

The background of the page is a complex geometric composition. It features a grid of squares and rectangles, some of which are filled with shades of teal and grey. A large teal shape in the top left corner curves into a white space. Another teal shape in the bottom right corner also curves into a white space. The overall effect is a modern, abstract design with clean lines and a limited color palette.

Economic impact assessment of the Cambridge Biomedical Campus

A Cebr report for the Cambridge
Biomedical Campus

August 2022

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The report does not necessarily reflect the views of the Cambridge Biomedical Campus.

London, August 2022

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Abbreviations

BHWS	Britain's Healthiest Workplace Survey
CBC	Cambridge Biomedical Campus
CAT	Cambridge Antibody Technology
Cebr	Centre for Economic Business and Research
DALYs	Disability Adjusted Life Years
DCD	Donation after Circulatory Death
FTEs	Full-Time Equivalent Employees
FY 18-19	Financial year ending 2019
FY 20-21	Financial year ending in 2021
GVA	Gross-Value Added
HLE	Healthy Life Expectancy
IHME	Institute for Health Metrics and Evaluation
IO	Input-Output
Local Authorities	Cambridge City Council and South Cambridgeshire District Council
MRC LMB	Medical Research Council Laboratory of Molecular Biology
NICs	National Insurance Contributions
ONS	Office for National Statistics
SOC	Standard Occupational Classification
WLE	Working Life Expectancy

Executive Summary

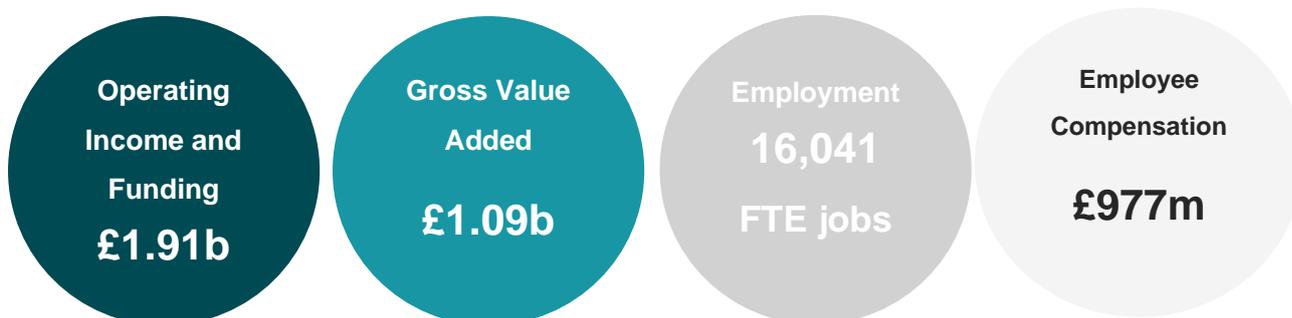
Report overview

- This is a report by the Centre for Economics and Business Research (Cebr), on behalf of the Cambridge Biomedical Campus (CBC), detailing the economic contribution of the CBC to the UK and regional economies.
- The report considers the direct economic contributions made as well as the wider economic footprint supported through indirect (supply-chain) and induced (wider-spending) impact layers.
- The report then considers the wider socio-economic benefits associated with organisations on the CBC. Specifically, it considers the impact that health and research has on economic growth and the health-driven economic benefits associated with the CBC. Specific further focus is placed on the benefits of organisations being clustered together within the Campus.

Direct economic contributions

- In the financial year ending in 2021 (FY 20-21), it is estimated that the organisations on the CBC directly contributed:

Figure 1: Direct impacts, FY 20-21



- The operating income and funding, gross-value added (GVA), employment and employee compensation contributed by the organisations on the CBC have all significantly increased from FY 18-19 to FY20-21.
- Over the same period, operating income and funding increased in absolute terms from 1.15 billion to 1.91 billion and GVA increased from £797 million to £1.09 billion.

- Full-time equivalent employment¹ increased from 14,961 to 16,041, an increase by 7.2% compared to 0.44% in the growth of employment across the UK economy² in the same period.
- The average annual compensation per FTE worker also increased slightly from £54,375 to £60,904.
- Productivity is another variable we can analyse with the data provided and we can use GVA per FTE worker as a measure of productivity. For the CBC, productivity was £53,275 for the financial year ending 2019 (FY18-19) and increased to £67,665 for the FY 20-21 representing a 27% growth in productivity over time.
- Therefore, over the period we have seen a faster increase in total employee compensation than employment, and average compensation per FTE has increased.
- The contribution to the Exchequer through tax revenues was £291 million during the financial year ending 2021.

Aggregate economic footprint

- The aggregate footprint supported by organisations goes beyond the direct impacts discussed above. Our modelling conceptualises two further impact layers:
 1. Indirect impacts consider the demand supported along the supply-chain of the organisations on the CBC.
 2. Induced impacts consider the demand supported when employees associated with the direct and indirect layers spend their earnings in the wider economy.

Our results show the following:

- For every £10 of operating income and funding directly generated by organisations on the CBC, a further £11.40 worth of operating income and funding is supported in the wider economy.
- For every £10 of GVA directly generated by organisations on the CBC, a further £10.31 of GVA is supported in the wider economy.
- For every 10 jobs directly generated by organisations on the CBC, a further 9.18 jobs are supported in the economy.
- For every £10 in employee compensation paid to organisations on the CBC, a further £6.06 worth of compensation is supported in the wider economy.
- By combining these multipliers with the direct impacts, it is estimated that in 2021 the organisations on the CBC supported an aggregate footprint of:

¹ We have used full-time equivalent as opposed to headcount for the purposes of this analysis. Due to availability of data in organisations that fall within the CBC and the in-scope organisations, the true headcount at the CBC is between 20,000 and 21,000.

² Employment numbers for the UK were obtained from the Office for National Statistics. We then converted the employment numbers from 2018 to 2021 to FTEs to provide a direct comparison with the employment growth on the CBC.

Figure 2: Aggregate impacts, FY 20-21



Regional economic footprint

All the direct impacts are attributed to the East of England, as this is where the CBC is located. Similarly, at a more granular level, the direct impacts likewise attributed solely to the Cambridge City Council and South Cambridgeshire District Council (local authorities).³

Our results show the following:

- For every £10 of operating income and funding directly generated by organisations on the CBC, a further £4.59 worth of operating income and funding is supported in the East of England and a further £3.53 is supported within the CBC local authorities.
- For every £10 of GVA directly generated by organisations on the CBC, a further £5.32 of GVA is supported in the East of England and a further £3.91 is supported within the CBC local authorities. This suggests that of the £5.32 worth of GVA that is supported in the East of England, 75.4% is supported within the CBC local authorities and the remaining 24.6% falls within the other local authorities within the East of England.
- This means that the CBC is responsible for supporting £1.30 billion in turnover and £542 million in GVA for UK businesses, outside of the East of England.
- For every 10 jobs directly generated by organisations on the CBC, a further 3.95 jobs are supported in the East of England and a further 2.70 jobs are supported within the CBC local authorities. Again, this suggests that of the 3.95 jobs that are supported in the East of England, 72.7% are supported within the local authorities that the CBC fall on and the remaining 27.3% falls within other local authorities within the East of England.
- For every £10 in employee compensation paid to organisations on the CBC, a further £6.06 worth of compensation is supported in the wider economy.
- This means that the CBC is responsible for supporting 8,391 FTEs and £330 million in employee compensation for UK businesses, outside of the East of England.

Within the East of England, there are a number of other science parks, including the Babraham Research Campus and the Stevenage Bioscience Catalyst. In direct comparison to the Babraham Research Campus, the aggregate GVA impact for Babraham equates to £285.7 million (v £2.20 billion for the CBC) approximately 13% as a proportion⁴ of the total CBC

³ As the CBC geographically falls into both the Cambridge City Council and South Cambridgeshire District Council, we have modelled the impacts experienced across the two local authorities combined.

⁴ Given the year the study was undertaken, we note that there is a slight time lag in the differences noted. The data for Babraham Research Campus was taken from 2017/18 as opposed to the CBC where we have analysed 2020/21 data.

aggregate impact of GVA⁵. The FTEs supported in the wider economy equates to 4,271 for the Babraham Research Campus compared to 30,762 for the CBC, approximately 15.3% of the total employment supported by the CBC.

Additionally, the Stevenage Bioscience Catalyst contributes £87 million of direct GVA⁶ to the UK economy (v 1.09 billion for the CBC), approximately 8% as a proportion of the total direct CBC impact of GVA. The number of direct FTEs that the Stevenage Bioscience Catalyst contributes is 1,610 jobs to the UK economy, as opposed to 16,041 on the CBC. As a direct comparison, this represents a 10% proportion of the direct jobs contributed by the CBC alone.

Wider socio-economic benefits

- There are key benefits associated with the unique characteristics of the CBC, above and beyond the benefits set out above.
- The wider benefits include the specific role that some of the organisations on the CBC undertake in treating patients on premises. This leads to better health outcomes, contributing to positive economic impacts such as an expanded labour force and increased productivity,⁷ supporting higher GDP.
- Additionally, another wider benefit is the broader role that the CBC plays in developing techniques, products, changes in care and supporting wider learning that facilitates wider improved health outcomes.
- We have outlined relevant examples in Section 5 of innovations and treatments that have been developed by organisations within the Campus that have provided improved healthcare outcomes to patients both within the region as well as on a national level.
- Finally, there are also wider benefits associated with clustering and agglomeration, allowing the organisations on the CBC to function more effectively, relative to all existing in separate locations. Agglomeration economies occur when a number of firms producing similar or complementary goods locate near one another, which, in turn, produces positive externalities for those firms.⁸
- The majority of organisations on the CBC believe that they would have been less effective or significantly less effective in improving health outcomes had it not been located on the CBC.

Methodology

- The analysis presented in this report relied on a bespoke survey that was completed by the organisations on the CBC, asking questions on core financials from the years ending 2019 to 2021. The bespoke survey allows us to estimate the aggregated direct economic contributions for the organisations on the CBC.
- Following the computation of direct impacts, we use the Office for National Statistics (ONS) national accounts framework to establish the typical supply-chain relationships of organisations on the CBC. This is used to estimate the indirect and induced impact layers and ultimately the aggregate economic footprint.

⁵ <https://www.babraham.com/media/0wyjdtzl/brc-impact-report-210520-na-web.pdf>

⁶ <https://www.flipsnack.com/stebiocat/stevenage-bioscience-catalyst-eia-report/full-view.html>

⁷ McKinsey Global Institute – Prioritizing Health

⁸ Porter. (1998). 'Clusters and the New Economics of Competition'

1. Introduction

This is a report by the Centre for Economics and Business Research (Cebr), on behalf of the Cambridge Biomedical Campus (CBC), detailing the economic contribution of the CBC to the UK economy, with additional specific focus on the CBC's contribution to the local Cambridge area.

The CBC dates to 1962, when Addenbrooke's Hospital and the Medical Research Council Laboratory of Molecular Biology (MRC LMB) moved from their respective locations in Cambridge city centre to the Campus.

Since then, several major research laboratories and hospitals have established a presence in and around the Campus, including the Rosie Hospital, Cambridgeshire and Peterborough Mental Health Trust, Royal Papworth Hospital, the University of Cambridge School of Clinical Medicine, Cancer Research UK Cambridge Research Institute and six Medical Research Council units/centres, in addition to the Laboratory of Molecular Biology.

Additionally, AstraZeneca is due to have operations including their headquarters on the CBC later this year, as the CBC continues to grow. The number of organisations that are on the CBC has fuelled the 'Cambridge Phenomenon' – the cluster of technology and bioscience based firms around Cambridge.

1.1 Background and aims of the study

The Cambridge Biomedical Campus is located at the heart of the UK's and Europe's leading life sciences cluster and is a global leader in medical science, research, education, and patient care.

The research presented herein seeks to estimate the economic contribution of the Cambridge Biomedical Campus. Specifically, we estimate the economic contribution of the Campus occupiers, encompassing healthcare, research, education, and industry organisations.

For the purposes of this study, in consultation with the CBC, we consider the following organisations to be on the Campus and therefore in-scope, while any organisations that are not listed below can be considered out of scope:

- Abcam.
- MRC Laboratory of Molecular Biology.
- Addenbrookes Hospital.
- University of Cambridge.
- Royal Papworth Hospital.

Whilst AstraZeneca is not in scope, we reference in our analysis the future economic impact it will bring to the Campus as it is due to have operations on the CBC later this year.

This report seeks to produce estimates for the economic contribution of the organisations located on the CBC from 2019 to 2021. We relied on a combination of a bespoke survey of organisations within the CBC and publicly available data.

Our analysis considers the contribution of the CBC measured by macroeconomic indicators such as operating income and funding, employment, gross value added (GVA) - a measure of economic output - and employee compensation. This is estimated at a national, regional, and local authority level.

