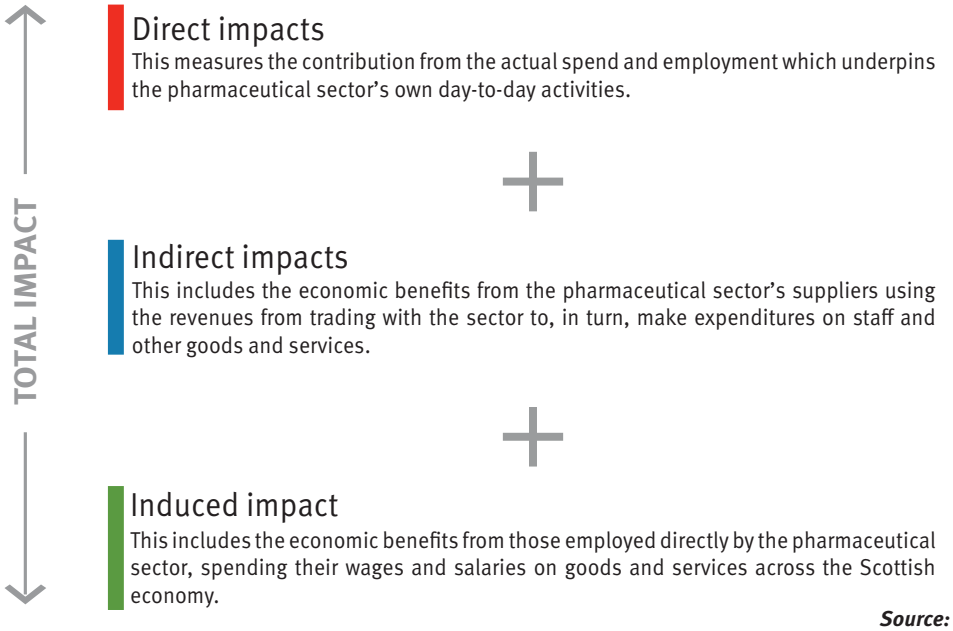
Included below is a brief description of how we define these industries - a more technical description of can be found in **Appendix 1**.

- The manufacturing of pharmaceuticals sector refers to the narrowest definition of the pharmaceuticals sector classified as SIC 21.
- The wider pharmaceuticals sector expands on the manufacturing of pharmaceuticals sector (SIC 21) and is most representative of ABPI members, including activities classified in other industries directly related to the pharmaceuticals sector, i.e. head office activities.
- The life sciences sector, as set out by the Scottish Government's growth sector definition, refers to a range of industries and sub industries which include but are not limited to the discovery, research and development, and manufacture of medications and medical devices.

The three pharmaceutical-related sectors interact with many other sectors by making sales and purchases of various goods and services. The HEM works by hypothetically extracting the pharmaceutical-related sectors by severing these linkages. By comparing the economy before and after removing pharmaceuticals we can estimate the economic contribution of the pharmaceutical industries in terms of output, FTE employment, and GVA.

Our model provides estimates of these direct, indirect, and induced impacts. **See Diagram 2**.

Diagram 2: Direct, indirect, and induced effects explained (pharmaceuticals example)



Source: *Fraser of Allander institute*

Results

In this section, references are made to GVA, output and FTE employment. Definitions for these can be found in the appendix.

Manufacturing of pharmaceuticals sector

Table 1 outlines the direct, indirect, and induced impact of extracting the manufacturing of pharmaceuticals sector from the Scottish economy.

