The contribution of medical research funding by charities to the Scottish economy

Fraser of Allander Institute

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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 June 2021 by the British Heart Foundation.

The analysis was undertaken independently by the FAI. The FAI is committed to informing and encouraging public debate through the provision of 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.

We are also thankful to the Association of Medical Charities (AMRC) and the UK Clinical Research Collaboration (UKCRC) for their help with this work.

Executive Summary

- Third sector medical research plays an important role both in the Scottish economy and society.
- Medical research makes huge contributions to society through developing new treatments, improving existing ones and advancing technologies that can help save lives, such as vaccines that help to fight against infectious diseases like Covid-19.
- Charities are major funders of medical research in Scotland. Medical research funding by charities has been estimated to be 46% of all third sector and public funding of medical research in Scotland, with active research funding of £122m in 2018.
- Without charities funding medical research and development in Scotland, the government and other public bodies would need to increase direct funding by 73% to make up for the shortfall.
- Our findings in the accompanying report show that medical research funded by charities has grown since 2014 in Scotland, with a fall in funding in 2020 due to the pandemic.
- Furthermore, whilst the primary aim of medical research funding by charities is to create benefits to people's health, the funding also makes a significant contribution to the Scottish economy:
    - Recipients of research funding purchase goods and services in order to undertake their research. This generates activity in their supply chains and across the whole of the Scottish economy.
    - R&D can boost output and productivity in an economy with new technologies, medicines and processes.
    - As new methods and technologies are discovered, there are knowledge spill-overs into the public, private and third sectors which boost productivity and economic growth.
- This report examines the first of these contributions and estimates the economic impact of medical research funding by charities on the Scottish economy in terms of jobs, output and GVA (Gross Value Added). This includes the direct impact of research on universities and medical organisations, as well as wider impacts on supply chains and wages.
- Our results estimate that, in 2019, medical research funding by charities supported 7,475 jobs, £470m output and £320m GVA in Scotland.
- The pandemic had a significant impact on medical research funding by charities, placing jobs in research and the wider economy at risk. In 2020, the fall in medical research funding by charities put 575 jobs, £36m output and £25m GVA at risk in Scotland.
- We also estimate multipliers for medical research funding by charities and compare these to 97 sectors of the Scottish economy. Every £1 million spent on medical research funding in Scotland by charities supports:
    - £1.98 million of output – 23rd highest multiplier out of 97 sectors.
    - £1.33 million of GVA – 4th highest multiplier out of 97 sectors.
    - 31 jobs – 6th highest multiplier out of 97 sectors.

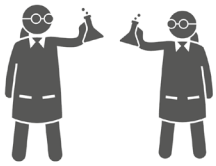
SCOTLAND
THIRD SECTOR MEDICAL RESEARCH

£470m

Total output supported in the Scottish economy by third sector medical research expenditure

Third sector medical research supported a total of **7,475 FTE jobs** across the Scottish economy in 2019

Medical research spend by charities in Scotland was **£226m** in 2019



In 2018, health-related research accounted for **25%** of all UK research and development, or **£8.64 billion**

Charity medical research spend has the **23rd highest** output multiplier out of 97 Scottish sectors

Charity medical research spend has the **6th highest** employment multiplier out of 97 Scottish sectors

Charity medical research spend has the **4th highest** GVA multiplier out of 97 Scottish sectors

Third sector medical research supported **£320m** of GVA across the Scottish economy in 2019

[1]*Source: UKCRC*

1. Introduction

Medical research funding by charities makes an important contribution to Scotland. In addition to the socio-economic benefits of medical research such as improved health outcomes and better health technologies, medical research also contributes positively to the Scottish economy.

The Scottish Government include medical research and development as part of the Life Sciences Growth Sector. This is one of the 6 Growth Sectors in its 2015 Economic Strategy. These sectors are identified industries where Scotland has a significant comparative advantage and play a key priority role in Scotland's continued economic growth.

The Covid-19 pandemic has also accelerated the role that R&D has to play in the Scottish economy. Science and innovation have played a crucial role in attempts to curtail the virus and provide treatment which have allowed the loosening of restrictions and the re-opening of the economy.

This report assesses the economic contribution and wider spill-over impacts of medical research expenditure by charities on the Scottish economy.

The analysis focuses only on the economic impact of charity-funded medical research expenditure in Scotland. It does not account for capital expenditure, non-medical research and research undertaken in other countries.

We also refer to 2019 figures throughout this report due to the unprecedented effects of the Covid-19 pandemic on third sector medical research. This provides a more accurate representation of the economic contribution of medical research activities in Scotland.

This report is divided into the following sections:

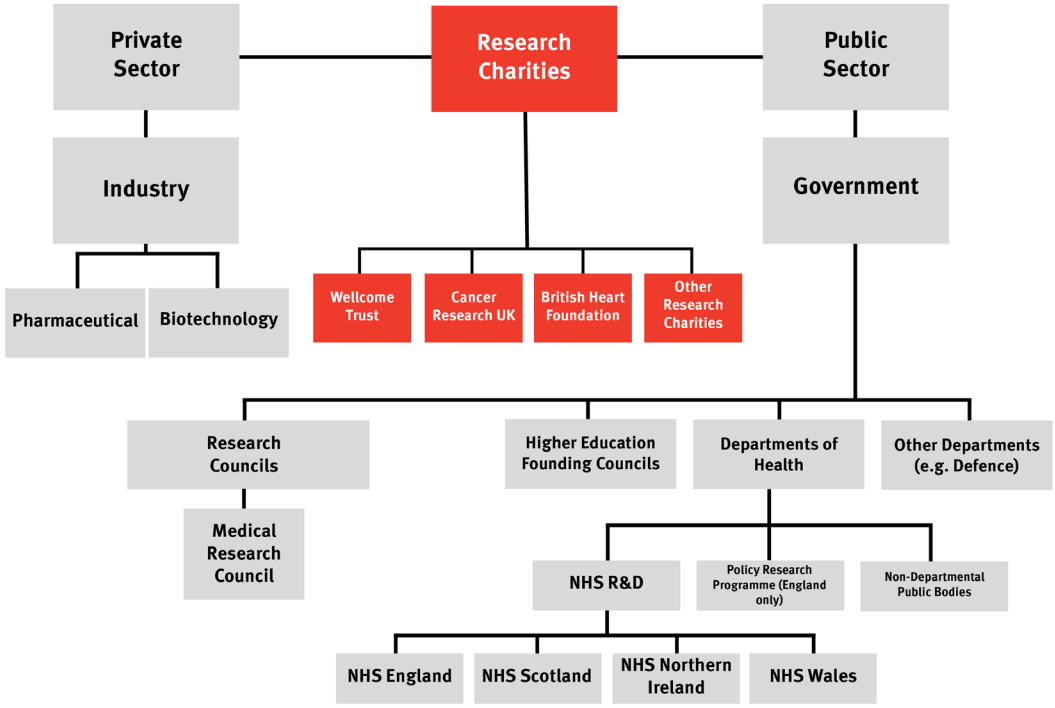
- Section 1 provides an overview of medical research in Scotland.
- Section 2 evaluates some of the socio-economic benefits provided by R&D, and in particular, health R&D in Scotland.
- Section 3 evaluates the economic contribution of third sector medical research expenditure in Scotland in terms of economic output, Gross Value Added (GVA) and employment.

2. Medical Research in Scotland

Who undertakes medical research in Scotland?

Medical research is an integral part of the Scottish economy and Scotland benefits greatly from its reputation of world-leading research. In part, this reputation has been built on unique characteristics of Scotland's research environment including the health and social care system and the many well supported medical research charities in Scotland and the UK.