In addition, we examine the indirect contributions made by the CBC to the wider economy through its supply chain relationships with other sectors and the additional economic activity supported through employee spending.

We also consider the wider socio-economic impacts of the CBC, including the impact on improving health outcomes and the associated economic value of this. Finally, we analyse the existing transport infrastructure and the potential role of investment in transport infrastructure that may be required to provide international connectivity for business and employees within the area.

The overall aim is to provide individuals, organisations, and stakeholders with a clear, robust and evidence-based understanding of their ongoing economic contributions to regional and national economies.

1.2 Structure of the report

The remainder of the report is structured as follows:

- **Section 2** provides our findings of the direct economic impact of organisations on the CBC, in terms of key financial metrics such as operating income and funding, Gross Value Added (GVA), employment, employee compensation and tax contributions.
- **Section 3** extends this analysis to consider the aggregate economic footprint of the organisations on the CBC, by the same metrics.
- **Section 4** outlines the estimated regional and local authority distribution of the economic contribution of the CBC.
- **Section 5** provides our analysis of the wider socio-economic benefits associated with the CBC.
- **Section 6** assesses the limitations on the existing infrastructure within the CBC and the potential role of investment in transport infrastructure that may be required.
- **Section 7** provides a conclusion to the report.
- Finally, **Appendix A** sets out the methodology of the report. This includes the methodology in calculating the direct economic impact of the CBC, as well as the indirect and induced economic footprint.

2. Direct economic impacts

This section details the direct impact of organisations on the CBC, at a national level. Our results are presented in terms of key economic indicators, namely: operating income and funding, Gross Value Added (GVA), employment, employee compensation, and tax contributions.

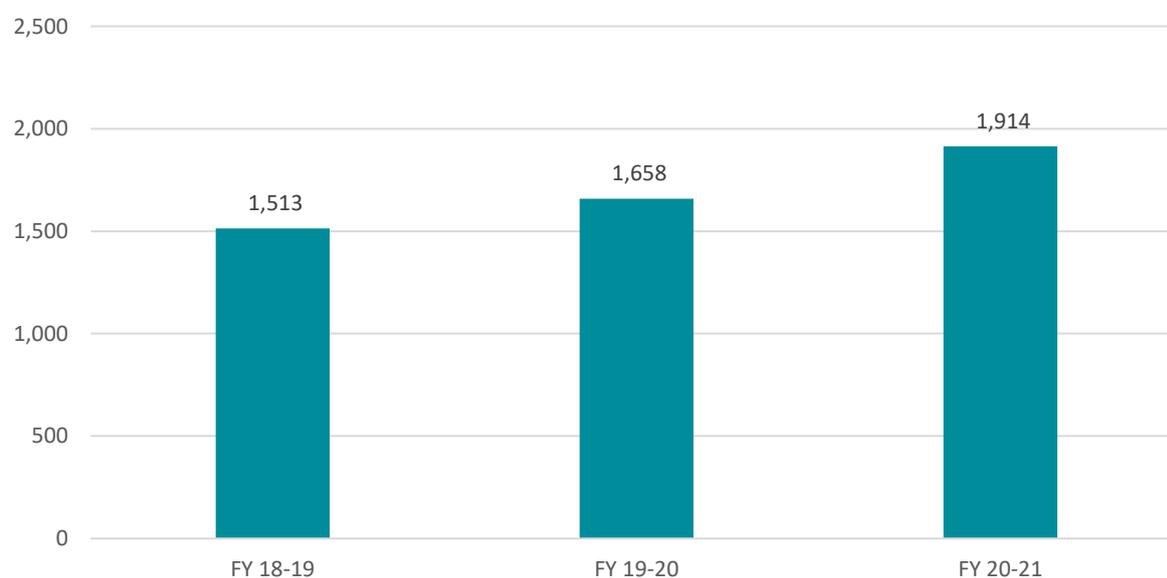
2.1 Operating Income and Funding

Figure 3 below illustrates the operating income and funding of organisations on the CBC for the financial years ending in 2019, 2020 and 2021. This operating income and funding can be thought of as either the reported turnover, or the total budget of organisations on the CBC for each of the financial years.

It is worth noting that due to the funding model of the organisations on the Campus, this should not be considered as economically meaningful a metric as for a purely private sector organisations, or collection of organisations, where solely turnover may be considered a good proxy for the demand generated for the goods and services produced. Within the sample of organisations considered within the CBC scope for this study, four of the five (the University of Cambridge's School of Clinical Medicine; MRC Laboratory of Molecular Biology operations; and the two NHS trusts) are at least partially publicly funded.

Therefore here, given the nature of the CBC, we take a more holistic approach to assessing the economic value of the Campus. Operating income and funding should be used here solely to indicate the growth of organisations on Campus, without broader inference or economic conclusion drawn.

Figure 3: Direct operating income and funding of organisations on the CBC, £ million, FY 18-19 – FY 20-21



Source: Cambridge Biomedical Campus, Cebr survey and analysis

The operating income and funding of organisations on the CBC has been increasing consistently over time. From the financial years ending 2019 to 2021, **operating income and funding increased by £400 million (26.5%) from 1.51 billion to 1.91 billion**. This illustrates the growth that has occurred on the CBC over the time period, and is notably consistent over the period, despite the COVID-19 pandemic occurring at the beginning of 2020.

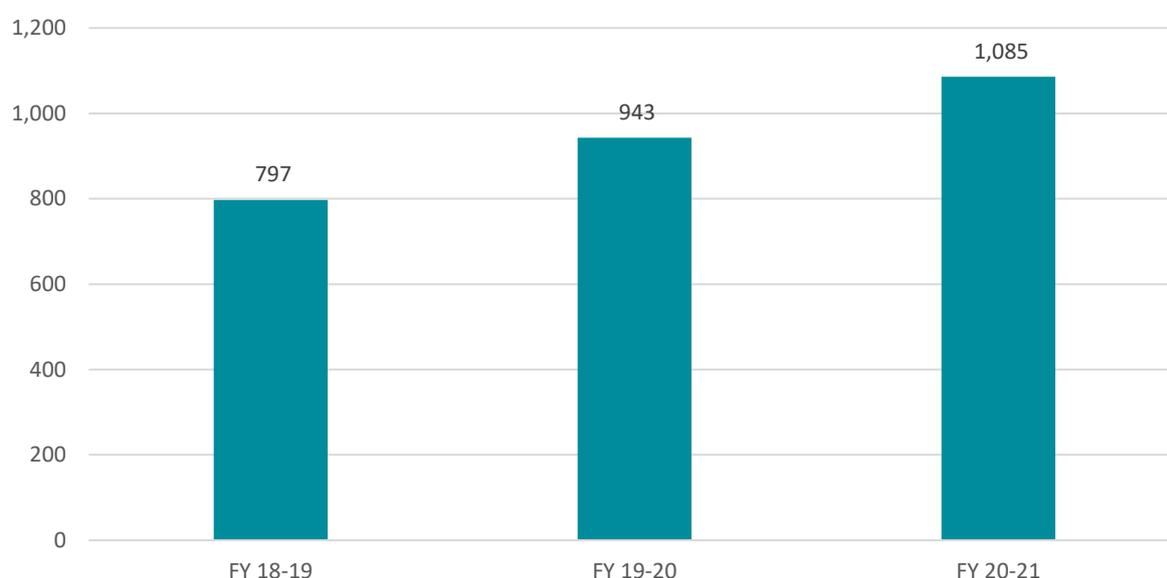
2.2 Gross Value Added (GVA)

While the operating income and funding contributions discussed in the previous section provide an indication of the size of the CBC operations, it would be conceptually wrong to simply interpret these in their entirety as direct value-added contributions. To provide an example, part of the revenue raised is to cover utility costs and as such is paid to utility providers. This part of revenue in fact represents the value added to the economy by a part of the supply chain of organisations on the CBC as opposed to the organisations themselves.

To take this into account, we use the concept of Gross Value Added (GVA) when considering the 'value-added' by organisations on the CBC. In the simplest terms, GVA calculates the difference between total revenue and total intermediate expenditure. This intuitively represents the 'value-added' by the organisations on the CBC and is often considered their contribution to UK GDP.

Figure 4 below illustrates the GVA contributions made by the organisations on the CBC for the financial years ending 2019, 2020 and 2021.

Figure 4: Direct GVA of organisations on the CBC, £ million, FY 18-19 – FY 20-21

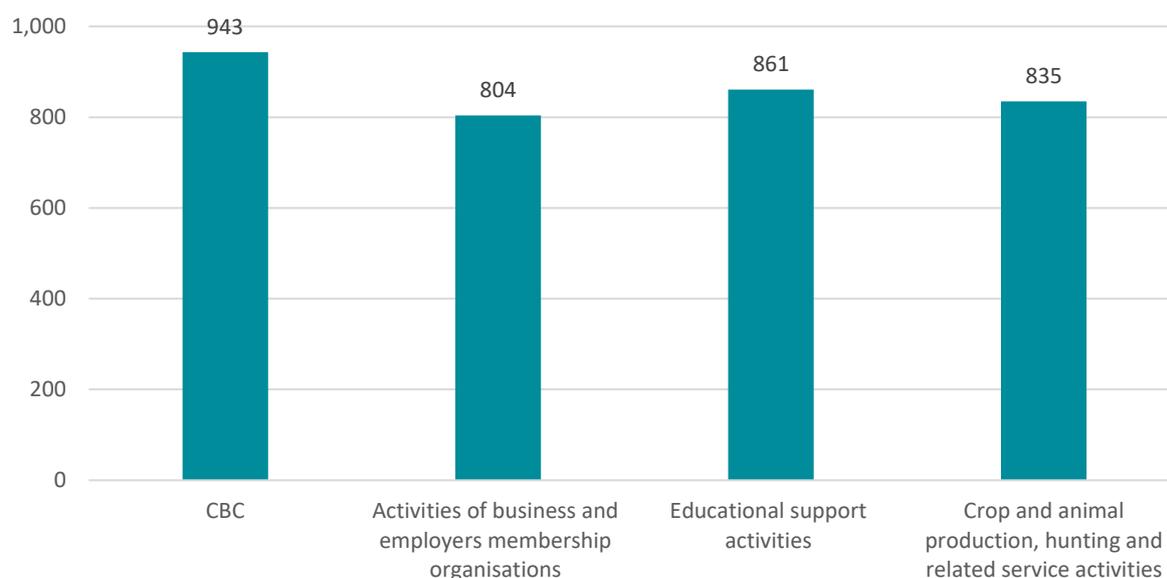


Source: Cambridge Biomedical Campus, Cebr survey and analysis

Overall, as of FY 20-21, the CBC contributes £1.09 billion in GVA to the UK economy; **a figure that has increased by 36.2% since FY 18-19.**

As the CBC is a combination of different organisations, it does not align into one sector. For wider context, the GVA of the organisations on the CBC for FY 19-20 are compared to other similarly sized key sectors in the economy, as illustrated in Figure 5.

Figure 5: Comparison of GVA generated by the CBC with other key industries, 2019, £ million



Source: Office for National Statistics, Cebr survey and analysis

Figure 5 provides some further context by comparing the GVA produced by the CBC to other key sectors in the economy. As illustrated, **the CBC contributes more in GVA than educational support activities, activities of business and employers' memberships organisations, and crop and animal production, hunting and related service activities.** This demonstrates the size and contribution the organisations on the CBC contribute to the UK economy.

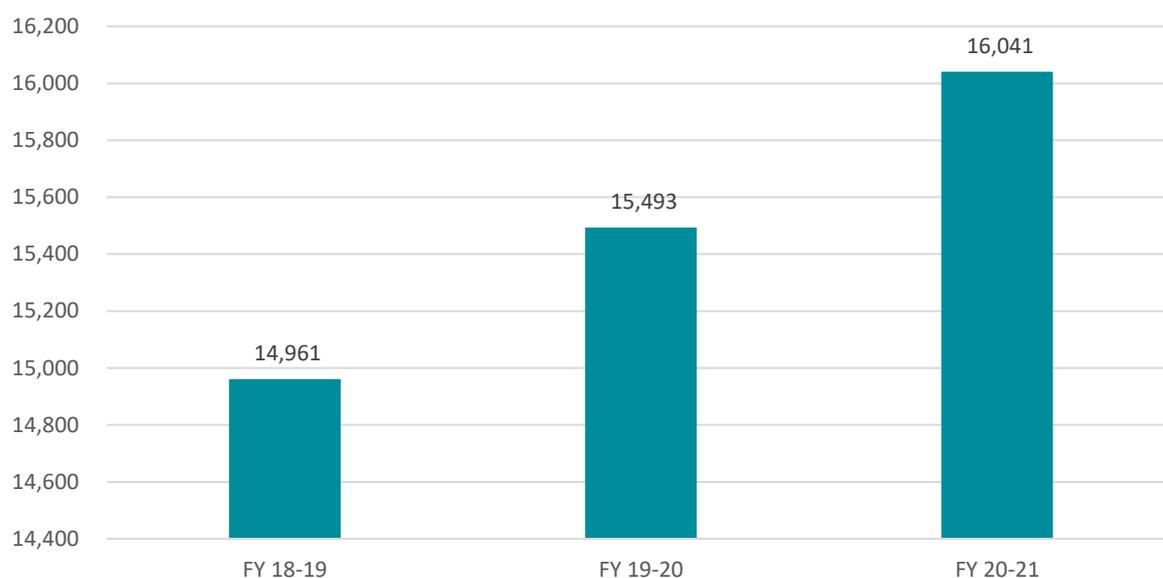
We can also recognise the future economic impact that AstraZeneca will have on the CBC, as it intends to move some of its operations onto the CBC later this year. In the aggregate GVA impacts in Section 3, we have gone into further detail about the potential future benefit of AstraZeneca on the CBC.