Table 1: Economic impact of the manufacturing of pharmaceuticals sector, current prices (2018)

	Output (£m)	Employment (FTE)	GVA (£m)
Direct	1,245	4,250	980
Indirect	105	965	55
Induced	680	6,140	420
Total	**2,030**	**11,350**	**1,455**

**Totals may not sum due to rounding*

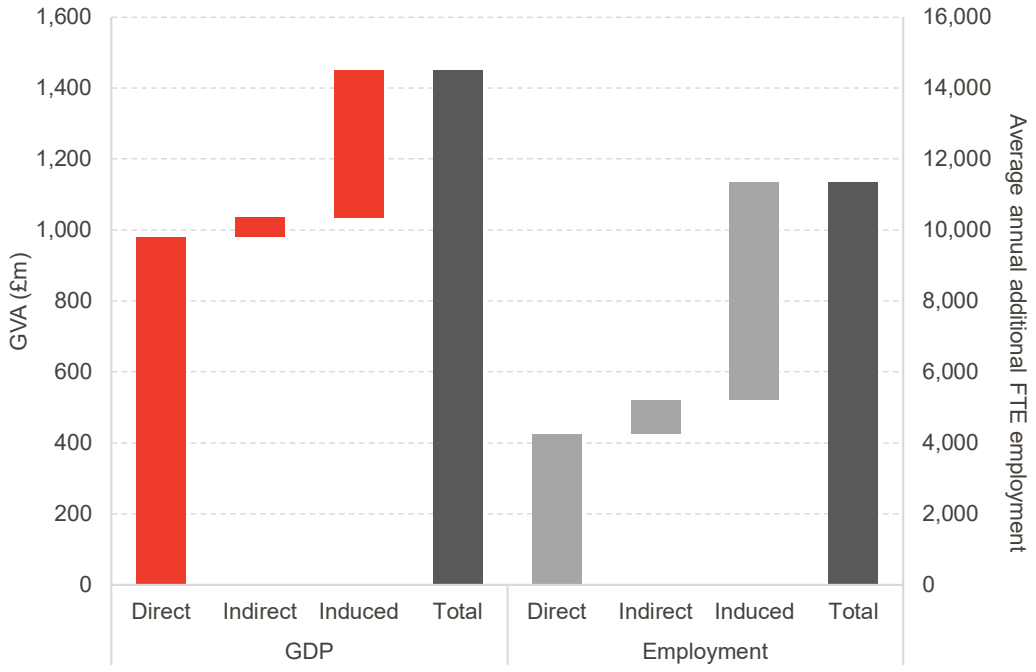
Source: *FAI Calculations*

The direct contribution of the manufacturing of pharmaceuticals sector in terms of output, employment and GVA are found in the first row of the table above. This sector directly contributes around £1.2bn in output, 4,250 FTE jobs, and almost £1bn in GVA to the Scottish economy. When spill-over effects are accounted for – the indirect and induced impacts - the manufacturing of pharmaceuticals sector is estimated to support over £2bn in output, almost £1.5bn in GVA and supports 11,350 jobs across the Scottish economy.

These model estimates indicate that for every 1 job created in the manufacturing of pharmaceutical sector, 1.7 jobs are created elsewhere in the Scottish economy.

Chart 16 shows the composition of the total economic impact associated with the manufacturing of pharmaceuticals sector.

Chart 16: Economic impact of the manufacturing of pharmaceuticals sector, current prices (2018)



Source: *FAI calculations*

Wider pharmaceuticals sector

Table 2 outlines the direct, indirect, and induced impact of extracting the wider pharmaceuticals sector from the Scottish economy.

Table 2: Economic impact of the wider pharmaceuticals sector, current prices (2018)

	Output (£m)	Employment (FTE)	GVA (£m)
Direct	1,480	5,900	1,110
Indirect	175	1,750	100
Induced	810	7,280	495
Total	**2,460**	**14,930**	**1,705**