Diagram 1: Health R&D system in the UK



Source: *UK Government*

Funding in medical research and Health R&D is distributed through three main channels (Figure 1):

- Private sector
- Public sector
- Research charities

Private sector medical research primarily includes firms in the human health and pharmaceutical

sectors in the UK. According to analysis by the UK Clinical Research Collaboration[1], the private sector is the largest performer of health-related research in the UK, undertaking half of all research.

This is followed by universities who undertake over a third of all research (36%).

However, these figures do not fully demonstrate the source of funding for research in the UK. While data is typically collected on who is undertaking the research, less is known about the size of the contribution from these different groups to health-related research funding.

Who funds medical research in Scotland and the UK?

The UK's Governments are not major undertakers of research but provide a significant amount of funding to those performing the research. This is funded primarily through taxation and includes funding by the Scottish Government, through the Chief Scientist Office, the Scottish Funding Council, and the UK Government, through UK Research and Innovation and the National Institute for Health Research (NIHR).

Similarly, medical research charities provide significant funding for health-related research. A 2018 survey by the UK Clinical Research Collaboration (UKCRC) has attempted to inform this discussion by speaking to 13 member organisations, 25 UK Government and other publicly funded organisations, 12 professional organisations, 87 medical research charities that are members of AMRC and 9 non-AMRC charities.

For the UK as a whole, the survey found that in 2018:

- UK Research and Innovation funded £986 million of health research (39%).
- Other government and public bodies funded £460 million of health research (18%).
- Charities and not-for-profit organisations funded £1,115 million of health research (44%).

Although the response rate for member organisations was 100%, it's important to note that the response rates for UK Government and other publicly funded organisations, professional organisations, AMRC medical research charities and non-AMRC charities were only 63%, 39%, 62% and 16% respectively.

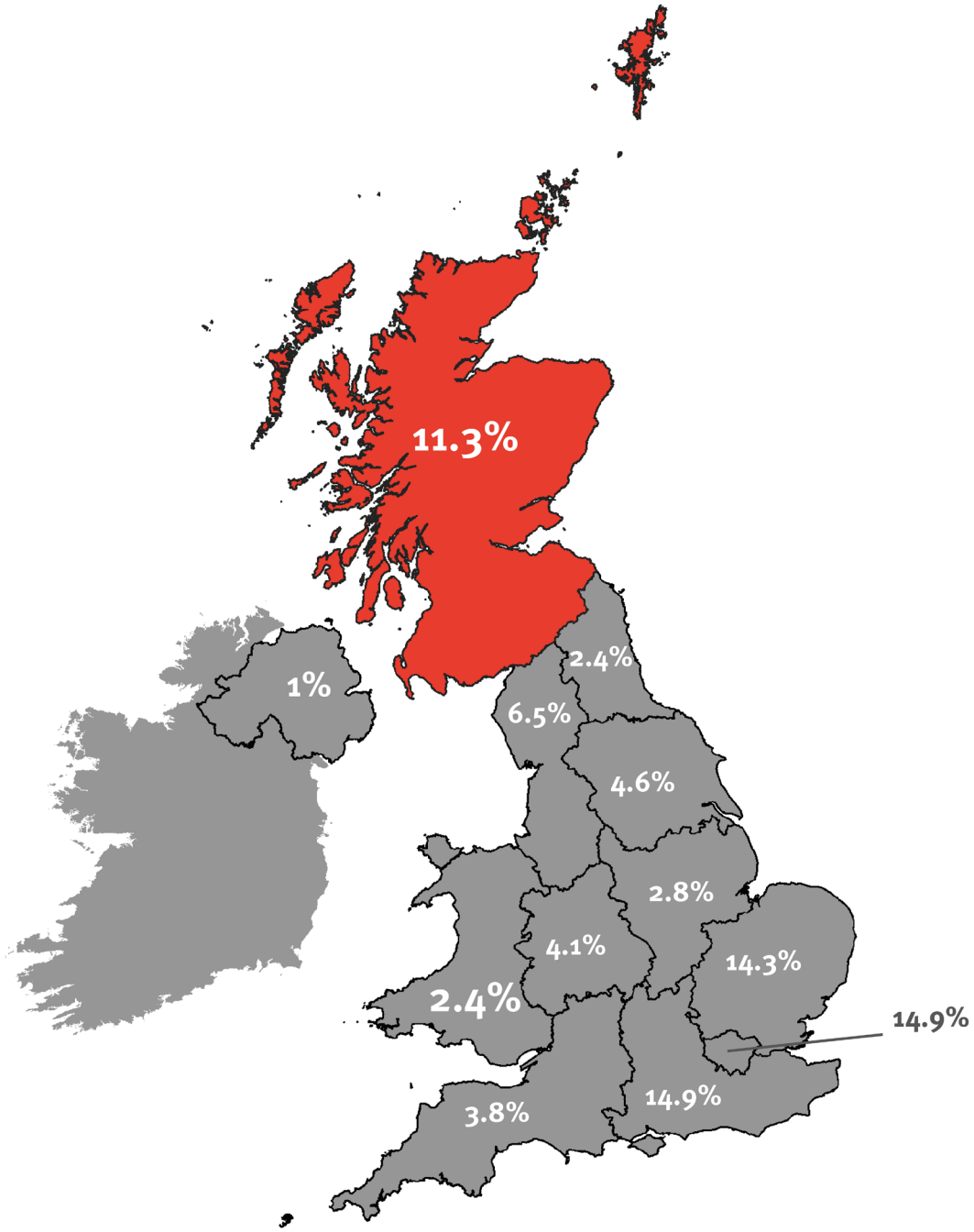
The UKCRC data does not cover all charity research funding. The survey finds that all charities and not-for-profits funded £1,115m of health-related research in 2018, of which AMRC charities made up £1,018m.

However, a small number of AMRC charities did not provide data in the UKCRC survey – their grants are estimated at £42m[2]. In addition, the UKCRC survey does not include a large amount of Cancer Research UK funding for 2018. Difficulties in comparing data provided by financial year and by calendar year make it difficult to precisely estimate this, but time-based estimates of grant funding by Cancer Research UK[3] suggest that the UKCRC figure may underestimate their funding by approximately £65m - £81m.

1 See UKCRC
2 These figures are sourced from the publicly available AMRC dashboard.
3 Analysis of Grant Costs and Time-Apportioned Spend by Host Institution, Cancer Research UK.

In total, we therefore estimate that total research funding by charities was £1,222m in 2018, or 46% of all public and third sector medical research funding. This is on a time-apportioned basis where funding is allocated to years based on active research time[4].

Diagram 2: Public and charity health related R&D by devolved nation and parts of the UK, 2018



Source: *UKCRC*

4 This is different to the transaction based estimates used in the modelling which allocates funding to years based on financial transactions. AMRC transaction based estimates for 2018 financial years stood at £1,303m.

Using the UKCRC dataset, we find that the third sector supports £122m of medical research expenditure in Scotland and the public sector supports £168m.

Without charities funding medical research and development in Scotland, the government and other public bodies would therefore need to increase direct funding by 73% to make up for the shortfall.

Growth in Scottish medical research funding by charities over time

Charity-funded medical research also plays a crucial role in the research environment. Due to the unique purpose of charities, the research they fund is inherently patient-centric due to their strong relationships with patients and insights into their priorities. The research funded by charities is also crucial to building the wider research base through developing the skills of the workforce, investing in infrastructure and funding high-risk, high-reward research that de-risks discovery for industry. This investment works to leverage investment from industry.

Charities are therefore crucial to the foundation of the research environment that allows for the creation of economic benefit.