2.3 Employment

The figure below illustrates the employment contributions made by the organisations on the CBC between the financial years ending 2019 to 2021. Our results below present the standardised full-time equivalent employees (FTEs)⁹.

⁹ We have used full-time equivalent as opposed to headcount for the purposes of this analysis. Due to availability of data in organisations that fall within the CBC and the in-scope organisations, the true headcount at the CBC is between 20,000 and 21,000.

Figure 6: Employment contributions of organisations on the CBC, £ million, FY 18-19 – FY 20-21



Source: Cambridge Biomedical Campus, Cebr survey and analysis

From the figure above, the number of FTEs on the CBC has increased from 14,961 in 2018 to 16,041 in 2021. **This is an 7.2% increase in the number of FTEs on the CBC, compared to 0.44% in the growth of employment across the UK economy¹⁰** in the same period.

As a further comparison, we compare CBC employment relative to wider UK employment by occupation as defined by the Standard Occupational Classification (SOC) code. Table 1: below compares the total employment at the CBC, to wider SOC codes that conduct similar activities to the organisations on the CBC.

Table 1: Breakdown of employment by SOC code, 2021

SOC code	Number of jobs	CBC employment as a % of total ¹¹
Natural and Social Science Professionals	294,200	5.5%
Research and Development Managers	71,600	22.4%
Health Professionals	653,100	2.5%
Teaching and educational professionals	1,671,300	1%

Source: Office for National Statistics, Cebr survey and analysis

As with GVA, we can also recognise the future benefit AstraZeneca will have on the CBC in terms of increasing the Campus' employment. The discussed report outlines that approximately 2,200 employees will be present at the Cambridge Discovery Centre on the CBC later this year, which is 27.9% of the total share of AstraZeneca UK employees. Given

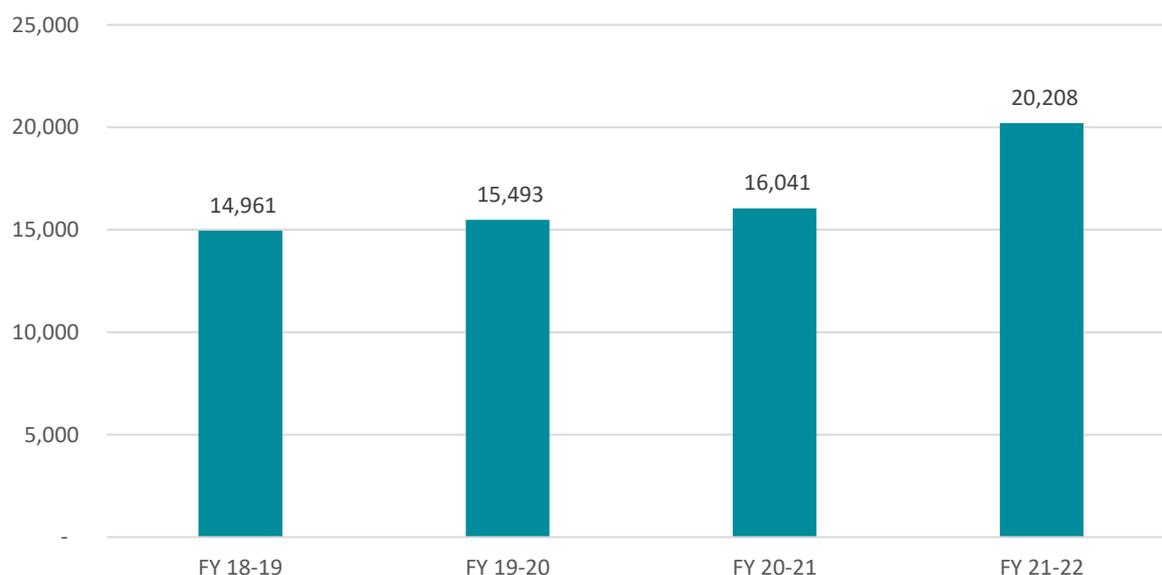
¹⁰ Employment numbers for the UK were obtained from the Office for National Statistics. We then converted the employment numbers from 2018 to 2021 to FTEs to provide a direct comparison with the employment growth on the CBC.

¹¹ Note that this does not imply that this percentage is the share of all employees within the SOC that are on the CBC, but rather is an indicative comparison for the size of the labour force of the CBC, relative to similar industries.

the size of AstraZeneca's operations moving to the CBC, this further demonstrates the potential benefit of the CBC. Although this increase in employment will be a direct impact in future years, there will also be additional indirect and induced impacts associated with the operations, supporting further economic benefits.

To understand the potential direct impact on CBC employment once these employees are on the Campus, we have incorporated this into the figure below. Figure 7 incorporates the employment that AstraZeneca will bring to the CBC in future years. In the model, we have assumed we have assumed a constant growth rate for current organisations on the CBC and in doing so, we calculated the growth rate from FY 19-20 to FY 20-21 and applied it to FY 21-22.

Figure 7: Employment contributions of organisations on the CBC, £ million, FY 18-19 – FY 20-21

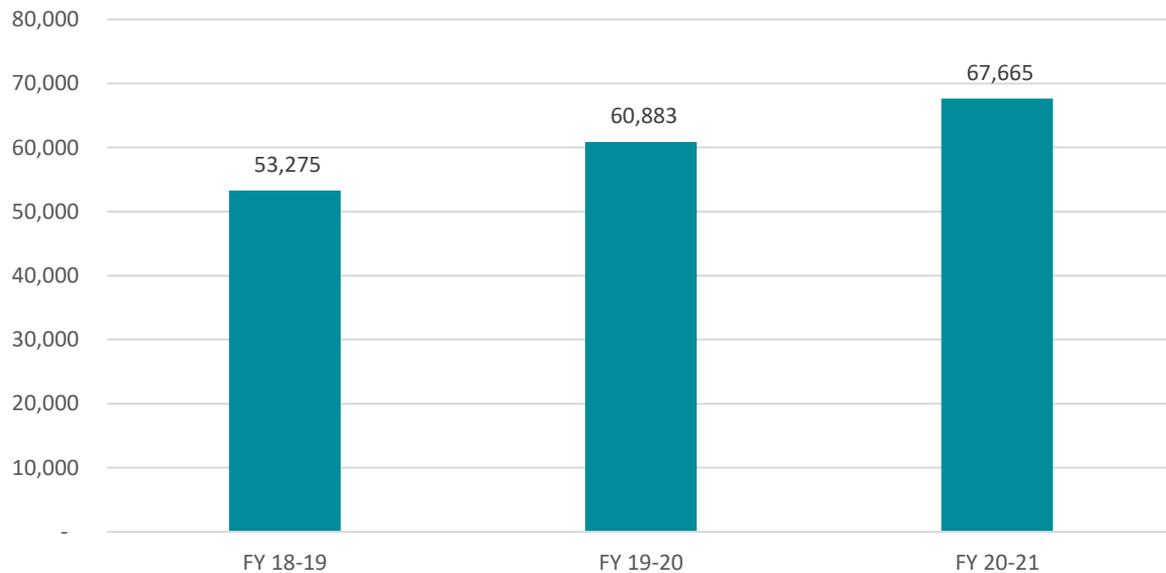


Source: Cambridge Biomedical Campus, Cebr survey and analysis

As the figure above illustrates, the Campus' role in supporting employment is set to increase in the future, incorporating AstraZeneca's presence on the CBC. Taking a prudent approach, **we expect a 25.5% increase in employment on the CBC**, demonstrating the future benefits of the Campus, with FTE employment exceeding 20,000 in FY 21-22.

Considering the analysis above, we can provide further evidence into another variable – productivity. Measuring productivity can be a nuanced exercise but a standardised approach is to consider average output per worker. Per the analysis undertaken above, we can use GVA per FTE worker as a measure of productivity. The results over the assessed period can be seen below.

Figure 8: Productivity of organisations on the CBC, £ million, FY 18-19 – FY 20-21

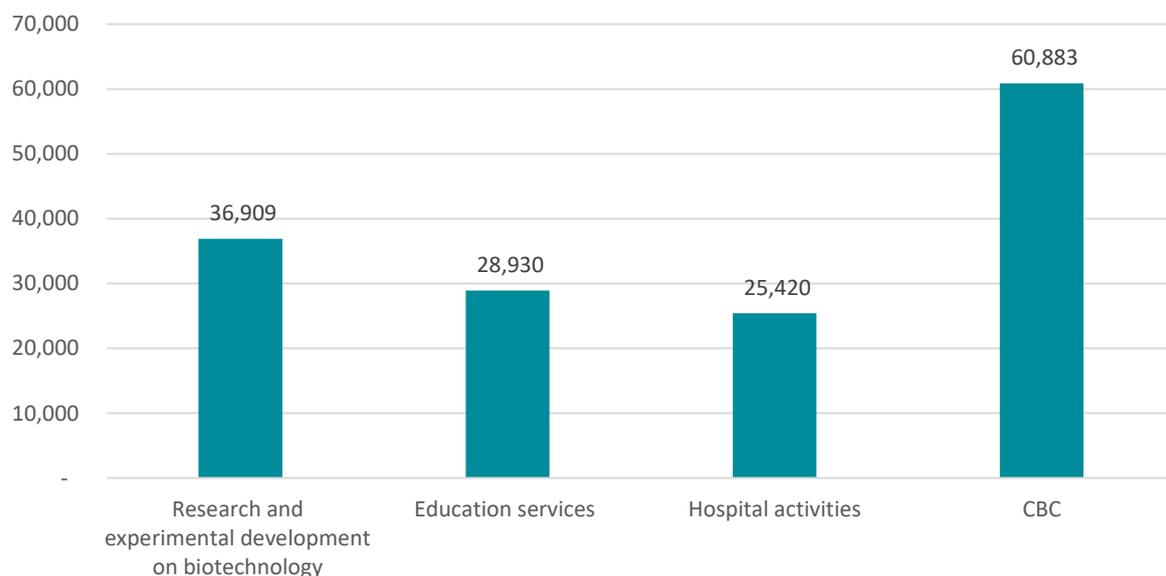


Source: Cambridge Biomedical Campus, Cebr survey and analysis

The above figure illustrates the average output per FTE worker of the CBC. In the financial year ending 2019, this figure was £53,275 and increased to £67,665 for the financial year ending 2021, **representing a 27% growth in productivity over time.**

For context, we can also compare the productivity level to the wider SIC codes that the organisations on the CBC fall into, and this is show below.

Figure 9: Productivity in certain SIC codes and the CBC, £, 2019



Source: Annual Business Survey, ONS National Accounts, Cebr analysis

The figure above emphasises the high productivity of organisations on the CBC, with a higher average productivity than any of the SIC codes that CBC organisations fall within. Specifically, **CBC productivity is 65% higher than the next highest**, which is research and experimental development on biotechnology. There also may be evidence that productivity is higher in the

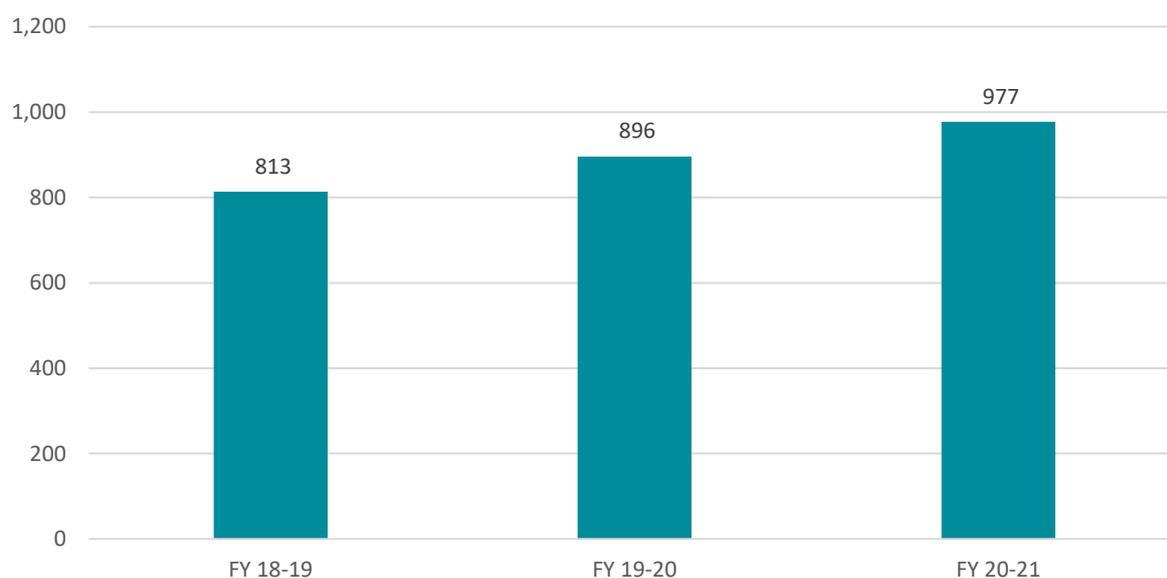
CBC, due to organisations being clustered together often known as agglomeration economies. This is further explained in Section 6 of the report.