**Totals may not sum due to rounding*

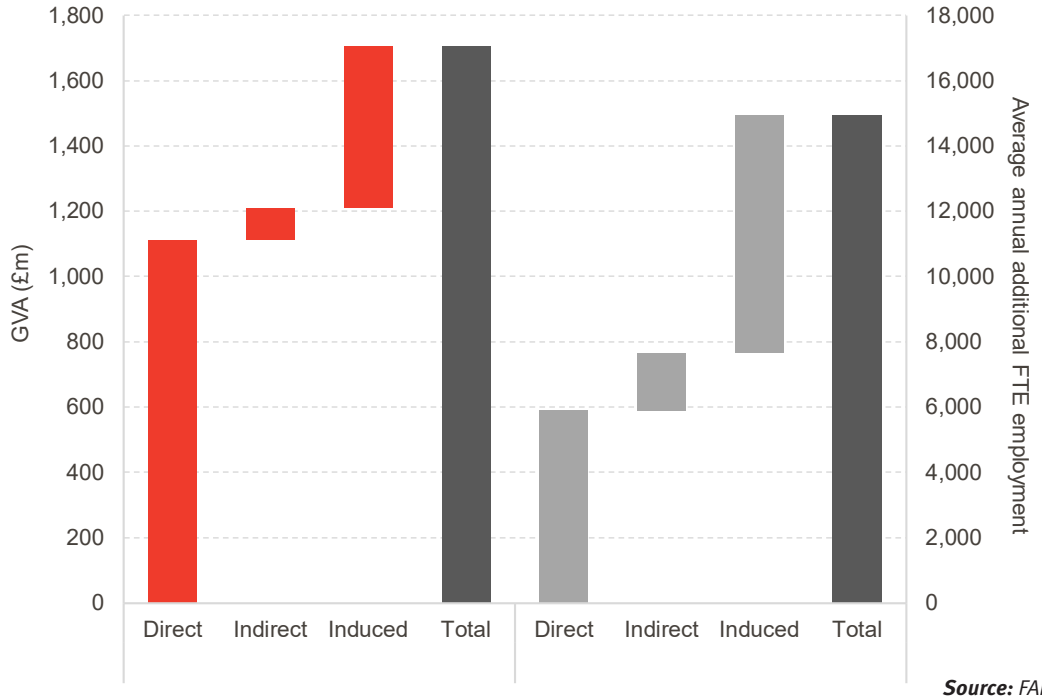
Source: *FAI Calculations*

The wider pharmaceuticals sector can be seen to directly contribute over £1.1bn in GVA to the Scottish economy, and almost £1.5bn in output. However, when the indirect and induced effects are considered, the overall economic impact of the wider pharmaceuticals sector on the Scottish economy increases to £1.7bn in GVA and almost £2.5bn of total output.

Across the entire Scottish economy, the wider pharmaceuticals sector supports just under 15,000 direct, indirect, and induced FTE jobs. For every 1 job created in the wider pharmaceuticals sector, 1.5 jobs are created elsewhere in the Scottish economy.

Chart 17 shows the composition of the total economic impact associated with the wider pharmaceuticals sector.

Chart 17: Economic impact of the wider pharmaceuticals sector, current prices (2018)



Source: *FAI calculations*

Life sciences sector

Table 3 outlines the direct, indirect, and induced impact of extracting the life sciences sector from the Scottish economy.

Table 3: Economic impact of the life sciences sector, current prices (2018)

	Output (£m)	Employment (FTE)	GVA (£m)
Direct	3,065	17,125	2,305
Indirect	560	6,335	325
Induced	1,665	15,000	1,020
Total	**5,290**	**38,460**	**3,380**