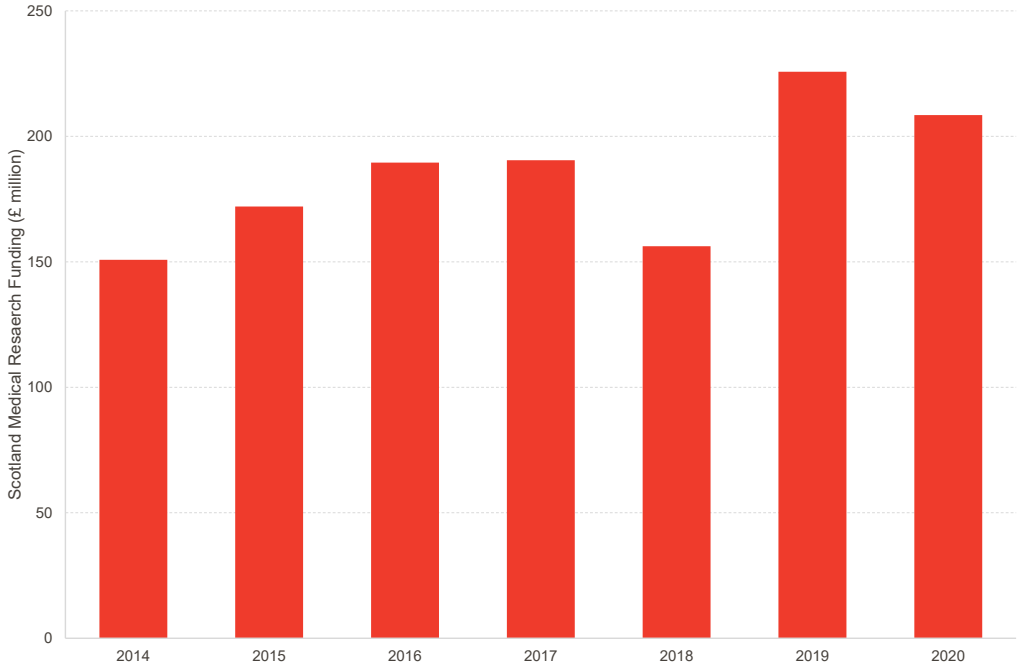
Medical research expenditure[5] has increased since 2014, with more than £150 million distributed by AMRC charities in Scotland in 2020 (Chart 1).

In 2020, Scotland experienced a drop in medical research expenditure by charities. Reported expenditure was around £120 million lower than in 2019 – a fall of around 44%. This can be attributed to the pandemic, with in-person charity retail operations having to close and household finances at risk.

2018 was a comparatively weak year for charity funding of medical research in Scotland with a fall of around £34 million from 2017. This was due to lower funding from Wellcome in this year.

5 This is expenditure by 154 member charities of the Association of Medical Research Charities.

Chart 1: Total AMRC medical research expenditure in Scotland, £ million, annualised value, 2014 - 2020



Source: *UKCRC, AMRC, FAI Calculations*

The Covid-19 pandemic impact on charity-funded medical research

The ongoing Covid-19 pandemic has significantly affected medical research in Scotland.

National lockdowns have slowed down lab-based research and the tightened financial situation of many households, combined with national lockdowns has affected charity income from donations and retail sites.

Further to this, in Glasgow, researchers funded by the British Heart Foundation Scotland were seconded to support the work of the Glasgow Lighthouse Lab, using their expertise to support efforts to control the pandemic.

A survey by the Scottish Charity Regulator in November 2020 found that at the peak of the pandemic around 1 in 5 charities had ceased all operations, with 39% having suspended some operations[6]. Across the UK, funding from AMRC charities, excluding Wellcome, fell from £917 million in 2019 to £776 million in 2020, a drop of 15%. This trend is expected to continue with a survey of member charities estimating that funding will fall to £653 million during 2021.

As well as this, the AMRC[7] highlights the potential long-term implications of the pandemic on medical researchers. They estimate that in 2020 there were 1,750 early career medical researchers or PhD students of which two thirds relied solely on medical research funding to support their salaries.

6 See OSCR
7 See AMRC

The cuts in charitable funding during the pandemic meant around 60% of charities had to reduce or cancel support for early career and skilled researchers.

The direct consequences of these cuts are evident, with 40% of early career researchers admitting to having considered leaving medical research, and 82% of researchers feeling less secure in the profession.

The resulting uncertainty in the sector, caused by the pandemic, means that not only might the sector lose good talent but could also lead to long-term shortages in highly skilled medical researchers. Additionally, in May 2020, the AMRC forecasted that the sector may not return to pre-pandemic levels for 4-5 years, leading to potential implications for the further advancement of medical treatments in the UK and Scotland.

Which charities fund medical research?

In Scotland, there are currently more than 24,000 charities operating for a wide variety of causes across society[8].

A study by the Charities Aid Foundation in the UK[9] found that in 2018, 64% of people had donated to a charity with the most donated to causes related to animal welfare and young people (26%); and a quarter of respondents reported having donated to medical charities.

Data provided by the Association of Medical Research Charities - a membership organisation with more than 150 registered charity members - shows that some of the largest members, by the amount of research they fund, in Scotland are:

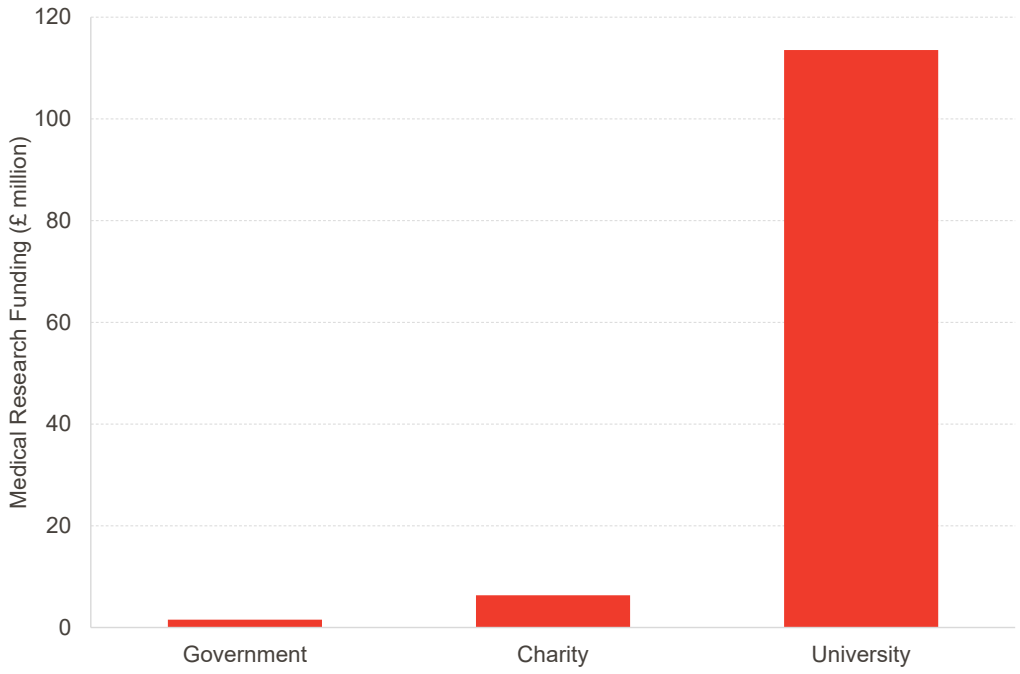
- The Wellcome Trust
- Cancer Research UK
- British Heart Foundation
- Versus Arthritis
- Asthma UK

Recipients of funding

The member charities of the AMRC distribute medical research funding across Scotland via several organisations and institutions. The largest type of recipient is universities, receiving 93% of the total value of research grants in 2018.