In economic terms, improving productivity can be associated with higher economic growth, highlighting the value that the CBC contributes to the UK economy.

2.4 Compensation of employees

Employee compensation refers to the total costs associated with the employment of workers. It includes wages, pension costs, social security costs and any company provided employee benefits. The figure below illustrates the total amount paid in employee compensation by the organisations on the CBC.

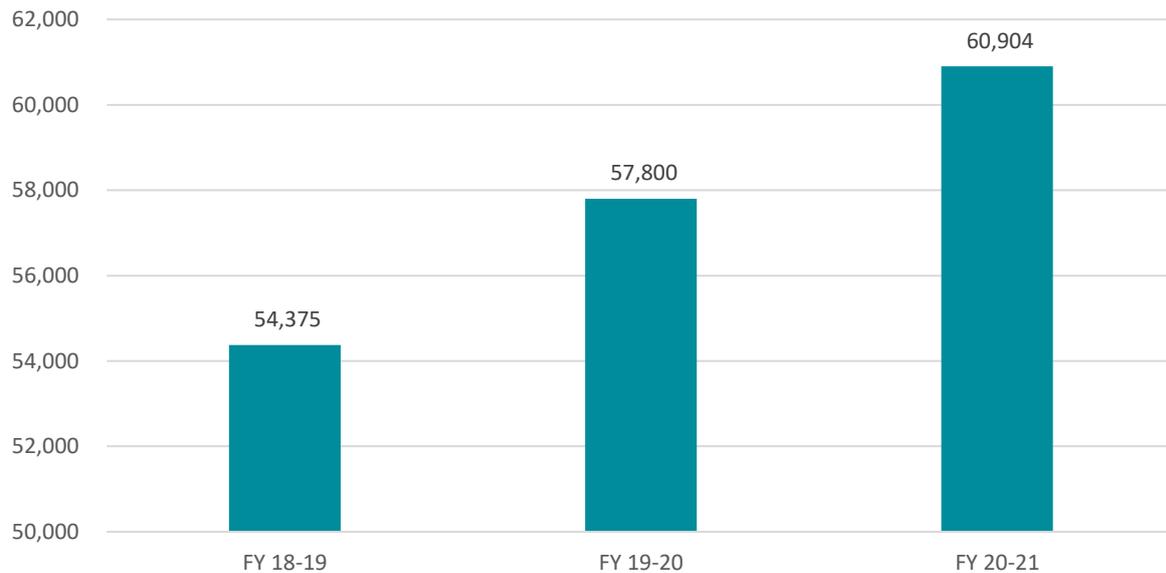
Figure 10: Employee compensation paid to workers on the CBC, £ million, FY 18-19 – FY 20-21



Source: Cambridge Biomedical Campus, Cebr survey and analysis

Over the period, total employee compensation increased **from £813 million to £977 million, an increase of 20.2%**. As FTEs have also increased over the period by 8.9%, a perhaps more meaningful comparison is to consider the average compensation paid per FTE employee. Figure 11 illustrates this below.

Figure 11: Average compensation paid per FTE worker on the CBC, £, FY 18-19 – FY 20-21



Source: Cambridge Biomedical Campus, Cebr survey and analysis

From the figure above, in the financial year ending 2019 the average compensation per FTE employee was £54,375 and increased to £60,904 for the financial year ending 2021, **an increase of 12%**. Therefore, over the period we have seen a faster increase in total employee compensation than employment, and average compensation per FTE has increased.

2.5 Tax contribution

The economic contribution of organisations on the CBC through tax revenues have been calculated in terms of the following tax heads for the financial year ending 2021:

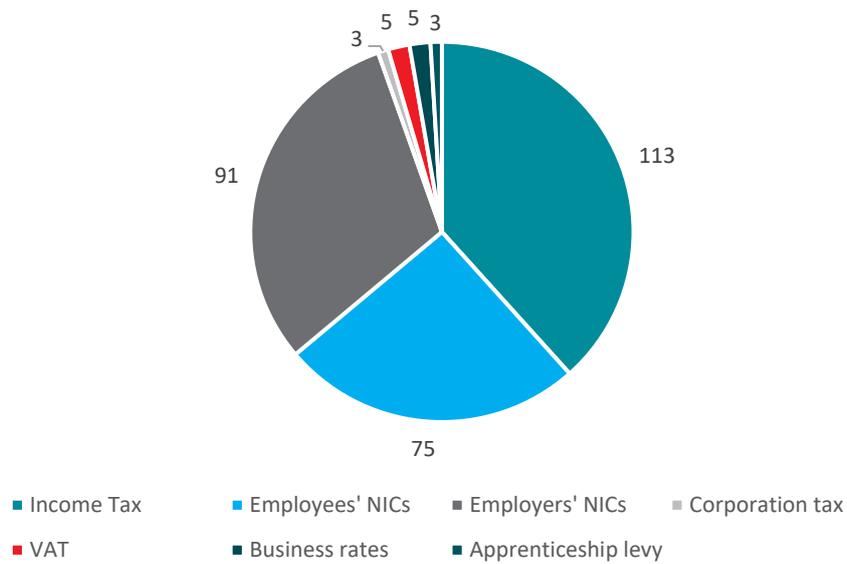
- Income Tax;
- National Insurance Contributions (NICs) – both from employers and employees;
- Corporation Tax;
- Value Added Tax;
- National Non-Domestic Rates (Business Rates); and
- Apprenticeship Levy.

Personal taxes (i.e. Income Tax and NICs) have been calculated through an internal Cebr tax model which applies the respective tax rates¹² to the estimated average salaries paid to employees from each region. Revenues from the other taxes listed above are directly taken from the bespoke survey that the organisations on the CBC completed.

The results of this analysis are shown in Figure 12.

¹² The rates and thresholds applied were sourced from HMRC.

Figure 12: Tax contribution of organisations on the CBC, £m



Source: Cambridge Biomedical Campus, Cebr survey and analysis

The total tax paid by organisations on the CBC was £292 million. Income tax represents **38.83% of total taxes** paid by organisations on the CBC. Corporation tax and VAT amount to a small proportion due to health service bodies generally being exempt from paying such taxes.

3. Aggregate footprint of the CBC

3.1 Modelling overview

The wider economic footprint of the CBC goes beyond the direct impacts discussed in the prior section. This section identifies the aggregate footprint supported by considering two further impact layers:

- **Indirect impacts** – The activity supported through the supply chains that feed into day-to-day operations of the organisations on the CBC. This focuses on the economic activity supported when the CBC purchases goods and services from suppliers. All of this supports significant further demand along supply-chains, and output and jobs amongst their suppliers. In turn, these suppliers place demands on their suppliers which supports further output and jobs. The indirect impact captures the revenue, GVA, employment and employee compensation supported along the supply-chains as a result of these operations.
- **Induced impacts** – The workers who receive income and employment benefits through the direct (the employees who work on the CBC) and indirect (the suppliers to the sector and in turn their suppliers) channels spend their increased earnings on goods and services in the wider economy. This helps to further stimulate demand, supporting additional revenue, GVA, employment and employee compensation. The induced impact captures these wider-spending effects.

Summing these direct, indirect, and induced impact layers allows us to estimate the aggregate footprint supported by organisations on the CBC.

To compute these impacts, Cebr uses input-output (IO) modelling¹³, to generate economic multipliers. This allows us to identify the key sectors of the economy from which organisations on the CBC purchase their inputs.

The input-output model employed uses this supply-chain disaggregation to calculate the economic contributions supported along the supply-chains of the organisations on the CBC. We then use typical employee-spending patterns to estimate the induced impact layer.

This section focuses purely on these impacts at national level: more granular regional analysis follows in Section 4.

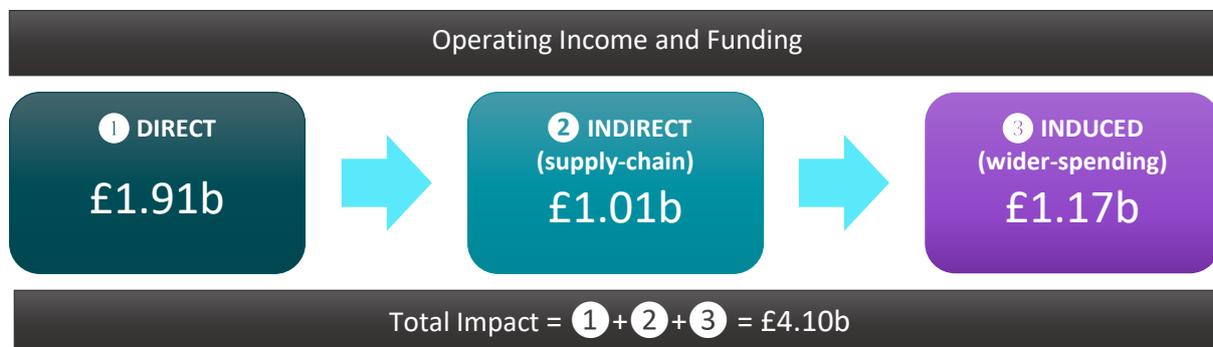
3.2 Operating Income and Funding

Organisations on the CBC were responsible for an estimated £1.91 billion in operating income and funding for the financial year ending 2021. Through our input-output modelling, we estimate that this direct operating income and funding supports an additional £1.01 billion worth of operating income and funding along the supply-chains (the indirect effect). Furthermore, it is estimated that the increase in wider-spending that occurs when organisations employees (and the employees supported along the supply-chains) spend their earnings in the wider economy **supports £1.17 billion (the induced effect)**.

¹³ For the purposes of this analysis, we first categorised each organisation on the CBC that was in-scope to the relevant SIC code, taking into considering the main activities of the organisation.

Combining these direct, indirect and induced impacts, it is estimated that the organisations of the CBC support an **aggregate footprint of £4.10 billion in operating income and funding**. This is further illustrated in the figure below.

Figure 13: Operating income and funding multiplier results



Source: Cambridge Biomedical Campus, ONS, Cebr survey and analysis

The above figure should be interpreted as follows. For every £10 of operating income and funding directly generated by organisations on the CBC, a further £5.27 of operating income and funding is supported in firms along their supply chain. Furthermore, £6.13 of operating income and funding is supported in businesses when individuals associated with the direct and indirect impact layers spend their earnings in the wider economy. Combining the indirect and induced impact layer, we say that for every £10 of operating income and funding directly generated by organisations on the CBC, **a further £11.40 worth of operating income and funding is supported in the wider economy**.

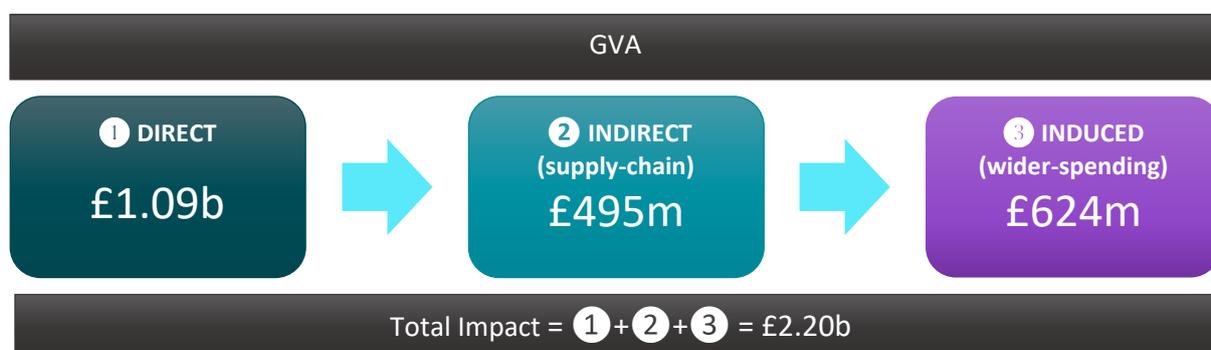
3.3 Gross Value Added (GVA)

In 2021, the organisations on the CBC directly generated £1.09 billion in Gross Value Added (GVA) contributions.