**Totals may not sum due to rounding*

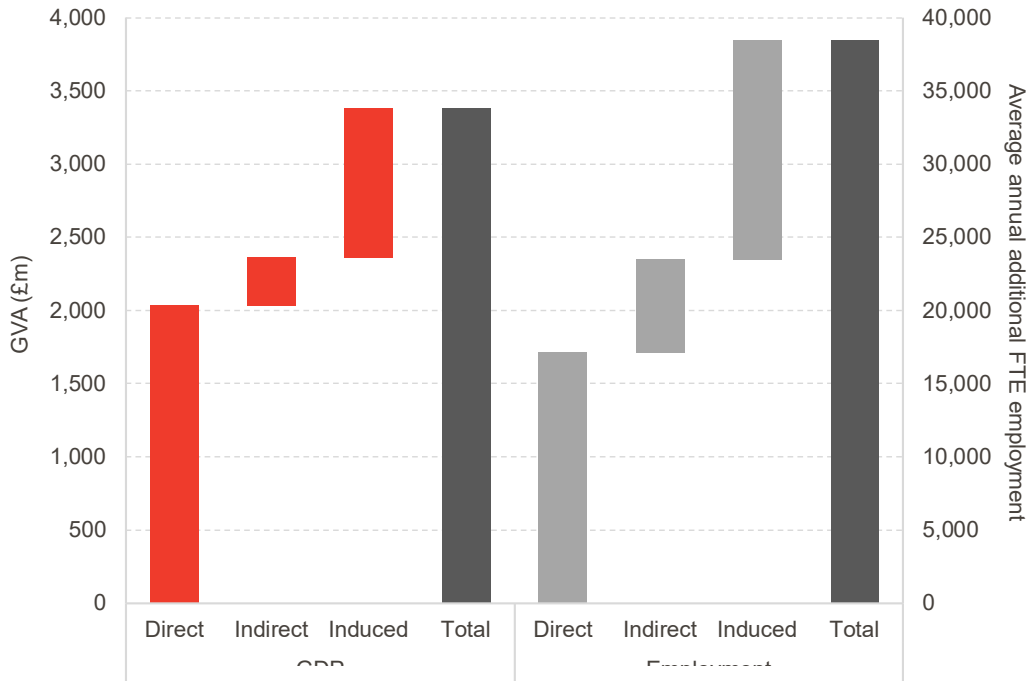
Source: *FAI Calculations*

Our model also shows that the life sciences sector contributes significantly to the Scottish economy, directly contributing over £2.3bn in GVA. Once spill-over effects into the wider economy are accounted for, the life sciences sector can be seen to contribute almost £3.4bn in GVA and support more than 38,000 FTE jobs across the Scottish economy.

For every 1 job supported in the life sciences sector, 1.3 jobs are supported elsewhere in the economy.

Chart 18 shows the composition of the total economic impact associated with the life sciences sector.

Chart 18: Economic impact of the life sciences sector, current prices (2018)



Source: *FAI calculations*

Contextualising the results

Comparison to hospitality

To understand these economic indicators, it is helpful to put them in the context of other well-known industries. In this subsection, we compare two sectors: the manufacturing of pharmaceuticals (SIC21) and accommodation (SIC55) to highlight how pharmaceuticals compares to other prominent sectors in Scotland. **See Table 4**.

We chose hospitality because it is a very labour-intensive industry, whereas pharmaceuticals is a very productive, capital-intensive industry. As these industries are so different, comparing their impacts best helps to add some context to the economic impact results.

Table 4: Economic impact of the manufacturing of pharmaceuticals and accommodation sectors, current prices (2018)

	Output (£m)		Employment (FTE)		GVA (£m)	
	SIC21	*SIC55*	*SIC21*	*SIC55*	*SIC21*	*SIC55*
Direct	1,250	2,755	4,250	43,490	980	1,730
Indirect	105	750	965	5,615	55	400
Induced	680	1,550	6,140	13,780	420	950
Total	**2,025**	**5,055**	**11,350**	**62,880**	**1,450**	**3,080**

**Totals may not sum due to rounding*

Source: *FAI Calculations*

The most striking difference between these two sectors is the extent to which the accommodation sector is directly responsible for more FTE employment than the manufacturing of pharmaceuticals – around 10 times as many directly employed. This is unsurprising given the labour intensity of the hospitality sector.

However, for every 1 job supported by the accommodation sector, 0.4 additional jobs are supported elsewhere in the economy. In contrast, for every 1 job supported by the manufacturing of pharmaceuticals sector, an additional 1.7 jobs are supported elsewhere across the Scottish economy, meaning that pharmaceutical activities have greater job spill-overs than the hospitality sector.

Additionally, despite having a direct workforce more than ten times greater than the manufacturing of pharmaceuticals, the GVA directly supported by the accommodation and food services sector is not even double that of pharmaceuticals. Therefore, as outlined already in this report, the manufacturing of pharmaceuticals is highly productive.

Comparing the wider pharmaceutical results to the results from 2021's report

In our 2021 report, we modelled the contribution of the manufacturing of pharmaceuticals sector and wider pharmaceuticals sector using 2017 IO tables. This report makes use of 2018 IO tables therefore, there are some small differences.