8 See Scottish Government
9 See Charities Aid Foundation

Chart 2: Charity-funded medical research grants in Scotland by recipient type, 2018



Source: *UKCRC*

The role of universities in Scotland

Not only do universities have commitments to provide high quality education they also conduct a significant amount of research. Medical schools and other relevant bodies within universities have core aims to provide ground-breaking research and technologies.

Scotland's universities have a strong reputation for such research which has supported the development of internationally competitive areas of research excellence, attracting significant funding to the nation.

This research base has also been crucial in attracting major investment from medical research charities. In 2018, Scotland attracted 11% of the total funding awarded by charities in the UK. Charities have also invested significant sums to support research centres in Scotland, linked with universities and NHS hospitals.

In recent years, examples of medical research conducted by Scottish universities and funded by charities include:

- Researchers at the University of Aberdeen investigating new treatments for sight loss as a result of diabetes. The research, funded by The British Heart Foundation, will see researchers tackle diabetic retinopathy (DR) by developing methods to identify physical signs of DR early and introducing preventative measures.
- The Precision-Panc trial, which received majority funding from Cancer Research UK, is a world-leading clinical trial that aims to find the best treatments for people with pancreatic cancer being led by researchers at the University of Glasgow.

- The creation of the Sir Jules Thorn Centre for Co-Creation of Rehabilitation Technology at The University of Strathclyde, funded by The Sir Jules Thorn Charitable Trust. The centre aims to develop innovations and cutting-edge technology to help those recovering from strokes and other debilitating illnesses.

Life Sciences in Scotland

The life sciences sector is widely identified as a key strength in Scotland's economy, with Scotland considered a global cluster for life sciences research. The life sciences sector has been identified as one of Scotland's six growth sectors - those sectors identified by government as having a distinct comparative advantage.

As a result of this, the sector is a focus area for the Scottish Government. The Government aims to support the sector and actively encourage inward investment to help drive growth. To do this, the Scottish Government has worked with its partners to develop the 'Life Sciences Strategy for Scotland 2025 Vision,' which aims to drive growth in the sector and contribute £8bn to the Scottish economy by 2025.

Scotland is seen as one of the major contributors to life sciences across Europe, employing more than 14,000 people across 423 organisations with combined turnover of £2.8bn[10].

Scotland is attractive as a location for investment, in part due to its established university sector and robust research environment, which has been enabled through funding by public and charitable sources.

As well as this, the life sciences sector has strong ties to the public sector. For example:

- Life sciences is identified as a key growth sector by the Scottish Government who have published the Life Sciences Strategy to support this growth.
- Scotland's higher education sector is committed to working to facilitate life sciences through the Scottish Universities Life Sciences Alliance (SULSA)

Other research and experimental development activities in the life sciences sector also generated £535m in Gross Value Added in 2018, further highlighting the strong contribution of research to the Scottish economy.

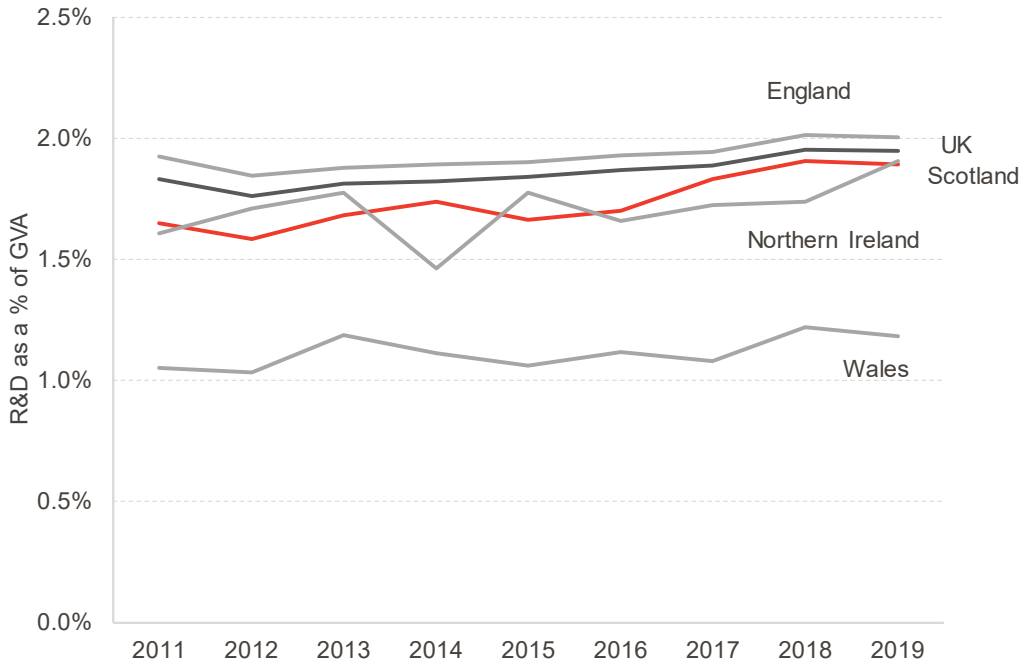
10 See Life Sciences Industrial Strategy

The benefits of medical research and development

How much R&D does Scotland perform?

In 2019, gross expenditure on research and development in Scotland was £2.8bn, or 1.66% of GDP.

Chart 3: R&D as a percentage of GVA[11]

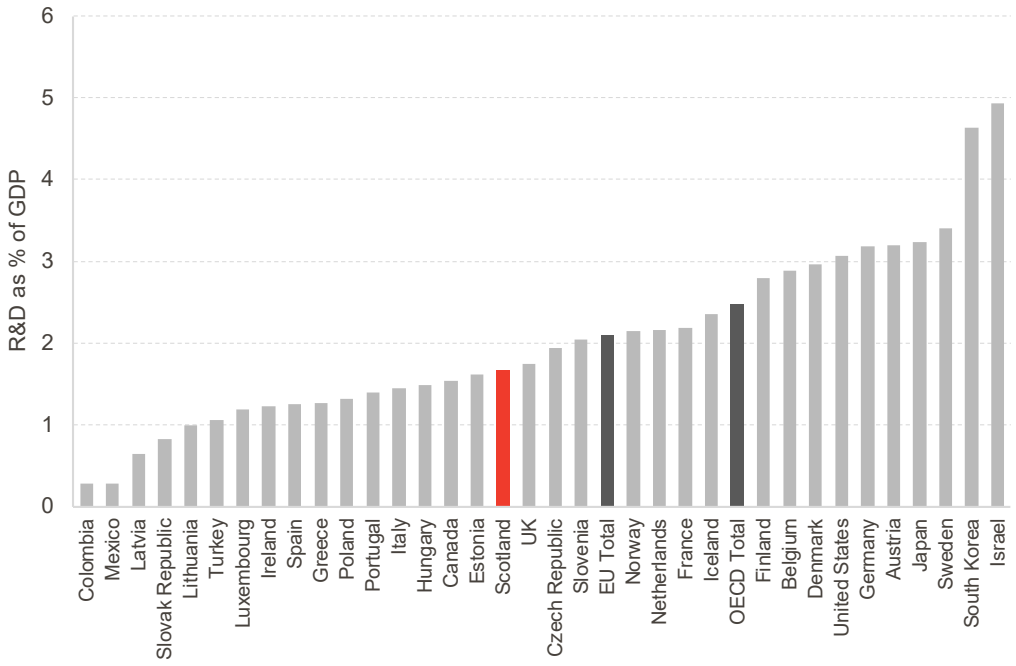


Source: *ONS*

Out of the three devolved nations of the UK and 8 regions of England, Scotland is positioned 5th in R&D expenditure as a percentage of GDP (and 4th on a per head basis). Nationally, this places Scotland ahead of Northern Ireland and Wales, but behind England by this measure.