It is estimated from the modelling that a further £495 million worth of GVA contributions are supported along the supply-chains (indirect effect) and £624 million is supported when employees on the CBC (and employees along their supply chains) spending their earnings in the wider economy. Combining the direct, indirect and induced impact layers, it is estimated that organisations on the CBC supported **an aggregate economic footprint of £2.20 billion worth of GVA** in the financial year ending 2021.

The figure below illustrates our calculated GVA impacts for organisations on the CBC.

Figure 14: GVA multiplier results



Source: Cambridge Biomedical Campus, ONS, Cebr survey and analysis

Once again, it is possible to generalise this result by considering the ratios between the direct, indirect, and induced impact layers. For every £10 in GVA directly generated by organisations on the CBC, a further £10.31 is supported through the indirect and induced impact channels.

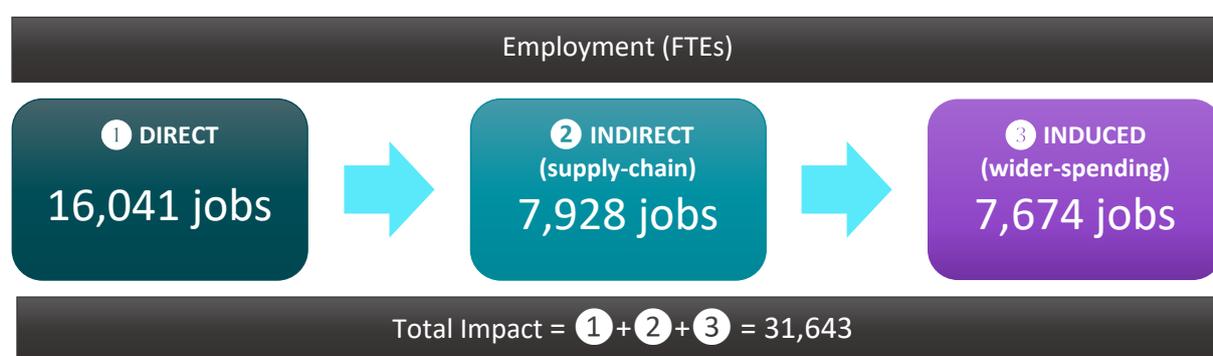
Specifically, within this study, we can identify the GVA supported by AstraZeneca within the UK and the East of England and recognise this as a future benefit.

It is estimated that AstraZeneca supported an **aggregate economic footprint of £3.60 billion worth of GVA in 2020**, of which **£1.23 billion was attributed to the East of England**. This represents 34.2% of total UK GVA that AstraZeneca supported in the region. It is therefore evident that the future economic impact of AstraZeneca's operations will significantly increase the economic impact of the CBC on the UK economy.

3.4 Employment

The figure below illustrates our calculated employment multipliers for organisations on the CBC.

Figure 15: Employment multiplier results



Source: Cambridge Biomedical Campus, ONS, Cebr survey and analysis

The modelling shows that for every 10 jobs directly generated by organisations on the CBC, a further 4.9 jobs are supported along their supply chains. Moreover, a further 4.8 are supported when employees associated with the direct and indirect impact layers spend their earnings in the wider economy. Overall, the indirect and induced impacts supports 15,602 jobs in the wider economy. By combining the indirect and induced impact layers, our modelling shows that for every 10 jobs directly generated by organisations on the CBC, a further 9.7 jobs are supported in the wider economy. Overall, on an **FTE basis 31,643 jobs are supported across the economy**.

From the input-output model, we can also isolate the sectors of the economy where the indirect and induced impacts are supported. This is illustrated in the table below, demonstrating the extent and breadth to which the CBC directly supports jobs across the economy.

Table 2: Jobs supported in the wider economy by the CBC

Sector	Number of jobs
Wholesale And Retail Trade; Repair Of Motor Vehicles And Motorcycles	2811
Administrative And Support Service Activities	2762
Professional, Scientific And Technical Activities	1787
Accommodation And Food Service Activities	1707
Manufacturing	1316
Transportation And Storage	1059
Human Health And Social Work Activities	641
Information And Communication	593
Education	535
Other Service Activities	405
Financial And Insurance Activities	393
Construction	315
Real Estate Activities	306
Agriculture, Forestry And Fishing	296
Arts, Entertainment And Recreation	289
Electricity, Gas, Steam And Air Conditioning Supply	135
Water Supply; Sewerage, Waste Management And Remediation Activities	129
All Other Sectors	123

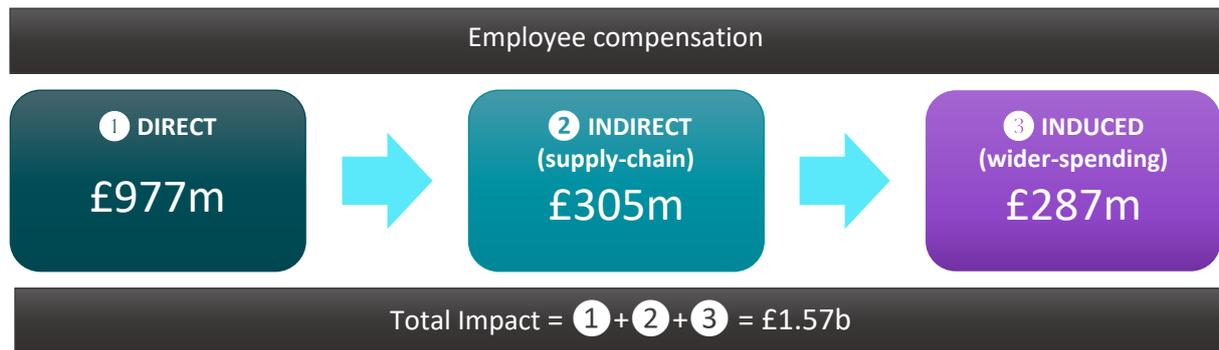
Source: ONS, Cebr survey and analysis

The table above illustrates the wider impact the CBC has on the UK economy. Per the above, 35.7% of the wider jobs are in wholesale and retail trade and administrative and support service activities.

3.5 Compensation of employees

Finally, we are interested in the aggregate compensation of employees supported by organisations on the CBC. In 2021 direct employee compensation paid to employees of organisations on the CBC, was £977 million. The additional indirect and induced impacts are set out below, in Figure 16.

Figure 16: Compensation of employee's multiplier results



Source: Cambridge Biomedical Campus, ONS, Cebr survey and analysis

In addition to the direct impact, we estimate that the indirect and induced economic activity supported by organisations on the CBC, **supports an additional £592 million of employee compensation.** For every £10 in employee compensation directly generated by organisations on the CBC, a further £6.06 of compensation is supported through the indirect and induced impact channels.

3.6 Tax contribution

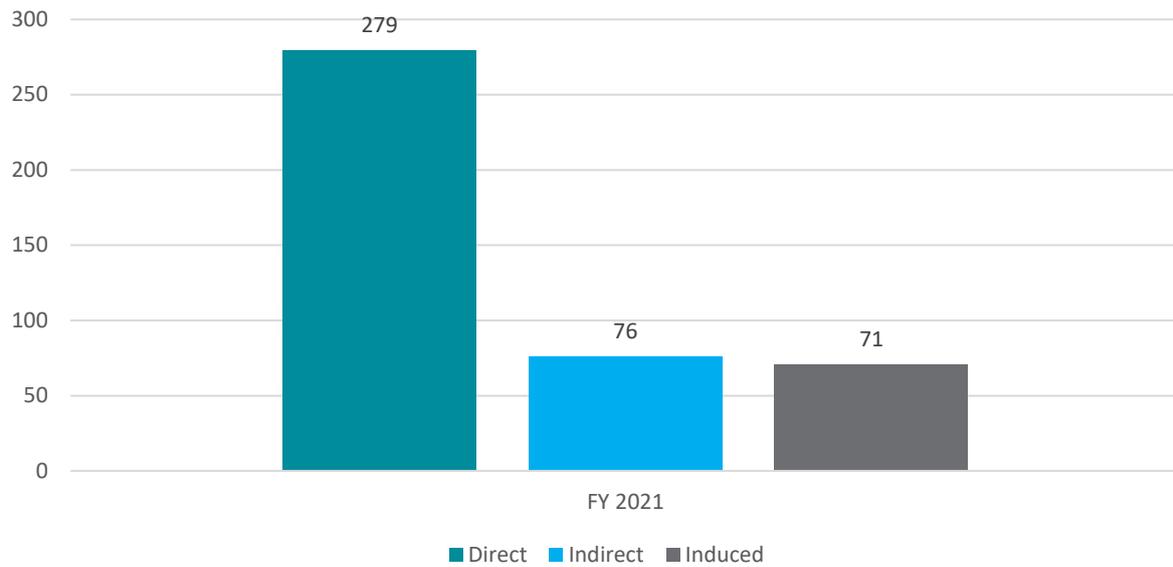
In addition to the direct tax contribution of organisations on the CBC, we are also able to estimate the indirect and induced tax contribution through the employment and employee compensation indirect and induced impacts

The tax contribution estimated through the indirect and induced impacts focuses on the income-related taxes (namely income tax, employer's national insurance and employee's national insurance) paid by these employees, whose jobs are supported by the CBC.

Considering the above, the indirect and induced impacts contribute a further £147 million. As a result, the aggregate income-related tax contribution to the Exchequer is £439 million.

The figure below outlines these income-related tax contributions, split by the direct, indirect, and induced impacts.

Figure 17: Income tax contributions, £m



Source: Cambridge Biomedical Campus, Cebr survey and analysis

The direct income tax contribution is £279 million compared to £76 million and £71 million for the indirect and induced impacts respectively. Although the indirect and induced income tax is driven by lower employment which directly lowers income tax, it is further driven by a lower average gross salary in employment across sectors resulting in lower income taxes being paid.

The average gross pay for employees within the CBC is £40,590 as opposed to £27,640 (31.9% less) and £26,870 (33.8% less) for the indirect and induced sectors respectively, leading to lower income-related tax contributions per employee.

4. Regional footprint of the CBC

4.1 Overview

The following section highlights two principle themes:

- **The economic value of the CBC in supporting activity in the East of England (region) and the Cambridge City Council and South Cambridge District Council (local authorities).**¹⁴ All the UK level direct impacts are allocated to the East of England and the two local authorities respectively; we then further estimate the share of the UK-level indirect and induced impacts that are specifically attributable to the region and local authorities.
- **The wider role of the CBC in supporting activity outside of the East of England and across the UK.**

4.2 Regional and Local Authority Operating Income and Funding

The organisations on the CBC were responsible for an estimated £1,914 million in operating income and funding for the financial year ending 2021.

For the purposes of this analysis, we have classified the CBC to be within both the Cambridge City Council and South Cambridgeshire District Council local authorities. As such, the direct impacts are attributed to both local authorities, while the indirect and induced impacts calculated are modelled to be within either of the two. For simplicity within the rest of this section, we refer to the Cambridge City Council and South Cambridgeshire District Council combined, as the 'CBC local authorities'.

From a regional perspective, as the CBC is located within the East of England, the direct impacts are attributed solely to this region. Through our input-output modelling, we estimate that this direct operating income and funding supports an additional £158 million worth of operating income and funding along the supply-chains (the indirect effect) within the East of England. Furthermore, it is estimated that the increase in wider-spending that occurs when organisations employees (and the employees supported along the supply-chains) spend their earnings in the wider economy supports £721 million (the induced effect) in the East of England.

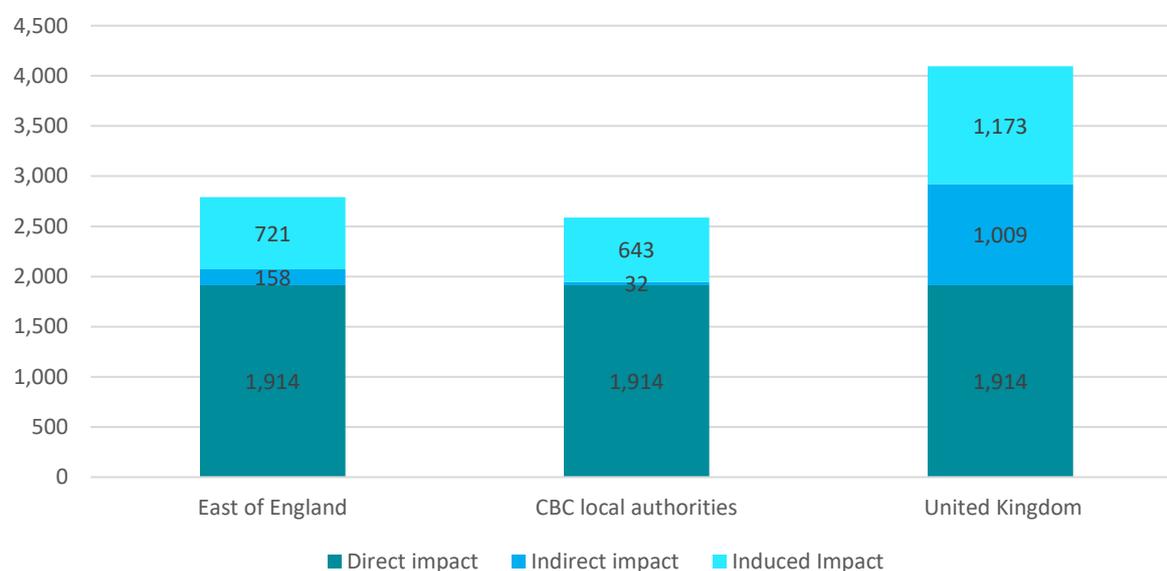
From a local authority perspective, we also estimate that the direct operating income and funding supports an additional £32 million worth of turnover along the supply-chains (the indirect effect) within the CBC local authorities. Furthermore, it is estimated that the increase in wider-spending that occurs when organisations employees (and the employees supported along the supply-chains) spend their earnings in the wider economy supports £643 million (the induced effect) within the local authorities.