Our overall modelling results from our latest report are broadly the same for the manufacturing of pharmaceuticals sector. However, there have been reductions in GVA and output impacts in this industry due primarily to smaller direct impacts - this means GVA and output in this sector were slightly lower in the 2018 tables than the 2017 tables. The employment impacts have remained broadly the same, except direct employment is now higher in our latest estimates.

In the wider pharmaceuticals results, GVA and output estimates are lower – driven by the change in manufacturing of pharmaceuticals discussed above – however, employment estimates are up. This is because the R&D component of the wider pharmaceuticals sector has saw employment impacts increase in the latest model used.

Conclusions

The pharmaceuticals sector is a significant contributor to the Scottish economy and a key player in one of Scotland's 'Growth Sectors' - the life sciences sector.

In this report, we modelled the economic contribution of the manufacturing of pharmaceuticals sector, alongside the life sciences growth sector to Scotland's economy.

However, as discussed, we also modelled a broader group of pharmaceutical contributors which is most representative of ABPI members, which we call the wider pharmaceuticals sector.

The wider pharmaceuticals sector can be seen to contribute a total of £1.7bn in GVA to the Scottish economy, supporting 15,000 FTE Scottish jobs.

For every 1 job created in the wider pharmaceuticals sector, 1.5 jobs are created elsewhere in the Scottish economy. While this is higher than the equivalent life sciences figure of 1.3, this is slightly less than the equivalent figure for the manufacturing of pharmaceuticals sector, where for every 1 job created in this sector, 1.7 jobs are created elsewhere.

These estimates clearly demonstrate that the pharmaceuticals manufacturing sector has a significant impact not just within its own industry but also in other industries of the economy.

Beyond its economic impact, the pharmaceutical industry delivers a range of wider impacts across the Scottish economy, directly supporting the Scottish Government's five programmes of its National Strategy for Economic Transformation.

For example, the pharmaceutical sector has seen tremendous growth in recent years. Between 2019 and 2021, total turnover rose from £690m to £1.65bn - down from its 2020 peak of more than £2bn.

Although this level of turnover remains above pre-pandemic levels, it is important that this sector is properly supported so that the increased jobs and growth are not lost and continue post-pandemic.

Due to this significant growth we are likely to see pharmaceuticals exports increase in 2020's export estimates despite the recent dip in exports to rUK shown in 2019's figures.

As discussed, clinical trials play a key role in pharmaceuticals' export growth potential however, patient access to industry research has fallen 44% since 2017/18, median wait time for regulatory approvals in trials rose by 25 days to 247 days in 2018 - 2020, and the number of clinical trials in the UK per year contracted by 41% between 2017 and 2021.

Improving the performance of clinical trials is an important challenge to overcome for this sector.

Despite these challenges, the pharmaceuticals sector is a key driver of innovation and productivity in the economy with a GVA per head of employment of £200,700 in 2020, more than 3 times the Scottish average.

Additionally, these productive jobs are not isolated to Scotland's big cities, as the sector primarily employs people in rural communities in the Highlands, and also in deprived areas that struggle with employment and income deprivation, such as North Ayrshire.

With almost a third of Scotland's inactivity rate driven by long-term sickness, there are key concerns surrounding drivers of longer-term productivity and the potential strain on public finances. Pharmaceutical innovations has and will continue to play a fundamental role in improving the health of people across the economy through reducing patient wait times and providing cutting edge medicines.

Appendix 1: Modelling methodology

In this report, a Hypothetical Extraction Model (HEM) was used to estimate the economic contribution of the pharmaceuticals sector to the Scottish economy. The HEM was specifically developed by the FAI for the present research and was built on the 2018 Input-Output (IO) tables for Scotland.

The HEM can be seen as "shutting down" the sectors, or proportions of sectors, to examine the resulting impact on the economy. The HEM extracts the sectors in which ABPI members operate in the Scottish economy, resulting in a reduction in economic activity across the whole economy.