11 Note that we have used GVA rather than GDP to calculate this chart. This has allowed for a full time series back to 2011, although the numbers are higher than those seen using GDP as the denominator.

Chart 4: Research and development expenditure as a % of GDP, OECD comparison, 2019



Source: *Scottish Government*

On an international scale, we can compare Scotland's R&D expenditure as a percentage of GDP to 34 OECD countries. Scotland has the 18th highest R&D spend as a percentage of GDP. Countries such as Israel, South Korea, Sweden, and Japan lead the table.

The benefits of health R&D

R&D can boost output and productivity in an economy. As technology advances, we can produce more with the same amount of resources and so productivity improves. As new methods and technologies are discovered, there are knowledge spill-overs into the public, private and third sectors. Productivity is a key, long-term driver of economic and wage growth.

There are many socio-economic benefits resulting from increased R&D, particularly in the case of health-related research. R&D can improve lives through improved health care, develop skills through new processes and ideas, and improve overall quality of life with advancements in medical technologies and treatments.

Scotland's strong performance within the life sciences sector also highlights the role of research and development to the Scottish economy, however health related R&D also has its own specific benefits to the economy and society.

Health research and development has been a huge contributor to improvements in health outcomes and technologies.

In general, health research can diagnose diseases and health problems, help to discover new drugs and treatments, and as previously mentioned, create vaccines to fight contagious viruses like Covid-19. Some examples of successful medical related R&D projects funded by charities in Scotland include:

- A project examining two drugs and their ability to help tackle specific forms of strokes in people. Currently there is no treatment for certain types of stroke, such as a lacunar stroke, and so this research, funded by the British Heart Foundation, will provide huge strides towards finding a treatment and improving health outcomes for those affected.
- The creation of a new Covid-19 drug screening and resistance facility which aims to investigate drug candidates for treatment of Covid-19 and help to identify and investigate new strains of the virus in a bid to fight the disease early. The Covid-19 Drug-Screening and Resistance Hub is funded by LifeArc and the Medical Research Council.
- A study, funded by a plethora of Motor Neurone Diseases related charities as well as the Medical Research Council, has broken new ground by discovering problems with nerve cells in MND patients which could potentially be repaired by the repurposing of other drugs. The research will not only help tackle a currently incurable illness, but also alter health outcomes for people all over the world.

Whilst these are only a few examples of ongoing and successful medical research projects funded by charities in Scotland, medical research ranges across all health conditions, from the rarest diseases to most common illnesses.

As well as benefitting society, charity-funded medical research has wider benefits to medical research environment as a whole.

For example, research by Burridge et. al (2016)[12] found that increases in government and third sector funded research can increase private sector funding. They find that increasing expenditure in the public sector and third sector by 1% creates nearly the same increase in private sector expenditure within a year.

However, whilst the primary intention of medical research is to improve our health, medical research spending by charities also provides a significant contribution to the economy.

12 See Burridge et. Al (2016)

3. Modelling the contribution of medical research expenditure

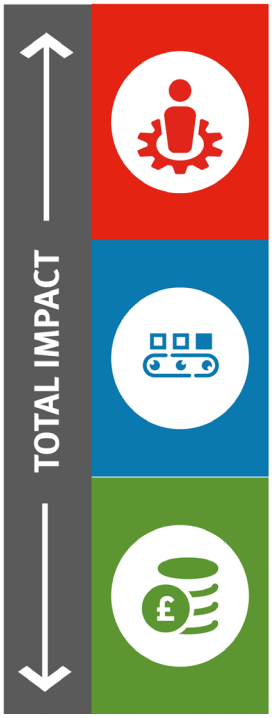
Improving treatments and outcomes for the people of Scotland is the priority for medical research. However, it is not the only achievement. Medical research expenditure funded by charities also makes a substantial contribution to the economy, supporting economic growth and jobs across the whole of Scotland.

In this section, we use our detailed model of the Scottish economy to estimate the economic impact of medical research expenditure funded by charities. We focus on the impacts of spending on supply chains and wages in Scotland. Notably, our estimates do not include the significant beneficial impacts of:

- Improved levels of health in Scotland which help unlock the potential of the workforce, reduce health service costs and improve quality of lives.
- The positive knowledge and innovation spill-overs of medical research on knowledge within the private, public and third sectors, which drives economic growth over the long term.
- The value of drugs, patents and technologies that are created as a result of the research.

Interpreting our results

The results highlight the direct, indirect, and induced impacts of medical research expenditure in Scotland. The diagram below explains each of these impacts.



Direct impacts

Medical research spending by charities funds research and development in universities and medical organisations. To perform their research they purchase goods and services from suppliers. The reaction of suppliers to meet this demand generates output, GVA and employment.

+

Indirect impacts

Their suppliers make purchases from their own suppliers who, in turn, have their own suppliers. The indirect impact measures the output, GVA and employment generated throughout the national supply chain.

+

Induced impact

The employment gained due to the direct and indirect impacts leads to additional wages. These wages are spent on goods and services around the nation, further boosting the economy.

Our estimates are presented using output, GVA and FTE jobs.

- Output is the value of all goods and services produced.
- Gross value added (GVA) is a measure of the contribution to an economy and is similar to GDP - gross domestic product. Put simply, it is output minus the cost of goods and services used in production.
- Full-time Equivalent (FTE) Jobs is a measure of jobs that accounts for the spread of part-time and full-time work across sectors of the economy. One FTE is equal to one job working full-time hours, or two part-time jobs.

Total Impact

In 2019, medical research funding by charities supported around £470 million output, £320 million GVA and 7,475 employment in Scotland.

Of these jobs, 5,125 jobs are supported directly in universities and medical organisations receiving funding, while a further 2,345 jobs are supported across Scotland as a result of spill-over effects.

The pandemic has had an impact on funding. Medical research funding in Scotland provided by charities fell from £226 million in 2019 to £208 million in 2020. As a result, there was less output and GVA, and fewer jobs supported by medical research funding by charities in 2020 than in 2019.

As a result of this fall in funding, as many as 575 jobs across all sectors of the Scottish economy were at risk of being lost. The true impact on job losses is likely much smaller than this figure due to significant government interventions such as the Job Retention Scheme.

Table 1 to Table 3 highlight the direct, indirect (supply chain spill-overs) and induced (wage spending spill-overs) impact of medical research expenditure by charities in Scotland.

Table 1: Economic impact of medical research funding by charities on Scottish output, £ million, 2019-2020*

	2019	2020
Direct	240	220
Indirect	40	40
Induced	190	180
Total	**470**	**440**

**Rounded to the nearest 10. Columns may not sum as a result.*

Source: FAI Calculations

Table 2: Economic impact of medical research funding by charities on Scottish full-time equivalent jobs, 2019-2020*

	2019	2020
Direct	5,125	4,725
Indirect	625	575
Induced	1,725	1,600
Total	**7,475**	**6,900**

**Rounded to the nearest 25. Columns may not sum as a result.*

Source: FAI Calculations

Table 3: Economic impact of medical research funding by charities on Scottish GVA, 2019-2020*

	2019	2020
Direct	180	170
Indirect	30	20
Induced	110	110
Total	**320**	**290**

**Rounded to the nearest 10. Columns may not sum as a result.*

Source: FAI Calculations

Economic multipliers

While large industries often have significant impacts, economic multipliers can be used to understand the value for money that an industry supports in the economy.