From both a regional and local authority perspective, the induced impacts are higher than the indirect impacts. The intuition behind this may be that given the supply chain requirements of organisations on the CBC, it's more difficult for the organisations to purchase goods and services locally compared to employees and/or consumers who typically have a greater propensity for local consumption. As such, this results in the regional and local authority

¹⁴ As the CBC geographically falls into both the Cambridge City Council and South Cambridgeshire District Council, we have modelled the impacts experienced across the two local authorities combined.

indirect multipliers being lower than the induced multipliers. The regional and local authority impacts are further illustrated below.

Figure 18: Operating Income and Funding multiplier results, £ million, FY 20-21



Source: Cambridge Biomedical Campus, ONS, Cebr survey and analysis

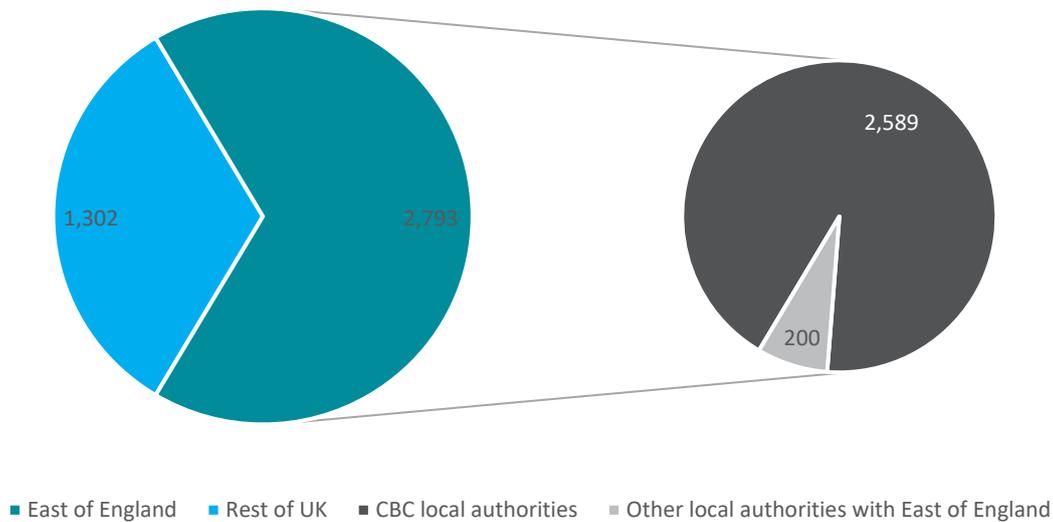
The above figure should be interpreted as follows. Combining the indirect and induced impact layer, we can say that for every £10 of operating income and funding directly generated by organisations on the CBC, a further £4.59 worth of operating income and funding is supported in the East of England. Additionally, for every £10 of operating income and funding directly generated by organisations on the CBC, a further £3.53 worth of operating income and funding is supported within the CBC local authorities

The analysis illustrates that of the £4.59 worth of operating income and funding that is supported in the East of England, 76.9% is supported within the local authorities that the CBC fall in and the remaining 23.1% falls within the other local authorities within the East of England.

Additionally, considering the UK national multipliers, of the £4.1 billion worth of operating income and funding supported in the UK (the direct, indirect, and induced impacts), 68.2% is supported in the East of England and the remaining 31.8% is attributed to the other regions within the UK. **This means that the CBC is responsible for supporting £1.30 billion in turnover for UK businesses, outside of the East of England.**

These impacts and their regional and local authority level breakdown are further presented visually below, in Figure 19.

Figure 19: Geographic share of operating income and funding, £ million, FY 20-21



Source: Cambridge Biomedical Campus, ONS, Cebr survey and analysis

From the £2.80 billion (68.2%) of operating income and funding that is supported in the East of England, £2.60 billion (63.2%) of that is supported in CBC local authorities and the remaining £200 million (5.0%) is supported in other local authorities within the East of England.

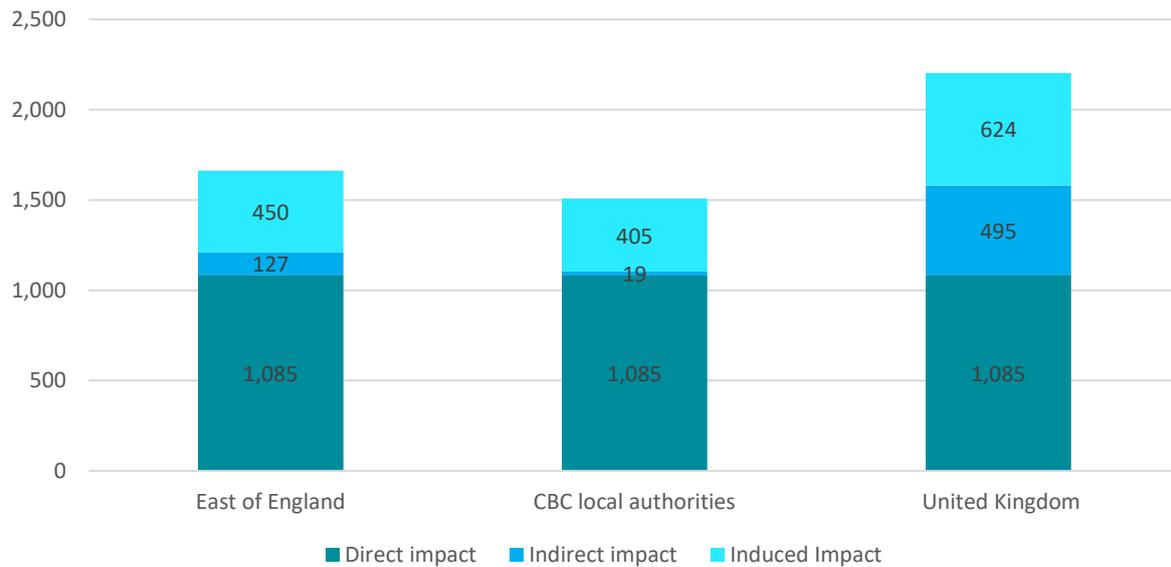
4.3 Local Authority and Regional GVA

In 2021, the organisations on the CBC directly generated £1,085 million in GVA contributions. Similar to operating income and funding, as all of the GVA is generated on the CBC, this is attributed solely to the CBC local authorities and the East of England.

Through our input-output modelling, we estimate that this direct GVA supports an additional £127 million worth of GVA along the supply-chains (the indirect effect) within the East of England. Furthermore, it is estimated that the increase in wider-spending that occurs when organisations employees (and the employees supported along the supply-chains) spend their earnings in the wider economy supports £450 million (the induced effect) within the East of England.

Additionally, from a local authority perspective, we estimate that a further £19 million worth of GVA contributions are supported along the supply-chains (indirect effect) within the CBC local authorities and £405 million is supported when employees on the CBC (and employees along their supply chains) spend their earnings in the wider economy in the CBC local authorities. This is further illustrated in the figure below.

Figure 20: GVA multiplier results £ million, FY 20-21



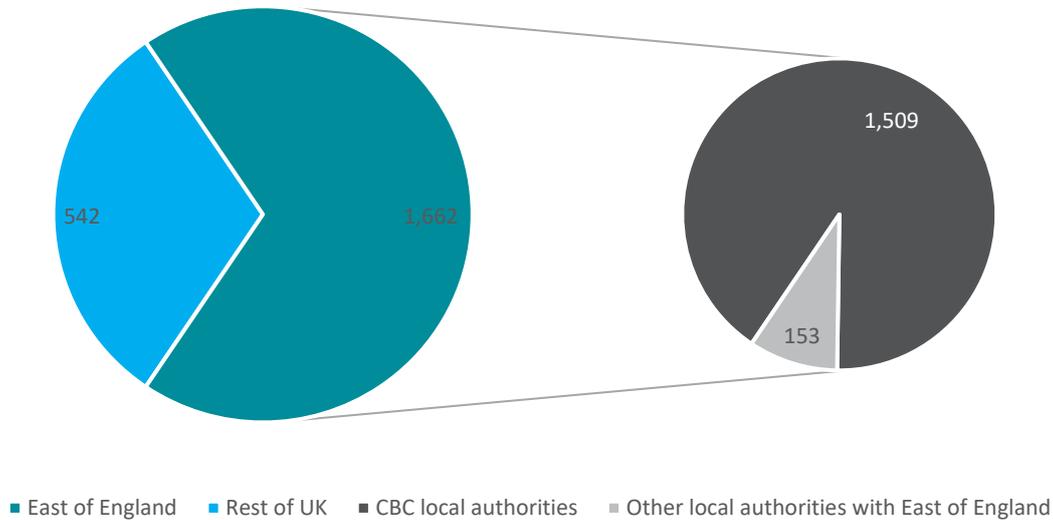
Source: Cambridge Biomedical Campus, ONS, Cebr survey and analysis

Once again, it is possible to generalise this result by considering the ratios between the direct, indirect, and induced impact layers for both the East of England and the CBC local authorities. For every £10 in GVA directly generated by organisations on the CBC, a further £5.32 is supported through the indirect and induced impact channels within the East of England. Also, for every £10 in GVA directly generated by organisations on the CBC, a further £3.91 is supported through the indirect and induced impact channels within the CBC local authorities.

The above analysis displays that of the £5.32 worth of GVA that is supported in the East of England, 75.4% is supported within the CBC local authorities and the remaining 24.6% falls within the other local authorities within the East of England. **This means that the CBC is responsible for supporting £542 million in GVA for UK businesses, outside of the East of England.**

These impacts and their regional and local authority level breakdown are further presented visually below, illustrated by Figure 21.

Figure 21: Geographic share of GVA, £ million, FY 20-21



Source: Cambridge Biomedical Campus, ONS Cebr survey and analysis

From the £1.66 billion (68.9%) of GVA that is supported in the East of England, £1.51 billion (62.5%) of that is supported in the CBC local authorities and the remaining £153 million (6.4%) is supported in the other local authorities in the East of England. Like operating income and funding, we find that a large proportion of turnover and GVA attributed to the East of England is within the local authorities that the organisations in the CBC operate in.

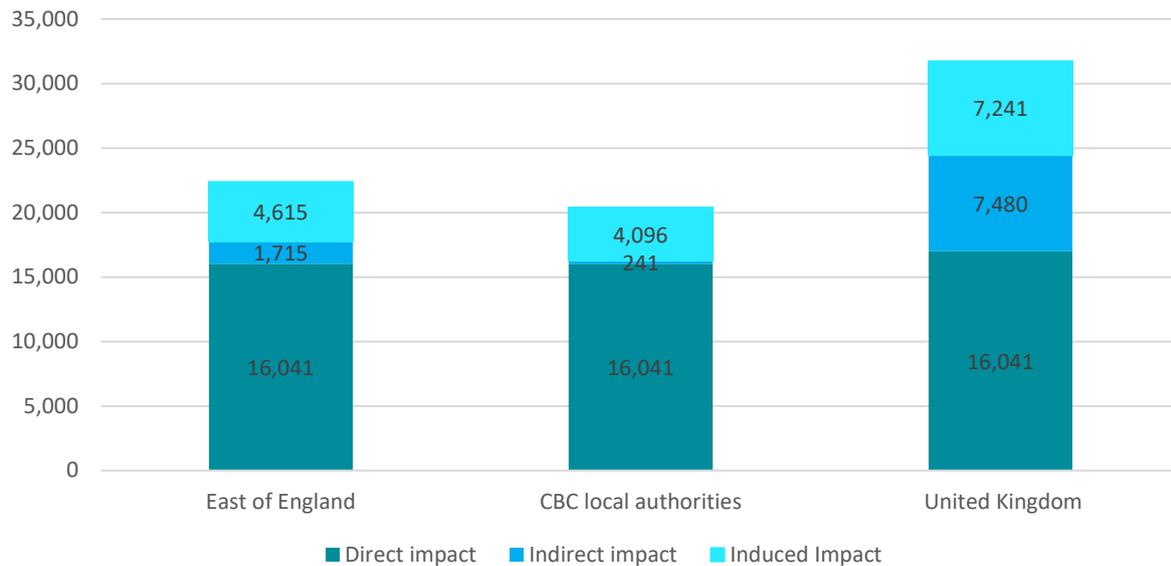
4.4 Local Authority and Regional Employment

Figure 22 illustrates our calculated employment multipliers for organisations on the CBC within the local authorities. The direct impacts are attributed to the East of England and by combining the indirect and induced impacts, a further 6,330 jobs are supported within the region.