By hypothetically removing the pharmaceuticals sector from the Scottish economy, we can estimate the size of the remaining economy and calculate the difference between the original economy and the newly extracted economy as the contribution of the pharmaceutical sector.

One key benefit of using a HEM is that the model is flexible. The HEM allows for the extracted sector/sectors to take many forms. For example, a single sector can be extracted – as was done here for the manufacturing of pharmaceuticals sector (SIC21) – or mixture of industries and sub-sectors can be extracted – as was also done here for the wider pharmaceuticals and life sciences sectors.

The composition of each sector is shown below with the share of each component extracted in red.

Manufacturing of pharmaceuticals sector:

- SIC21: Manufacture of basic pharmaceutical products and pharmaceutical preparations (100%)

Wider pharmaceuticals sector:

- SIC21: Manufacture of basic pharmaceutical products and pharmaceutical preparations (100%)
- SIC46: Wholesale trade, except for motor vehicles and motorcycles (0.51%)
- SIC70: Activities of head offices; management consultancy activities (0.02%)
- SIC72: Scientific research and development (12%)

Our definition of the wider pharmaceuticals industry comes from ABPI employment data provided by ABPI for our 2021 report. This data was used alongside Scottish IO tables to determine the share of a given Standard Industrial Classification (SIC) code that was directly attributable to the wider pharmaceuticals industry. The share of the scientific research and development industry attributed to wider pharmaceuticals was calculated using Business Enterprise Research and Development Scotland data for 2018.

Life sciences sector

- SIC21: Manufacture of basic pharmaceutical products and pharmaceutical preparations (100%)
- SIC26: Manufacture of computer, electronic and optical products (1.25%)
- SIC32: Other manufacturing (49%)
- SIC72: Scientific research and development (94.2%)

The definition of the life sciences sector used in this report can be found on the Scottish Government's website under Growth Sector Statistics. This sector is comprised of various two-, three-, and four-digit SIC codes. Using employment data from the Business Register and Employment Survey we determined the relevant share of each two-digit SIC code which comprised the life sciences sector to extract in the HEM. As the most recent Input-Output (IO) tables at the time of modelling – which form the basis of the HEM – are for the year 2018, employment data from 2018 was used for consistency.

The wider pharmaceuticals and life sciences sectors, as they are defined in this report, both include shares of SIC72. Approximately 94% of SIC72 is included in the growth sector definition of the life sciences sector – which is a substantially larger share than the 12% included in the wider pharmaceuticals industry.

This difference reflects the inclusion of scientific R&D activities present in life sciences sector definition that are not considered to be pharmaceutical R&D activities. While the life sciences sector encompasses a broader set of sectors than the wider pharmaceuticals sector – the rationale for modelling the economic contribution of this sector comes from the importance of the life sciences growth sector to Scotland's Economic Strategy.

Economic Indicators

The key results of our model are changes in output, GVA, and FTE employment.

Output refers to the value of sales of all goods and services produced in an economy. This is most easily thought of as similar to the turnover of firms. However, output is selected over turnover because a large amount of activity is not undertaken by just firms (e.g. Public Sector Spending). The key difference between Output and GVA is that value of intermediate goods is included in the calculation of output where they are not included in the calculation of GVA.

Gross value added (GVA) is the value of all final goods and services produced, and is a measure of the contribution to an economy. GVA is a preferred measure to output as a firm could buy £1m of goods and sell these on for a further £1m – clearly no additional value has been created. GVA can be expressed generally as the difference between revenue from sales and the cost of inputs.

Full-time equivalent (FTE) employment considers the importance of full-time and part-time employees. One FTE job equates to one full-time employee working for one year, or, alternatively, two-part time employees working half the number of full-time hours for one year.

Fraser of Allander Institute
University of Strathclyde
199 Cathedral Street
Glasgow G4 0QU
Scotland, UK

Telephone: 0141 548 3958
Email: fraser@strath.ac.uk
Website: fraserofallander.org
Follow us on Twitter via @Strath_FAI
Follow us on LinkedIn: FAI LinkedIn