Economic multipliers tell us the amount of output, GVA and jobs supported by a £1 million expenditure on final demand (for example: government spending, exporting, research and development). High multipliers typically describe industries that are strongly integrated with Scottish supply chains and spend significant amounts on wages.

We found that a pound spent by medical research funding by charities has a significantly larger impact on output, GVA and employment than the average pound spent in Scotland.

Every £1 million spent on medical research funding by charities in Scotland supports:

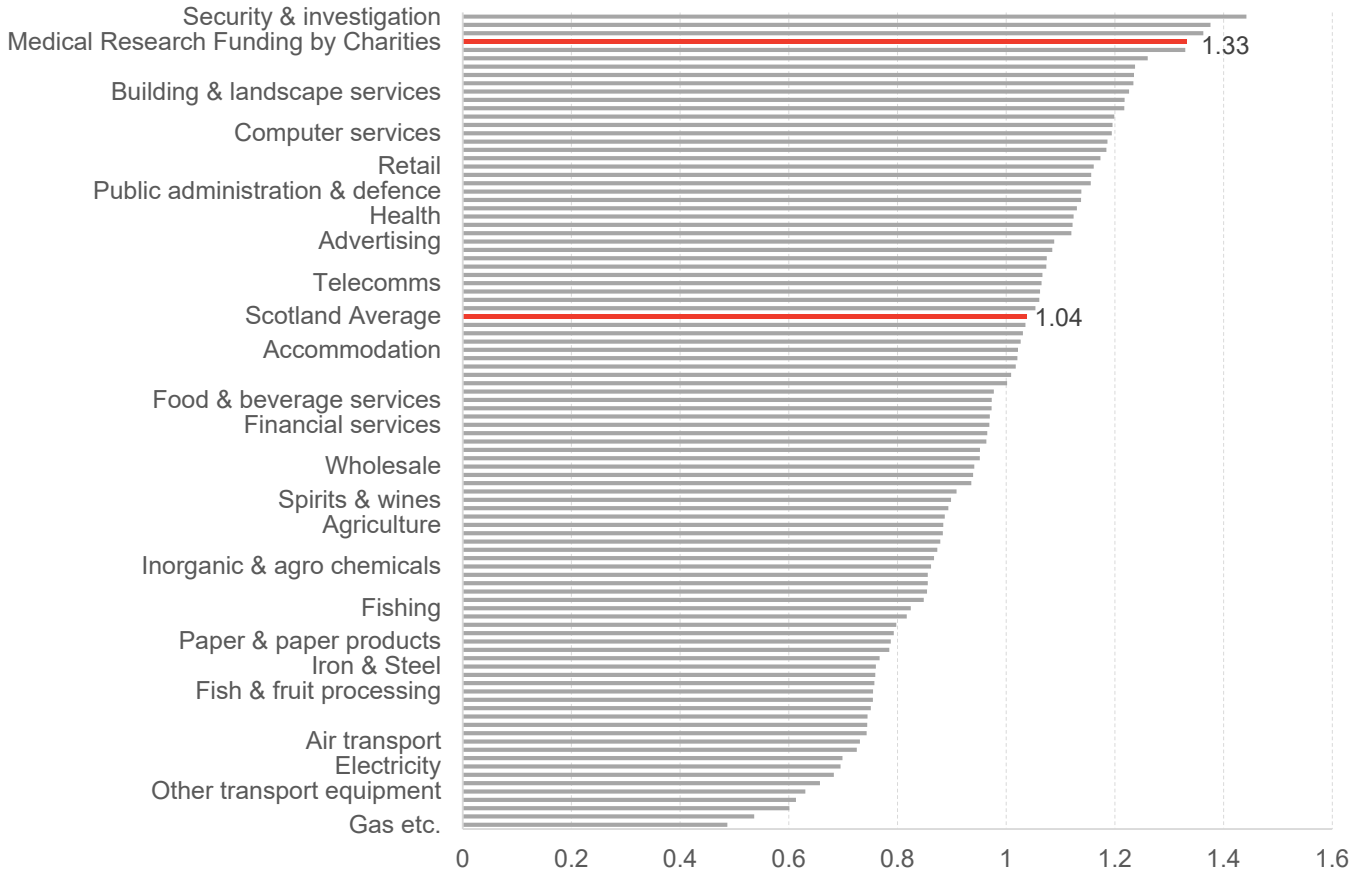
- £1.98 million of output
- £1.33 million of GVA
- 31 FTE jobs

How does this compare? On average across the whole economy, every £1 million spent in Scotland supports:

- £1.89 million of output,
- £1.04 million of GVA
- 17 FTE jobs

Charts 5 and 6 show the GVA-output multipliers and FTE jobs-output multipliers for medical research funding by charities compared to 97 sectors[13] of the Scottish economy. Medical research funding by charities places 4th for GVA-output multipliers and 6th for employment-output multipliers.

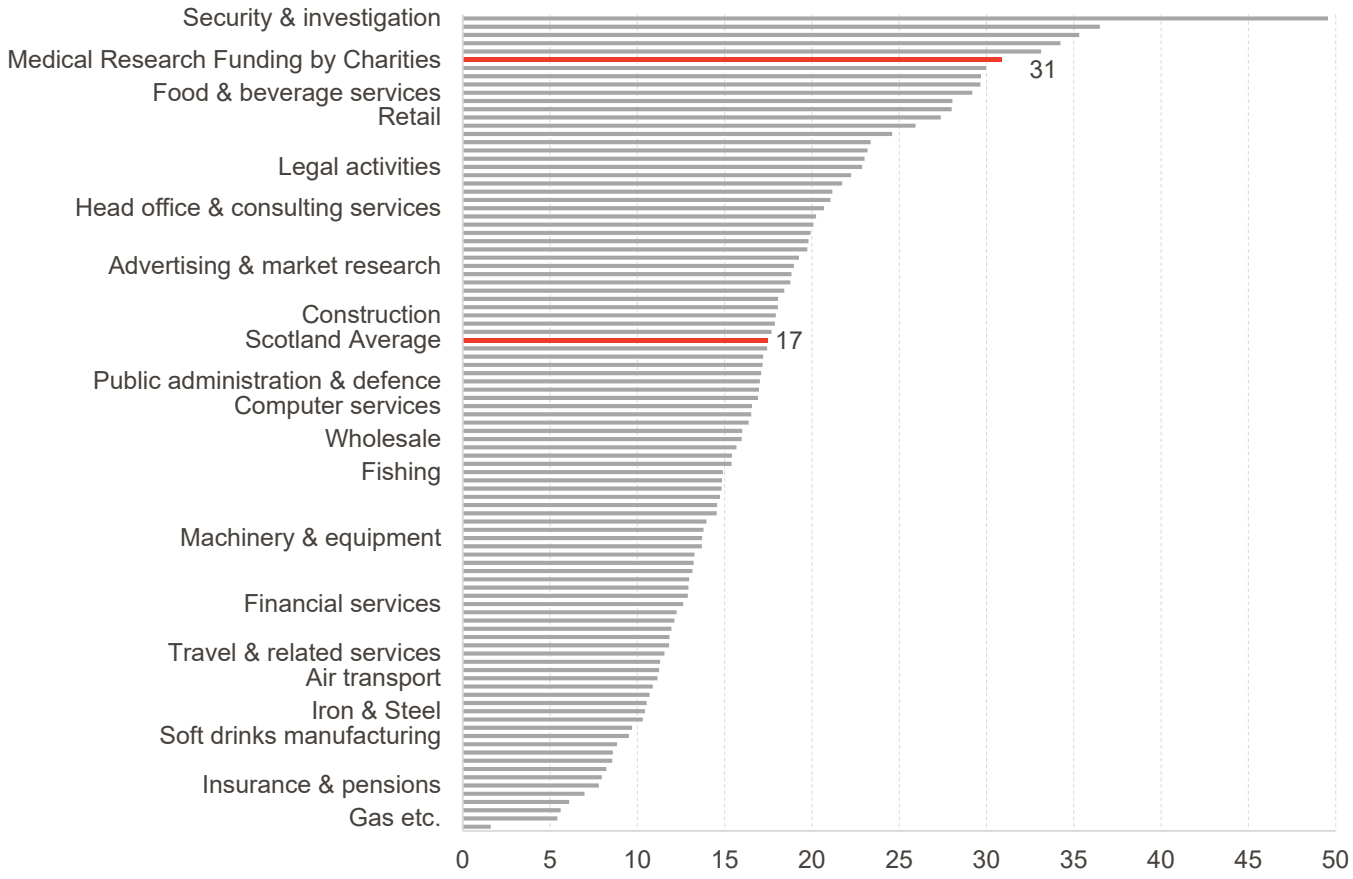
Chart 5: Comparison of Type II GVA-output multipliers across 97 sectors of the Scottish economy & medical research funding by charities. Selected sectors labelled.