Further, Figure 22 also illustrates our calculated employment multipliers for organisations on the CBC within the CBC local authorities.

The direct impacts are attributed to the CBC local authorities and by combining the indirect and induced impacts, a further 4,337 jobs are supported within the CBC local authorities.

Figure 22: Employment multiplier results, FY 20-21



Source: Cambridge Biomedical Campus, ONS, Cebr survey and analysis

By combining the indirect and induced impact layers our modelling shows that for every 10 jobs directly generated by organisations on the CBC, a further 3.9 jobs are supported in the East of England.

From a local authority perspective, for every 10 jobs directly generated by organisations on the CBC, a further 2.7 jobs are supported in the CBC local authorities.

The above analysis displays that of the 3.9 jobs that are supported in the East of England, 72.7% are supported within the local authorities that the CBC fall on and the remaining 27.3% falls within other local authorities within the East of England.

The total aggregate impact is that 22,371 FTEs are supported in the CBC local authorities and therefore 16.7% of FTEs (or around one in every six jobs) across the CBC local authorities are directly generated or indirectly supported by the CBC. This is broken down in the table below.

Table 3: CBC share of regional aggregate employment (FTEs)

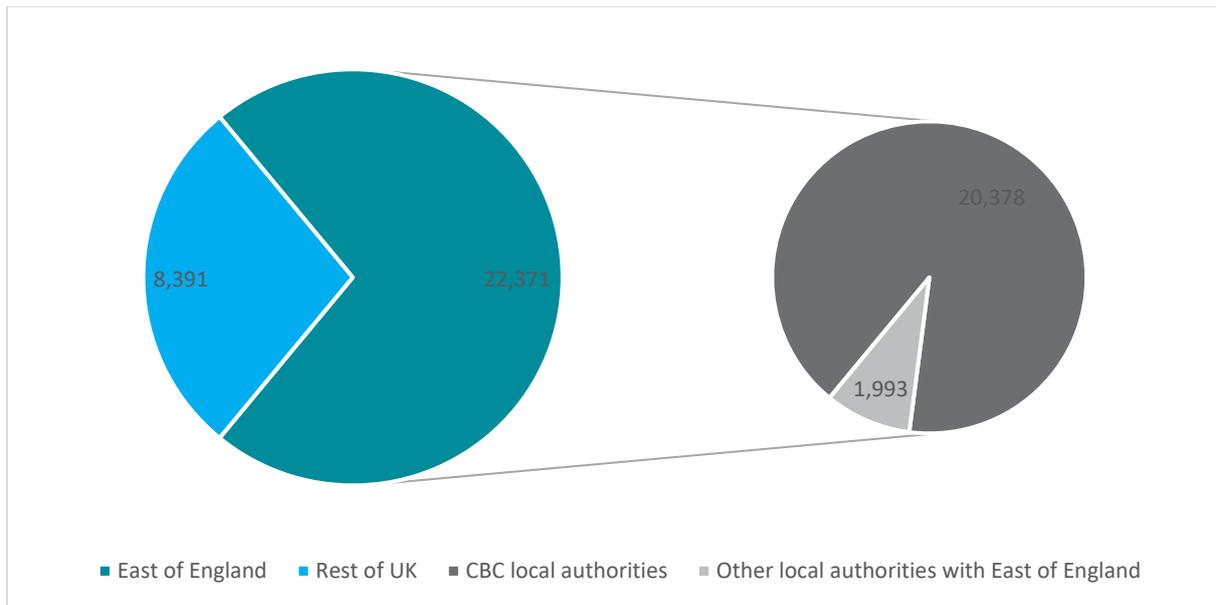
	CBC aggregate employment in CBC local authorities	Total employment within CBC local authorities	CBC share of aggregate employment
East of England	22,371	133,600	16.7%

Source: Cambridge Biomedical Campus, ONS, Cebr survey and analysis

Additionally, considering the UK multipliers, of the 9.7 jobs that are supported in the UK for every 10 direct CBC jobs, 72.7% are supported in the East of England and the remaining 27.3% are attributed to the other regions within the UK. **This means that the CBC is responsible for supporting 8,391 FTEs for UK businesses, outside of the East of England.**

These impacts and their regional and local authority level breakdown are further presented visually below, illustrated by Figure 23.

Figure 23: Geographic share of employment, FTEs, FY 20-21



Source: Cambridge Biomedical Campus, ONS, Cebr survey and analysis

From the 22,371 (71.9%) of employment that is supported in the East of England, 20,378 (66.2%) of that is supported in the local authorities that the organisations are classified in and the remaining 1,993 (6.5%) are supported in the other local authorities in the East of England. Like operating income and funding and GVA, we find that a large proportion of employment attributed to the East of England is within the local authorities that the organisations in the CBC operate in.

4.5 Local Authority and Regional Employee Compensation

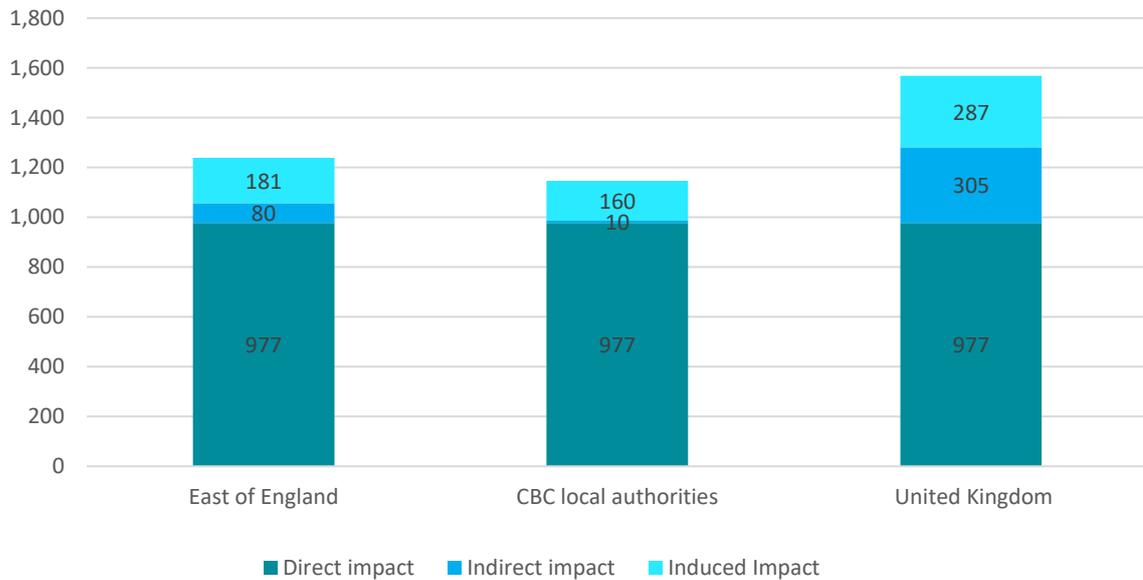
Finally, we are interested in the aggregate compensation of employees supported by organisations on the CBC. In 2021, total employee compensation was £977 million and can be attributed to the local authorities and the East of England.

In addition to the direct impact, we estimate that the indirect and induced economic activity supported by organisations on the CBC, supports an additional £261 million of employee compensation within the East of England. For every £10 in employee compensation directly generated by organisations on the CBC, a further £2.67 of compensation is supported through the indirect and induced impact channels within the East of England.

From a local authority perspective, we estimate that the indirect and induced economic activity supported by organisations on the CBC, supports an additional £170 million of employee compensation within the CBC local authorities. For every £10 in employee compensation directly generated by organisations on the CBC, a further £1.74 of compensation is supported through the indirect and induced impact channels within the local authorities.

The effects of the additional indirect and induced impacts are set out below.

Figure 24: Compensation of employee's multiplier results, ONS, £ million, FY 20-21

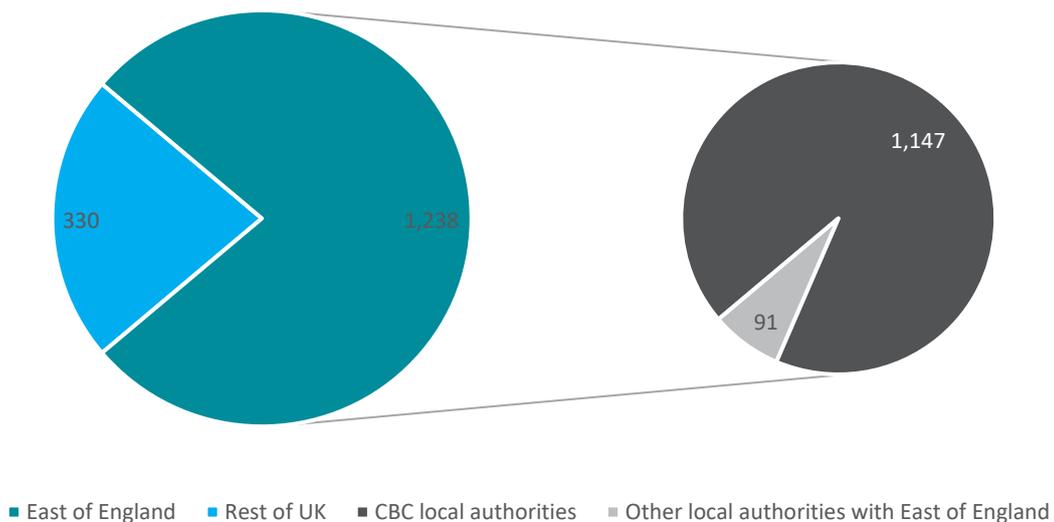


Source: Cambridge Biomedical Campus, ONS, Cebr survey and analysis

Additionally, considering the UK multipliers, of the £6.06 worth of employee compensation supported in the UK, 79.0% is supported in the East of England and the remaining 21.0% is attributed to the other regions within the UK. **This means that the CBC is responsible for supporting £330 million in employee compensation for UK businesses, outside of the East of England.**

These impacts and their regional and local authority level breakdown are further presented visually below, illustrated by Figure 25.

Figure 25: Geographic share of compensation of employee compensation, £ million, FY 20-21



Source: Cambridge Biomedical Campus, ONS, Cebr survey and analysis

From the £1.24 billion (79.0%) of employee compensation that is supported in the East of England, £1.15 billion (73.1%) of that is supported in the local authorities that the organisations

are classified in and the remaining £91 million (5.8%) are supported in the other local authorities in the East of England. Like the other variables analysed above, we find that a large proportion of employee compensation attributed to the East of England is within the local authorities that the organisations in the CBC operate in. This further demonstrates the impact the CBC has from both a regional and local authority perspective.

Within the East of England, there are a number of other science parks, including the Babraham Research Campus and the Stevenage Bioscience Catalyst. In direct comparison to the Babraham Research Campus, the aggregate GVA impact for Babraham equates to £285.7 million (v £2.20 billion for the CBC) approximately 13% as a proportion¹⁵ of the total CBC aggregate impact of GVA¹⁶. The FTEs supported in the wider economy equates to 4,271 for the Babraham Research Campus compared to 30,762 for the CBC, approximately 15.3% of the total employment supported by the CBC.

Additionally, the Stevenage Bioscience Catalyst contributes £87 million of direct GVA¹⁷ to the UK economy (v 1.09 billion for the CBC), approximately 8% as a proportion of the total direct CBC impact of GVA. The number of direct FTEs that the Stevenage Bioscience Catalyst contributes is 1,610 jobs to the UK economy, as opposed to 16,041 on the CBC. As a direct comparison, this represents a 10% proportion of the direct jobs contributed by the CBC alone.

¹⁵ Given the year the study was undertaken, we note that there is a slight time lag in the differences noted. The data for Babraham Research Campus was taken from 2017/18 as opposed to the CBC where we have analysed 2020/21 data.

¹⁶ <https://www.babraham.com/media/0wyjdtzl/brc-impact-report-210520-na-web.pdf>

¹⁷ <https://www.flipsnack.com/stebiocat/stevenage-bioscience-catalyst-eia-report/full-view.html>

5. Wider socio-economic benefits of the CBC

The following section summarises some of the wider socio-economic benefits associated with the Cambridge Biomedical Campus. These are the key benefits associated with the unique characteristics of the Campus, above and beyond the more standard benefits set out so far. While important, those do not distinguish the CBC from any other organisation which employs workers, produces a contribution to GDP and supports further activity both nationally and locally.