Source: *FAI Calculations*

13 The 'Households as employers' sector has been excluded as it is not a conventional industry.

Chart 6: Comparison of Type II FTE jobs-output multipliers across 97 sectors of the Scottish economy & medical research funding by charities. Selected sectors labelled.



Source: *FAI Calculations*

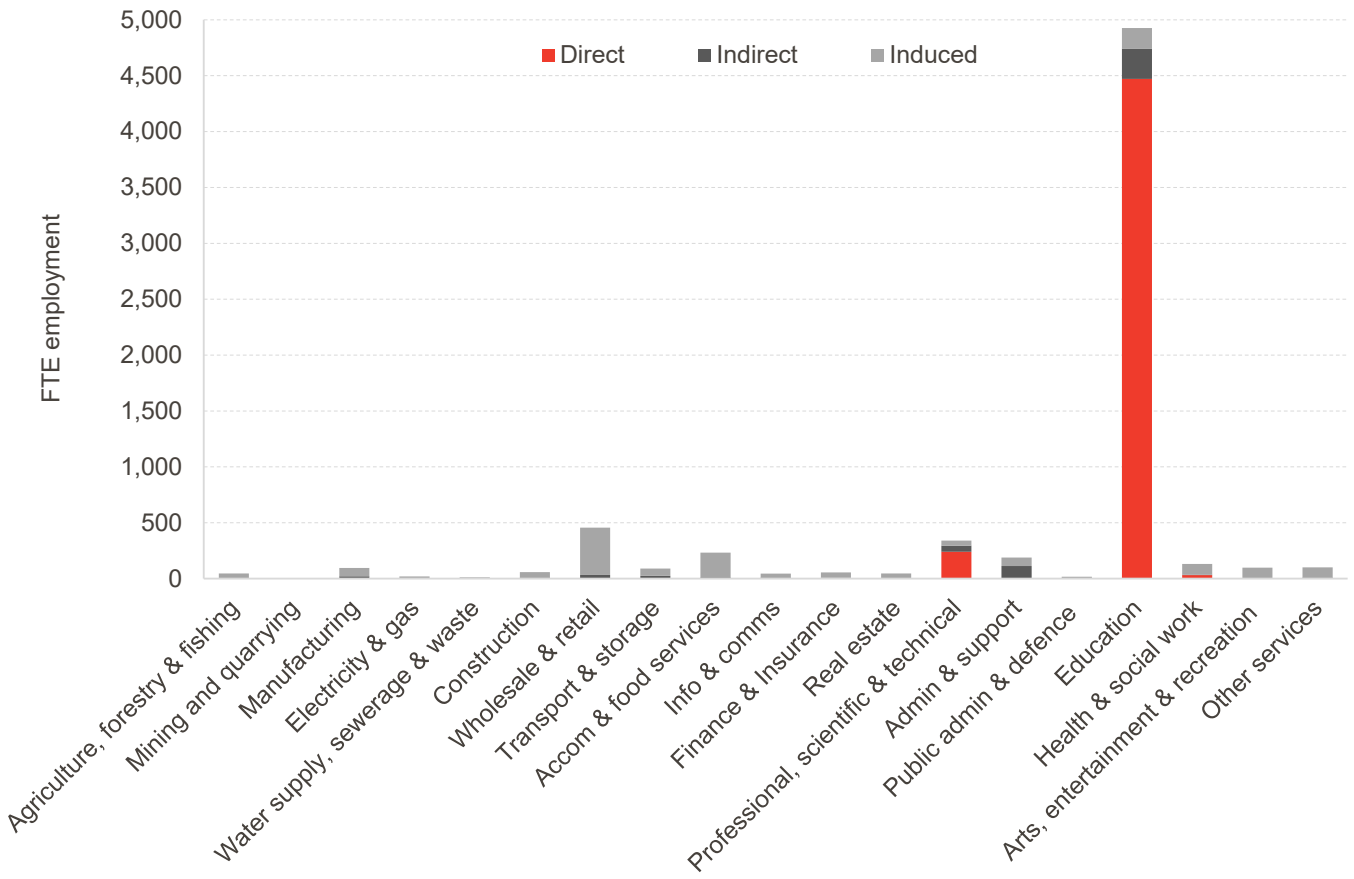
Impact by sector of the Scottish economy

Chart 7 shows the spread of the FTE employment supported by medical research across Scottish industries.

Unsurprisingly, the direct employment due to medical research funding by charities lies in the education, research and development and health sectors. However, the spill-over impacts extend into many other sectors.

For example, medical research funding supports around 460 FTE jobs in wholesale & retail, 230 in accommodation & food services and 190 in administration & support services.

Chart 7: Direct, Indirect and induced contributions of medical research spending, 2019



Source: *FAI Calculations*

Data and methodology

Data on medical research funding

Data on medical research by charities was provided by two sources.

The first source is the UK Health Research Analysis in 2018. This is a survey of the main funders of clinical research in the UK and is undertaken by the UK Clinical Research Collaboration (UKCRC). This survey covers 22,500 projects from 146 organisations and provides a highly detailed view of medical research funding by organisation in 2018.

The second data source is the Association of Medical Research Charities (AMRC), a membership organisation that supports medical research charities. The AMRC collects data on UK medical research expenditure annually from its 150+ members.

There are several differences between the AMRC and UKCRC datasets.

The AMRC surveys almost all UK charities funding medical research and has values for each year since 2014, while the latest UKCRC dataset represents 2018 only. Only 62% of AMRC membership responded to the UKCRC survey, however the respondents accounted for around 97.5% of total UK expenditure.

The AMRC data is a sum of research expenditure reported by the annual accounts of charities. As different organisations have different financial year start and end dates, the figures can therefore differ from calendar year values. These data also report the amount of grant provided that year, but this does not necessarily reflect the year that the research is undertaken.

Comparatively, the UKCRC dataset aggregates values of grants based on the years the research was undertaken. For example, a three year grant which finishes on the 31st December 2018 would have one third of the grant value assigned to 2018.

Other differences between the figures and the datasets can also exist. After discussion with the UKCRC, some potential differences exist due to the difficulty of allocating funding shared between charities to the individual charities.

But most critically, while the AMRC data is an excellent source of annual research data, it only provides the total value of UK medical research expenditure by year or by organisation. It does not provide a breakdown of research funding by nation or by type of recipient. We have therefore used AMRC data to inform the annual totals, while using detailed UKCRC data to apportion these totals into regions and recipient types.

While we believe that combining the data gives the most accurate representation of medical funding in the UK, this does come with assumptions and drawbacks. For example, proportions for the four nations by funding recipient type are fixed. Therefore, if one nation or recipient type was impacted more significantly than others (e.g. during the pandemic), then this data will not reflect the extent of this change.

Data for constructing the model

Our economic models use Input-Output tables from the nations of the UK. These include the ONS UK Input-Output table, the Scottish Government's Input-Output table and NISRA's Input-Output table.

Input-Output tables describe the flow of goods and services around the economy. They show how industries buy and sell from each other, compensate labour, and sell to sources of final demand such as Government, households and exports. Input-Output tables are a simple transformation of Supply and Use tables.

While individual data sources can suffer heavily from accurate measurement, bias, definitions and other issues, Supply and Use tables are constructed from many government datasets. The inclusion of many datasets allows for (a) each dataset to act as a check for other datasets and (b) to place heavier weight on more reliable datasets. As a result, Supply and Use tables are considered the cornerstone of National Accounts. These, along with input-output tables, are produced by many advanced economies and are used to create significant economic statistics, such as GDP.

We have also introduced employment data to produce estimates of employment impacts. These data sources include the ONS Workforce Jobs dataset and the ONS Business Register and Employment Survey.

Modelling methodology

We use input-output modelling to generate the estimates. This modelling methodology is well established and dates back to 1951 and resulted in the creator, Wassily Leontief, receiving the Nobel Memorial Prize in Economics.

It has widespread use in Government and academia. For example:

- UK Government Department for International Trade: Evaluating the impact of exports on UK jobs and incomes
- Scottish Government: Scottish Budget 2020-2021: carbon assessment
- OECD Trade in Value Added statistics

In National Accounts, charities can be found within both "industries" and "non-profit institutes serving households" (NPISH). This presents a difficulty from the perspective of modelling typical expenditures. Instead, our modelling focuses on the economic benefits associated with an uplift in research and development. This interpretation allows us to use economic multipliers – which model the economy-wide impacts of a change in final demand (e.g. research and development).

Once the model was created, data on UK medical research funding by charities was then used to map funding recipients (i.e. those with boosted R&D) to sectors of the economy. By sector, the major recipients of UK medical research funding by charities are:

- SIC 72: Scientific Research and Development
- SIC 85: Education
- SIC 86: Human health activities

In this report, three separate models have been developed to each cover a country – the UK, Scotland and Northern Ireland. Unfortunately, it is not possible to create a high-quality model for Wales as the Welsh Government currently does not publish the required data. Instead, we have used Welsh data to regionalise the UK model.

Our estimates model the impact of an uplift in research and development expenditure in education, research and development organisations and medical organisations.

The impact of an increase in research and development in these sectors results in the sectors increasing their output (i.e. to create R&D they must perform R&D). This is known as the direct impact.

These industries purchase goods and services in order to undertake their activities (e.g. electricity to power buildings, glass vials for experiments or research time from other organisations). These suppliers, in turn, purchase goods and services from their own suppliers and so on, down the supply chain. This is known as the indirect impact.

Employees are required to produce the additional output associated with both the direct and indirect impacts. These employees are paid wages, which are spent on goods and services around the UK. This results in additional output and employment, particularly in industries such as retail and food & accommodation services (i.e. bars, restaurants, hotels). This is known as the induced impact.

The total uplift in output in the economy resulting from an increase of £1m of final demand (e.g. research and development) is known as the output multiplier. Similarly, we can produce employment-output multipliers and GVA-output multipliers which represent the increase in employment or GVA from an increase of £1m of final demand.

The size of the multiplier is primarily affected by the proportion of (a) purchases from other industries [mainly affecting the direct and indirect effect], (b) leakages from the economy in the form of profits and imports [which reduces the multiplier at each stage], and (c) employee compensation such as wages [proportionately high wages increase the induced impact].

Estimates of multipliers for total business R&D expenditure were produced by mapping business R&D data, sourced from the ONS Business Enterprise Research and Development dataset, to sectors.

What are output, GVA and FTE jobs?

Our estimates are presented using output, GVA and FTE jobs.

Output: The value of all goods and services produced. This is most easily thought of as the turnover of firms. However, output is selected over turnover because a large amount of activity is not undertaken by firms (e.g. by government and third sector which can have no turnover but produce a large amount of goods and services).

GVA: Gross value added is a measure of the contribution to an economy and is very similar to GDP (gross domestic product).

It is a preferred measure than output as a firm could buy £1m of goods and sell these on for a further £1m – clearly no value has been created here despite output counting this as a £1m contribution.

GVA can be described simply as subtracting costs of goods and services inputs from the sales.

This is not the same as 'profits' since GVA also includes taxes on production, compensation of employees (e.g. wages, pensions), and gross operating surplus (e.g. company or self-employed profits). And an organisation can have no profit but can contribute to the economy by paying salaries.

Full-time Equivalent (FTE) Jobs: Full-time equivalent simply tries to account for the fact that supporting a part-time job does not have the same impact as supporting a full-time job. For calculating FTE, a full-time job equals one FTE while a part-time job equals half an FTE. In particular this avoids large overestimation in industries such as retail.

It should be noted that, while we have used the terms interchangeably in this report, there is a difference between "employees", "employment" and "jobs". For example, employment includes self-employment, while employees does not. And one employee can have multiple jobs.

Modelling assumptions and limitations

The choice of model can influence the resulting estimates. Input-output modelling is the correct choice for the research question as it can capture the economy-wide impacts of spending at a fairly granular level.

However, input-output modelling requires assumptions. Some of the key assumptions include:

- There is no restraint on the supply side – this becomes problematic with extremely large additional expenditures (e.g. a £400 billion construction project would result in a shortage of construction workers).
- Price impacts are not considered. Again, this is problematic for very large demand side shocks. In the above example, the cost of construction materials would increase, resulting in less output.
- There is no substitution between technologies.
- Unless otherwise specified, inputs are treated as sector averages.

The final assumption is important as medical researchers within a sector could have different expenditures to the sector as a whole. Without a survey of the expenditures of all medical researchers, it is difficult to say how this could affect the results. However, such a survey would likely be cost prohibitive and researchers may be unaware of all the costs associated with their organisation (e.g. such as building maintenance and electricity).

These assumptions also apply to the multiplier results for total business R&D expenditure.

Glossary

Output: The value of all goods and services produced.

GVA: A measure of contribution to an economy equal to output less intermediate consumption (i.e. purchases of goods and services as inputs).

GDP: A measure of economic growth, equal to GVA plus taxes less subsidies on products.

Employment: A measure of people that includes employees and self-employed. This differs from jobs, for example one employee can have multiple jobs.

Full-time equivalent: Using FTE measures of jobs and employment attempts to account for the difference in economic impact between part-time and full-time work. One full-time equivalent employee is equal to one person working full-time, or two people working part-time.

Direct impact: An increase in the final use of a sector results in organisations in the sector reacting by increasing their output. This is called the direct impact.

Indirect impact: Firms that increase their output as part of the direct impact must purchase goods and services from their suppliers in order to produce this output. In turn, their suppliers must increase purchases from their suppliers and so on. The sum of the impacts down the supply chain is called the indirect impact.

Induced impact: Employment is generated as a result of the direct and indirect impacts. Employees are paid wages which are then spent on goods and services. This household spending impact is called the induced impact.

Spill-overs: For input-output modelling results, spill-overs typically refer to the indirect and induced impacts.

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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