Specifically, we explore three channels through which the CBC makes a broader positive socio-economic contribution to the UK:

- 1) The specific role of the CBC in treating patients on premises;
- 2) The broader role of the CBC in developing techniques, products, changes in care and supporting wider learning that facilitates wider improved health outcomes; and
- 3) Benefits associated with clustering and agglomeration, allowing the organisations on the CBC to function more effectively, relative to all existing in separate locations.

These first two channels are discussed through an initial review of the literature surrounding the economic costs of ill-health and the potential benefits from improvements based on findings from survey data and medical studies. The review then analyses specific role of the Cambridge Biomedical Campus in supporting improved health outcomes and outline examples of ailments and corresponding treatments that have been developed by organisations within the CBC. These treatments have been provided to patients both within the CBC as well as on a national level. We then move on to discuss the wider contribution of research on the Campus. Finally, we analyse the economic benefits associated with organisations being clustered together within the CBC, with the wider spillover benefits associated with this.

5.1 Healthcare benefits

For the past century, health improvements from vaccines, antibiotics, and nutrition, among others have saved millions of lives and has also been a catalyst for economic growth. Better health promotes economic growth by expanding the labour force and by boosting productivity.

A pertinent and intuitive recent example of how important health is to the economy is the COVID-19 pandemic, demonstrating the clear importance of health for individuals, society, and the global economy.

A recent report by McKinsey Global Institute¹⁸ illustrates how better health can translate into higher GDP along four channels. The four channels illustrated were fewer early deaths, fewer health conditions, expanded participation and increase in productivity. Along these four channels, better health is associated with higher GDP, highlighting the importance of health on the economy, and are further explained below.

¹⁸ McKinsey Global Institute – Prioritizing Health

Fewer early deaths – An improvement in health expands employment by the number of people who can continue to work in the economy because the early death was averted. Therefore, preventing early deaths causes employment to increase, resulting in a higher GDP.

Fewer health conditions – Health conditions inevitably lead to a reduction in the participation of the workforce. Therefore, reducing health conditions leads to an increase in the workforce, increasing GDP in the long-term.

Expanded participation – The population of an economy can choose to work more or longer if healthier, contributing further to economic prosperity.

Increase in productivity – An increase in productivity of the workforce can lead to higher GDP. An important aspect of this is the ability to participate in the workforce at an early age. As such, improving children’s health can boost productivity as adults in the future.

Benefits of improved healthcare

Evidence from survey data and labour market case studies suggests that ill-health amongst employees negatively impacts their performance and is further correlated with losses in productivity and in some cases, also firm revenue. In 2019, Britain’s Healthiest Workplace Survey (BHWS) conducted by Vitality Insurance¹⁹ ran in its 8th year and found that employees lose 38 working days a year i.e., nearly 7.5 working weeks of productive time per year due to sickness or illness-related performance. In 2019, this cost the UK economy £91.2 billion a year, an over £10 billion increase on 2018. The survey attributed nearly three-quarters of the £92 billion i.e., £68 billion productivity loss to factors such as poor mental wellbeing and unhealthy lifestyle choices. These results were based on 26,393 workers across 130 businesses across the UK.

In terms of mental health concerns, the BHWS survey found that workers’ stress, depression and anxiety cost the economy £30 billion in 2019. This has been accompanied with a rise in depression rates as well, which have more than doubled since in the past five years. Almost 1 in 10 workers (8.5%) are now struggling with depression compared to just 4% in 2014.

Additionally, the survey found that the businesses making significant progress across the health and wellness of their employees had positive spillover effects on business productivity. The vast majority (75%) of those who do engage in health and wellbeing initiatives report a positive impact on their overall health, yet overall awareness and uptake of such initiatives is quite low (28% and 29% respectively) to begin with.

Another significant survey of employee mental health costs in the UK was conducted by Deloitte²⁰ in 2019. The study found that poor mental health costs UK employers £42-£45 billion a year, compared to £33 billion in 2017. According to the study, the returns to investing in improving mental health employee outcomes are quite high - for every £1 spent by employers on mental health interventions they get £5 back in reduced absence, presenteeism and staff turnover.

19 <https://www.vitality.co.uk/business/healthiest-workplace/findings/>

20 <https://www2.deloitte.com/uk/en/pages/consulting/articles/mental-health-and-employers-refreshing-the-case-for-investment.html>

A 2020 study by the Office for National Statistics (ONS)²¹ looks at sickness absence in the labour market. A total of 118.6 million working days were lost because of sickness or injury in the UK in 2020 (equivalent to 3.6 days per worker). The coronavirus (COVID-19) pandemic has affected the sickness absence data in several ways; while the virus may have led to additional sickness absence, measures such as furloughing, social distancing, shielding and increased homeworking appear to have helped reduce other causes of absence, allowing the general downward trend to continue.²²

Sickness absence rate was relatively flat between 2010 and 2020 and stood at 1.8% in 2020. Some of the most common reasons were categorised as: minor illnesses (including coughs and colds), musculoskeletal problems (including back pain and neck and upper limb problems), “other” conditions (including accidents, poisonings and diabetes), and mental health conditions (including stress, depression and anxiety).

Finally, a study conducted by International Longevity Centre and published by Centre for the Study of Financial Innovation²³ takes a granular view on regional inequality across the UK both in terms of health and income. The main findings suggest while good health is a necessary (although not sufficient) condition for reducing regional inequality in the UK, improvements in healthy life expectancy (HLE) translate into a higher working life expectancy (WLE) and longer life expectancy. A one-year increase in healthy life expectancy would lead to an approximate 3.4-month increase in working life expectancy and a 4.5 -month increase in total life expectancy. Consequently, this would also imply a smaller gap between healthy life expectancy and total life expectancy which in turn can be associated with reduced demand for health and social care, thereby leading to lower economic costs of the society in general.

5.2 How the CBC contributes to improving health

For FY 20-21, health priorities were dominated by the global pandemic. For Cambridge University Hospitals, there have been over 2,000 inpatients treated with Covid-19 and the number of admissions totalled 129,565 and there were 676,110 outpatient appointments. For Royal Papworth Hospital, the number of patient episodes seen at the hospital was 98,245 (2019/20 was 115,749).

Next, in terms of focussing on the economic health impacts of the Cambridge Biomedical Campus specifically, the following analysis covers relevant examples of ailments and corresponding treatments that have been developed by organisations within the Campus that have provided treatments to patients both within the CBC as well as on a national level.

Case study: The cytosponge test

The cytosponge test often referred to as a ‘pill on a string’ is an innovative test for Barrett’s oesophagus – a condition that can increase a person’s risk of developing oesophageal (food

²²<https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/articles/sicknessabsenceinthelabourmarket/2020>

²³ <https://ilcuk.org.uk/wp-content/uploads/2021/06/CSFI-ILC-Business-School-The-cost-of-inequality.pdf>

pipe) cancer. Prior to the cytosponge test, Barrett's oesophagus was usually diagnosed in hospital by an endoscopy following a GP referral for longstanding heartburn symptoms.

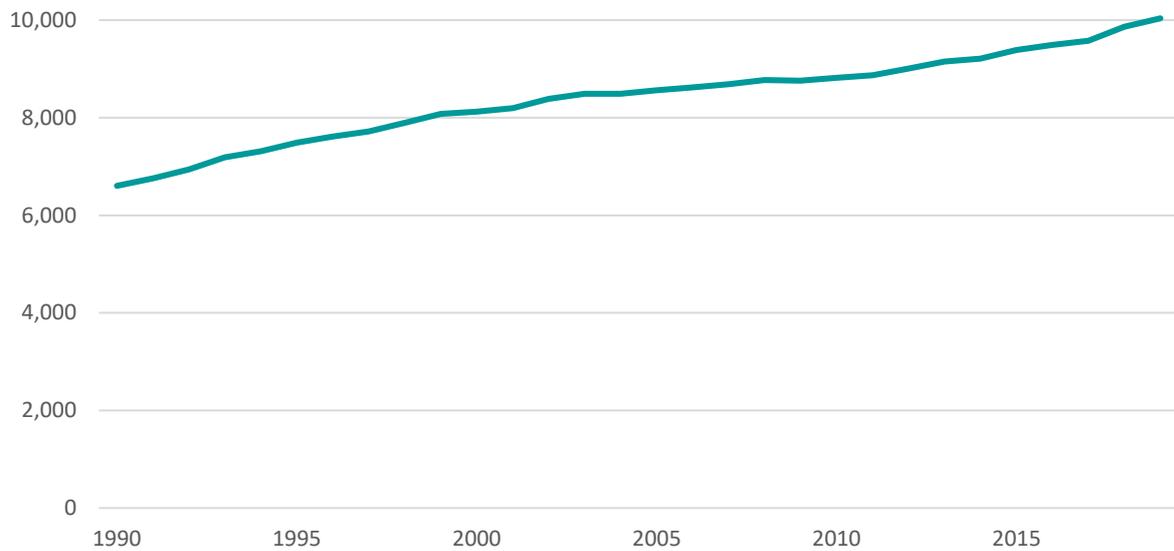
The cytosponge test is a quick, simple, and well tolerated test that can may performed in a GP surgery and help doctors who needs an endoscopy. This can crucially spare many people from having potentially unnecessary endoscopies.

According to the Institute for Health Metrics and Evaluation (IHME), the institution that maintains the leading database on the global disease burden, the total number of deaths from oesophageal cancer has generally increased from the 1990s for the UK, also increasing the disability-adjusted life year²⁴ (DALYs). Specifically, the number of deaths from oesophageal cancer in 2019 was approximately 10,000 and the number of DALYs was approximately 189,000. This is illustrated further below.²⁵

24 DALYs are the sum of the number of years of life lost, which measures years lost to premature mortality and the number of years lost to disability, which measures the time lost to poor health.

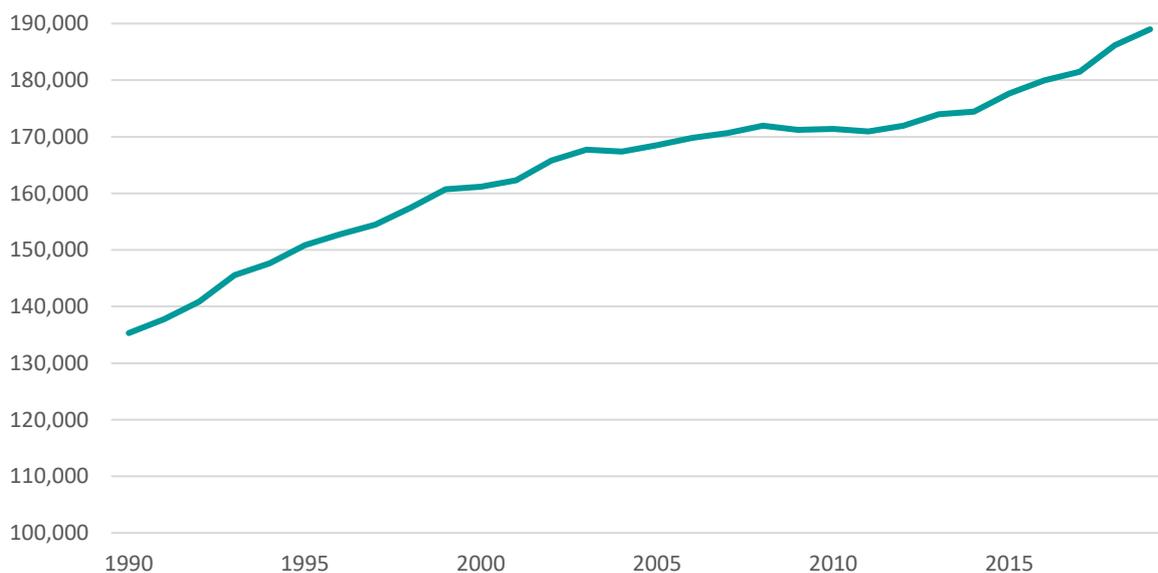
25 <http://ghdx.healthdata.org/gbd-results-tool>

Figure 26: Deaths per year attributable to oesophageal cancer, 1990-2019



Source: IMHE, Cebr analysis

Figure 27: Disability-Adjusted Life Years from oesophageal cancer, 1990-2019



Source: IMHE, Cebr analysis

As Figure 26 shows above, there has been a consistent increase in the number of deaths in the UK due to oesophageal cancer. The importance of early detection of oesophageal is therefore crucial in minimising deaths in the future.

According to a study²⁶ on using the cytosponge as a method of detection, the research paper studied 13,222 participants who were randomly allocated to the sponge test or were looked after by a GP in the usual way. Over the course of a year, the results at detecting Barrett's were remarkable; the odds of detecting Barrett's were ten times higher in those that were offered the cytosponge as opposed to the usual GP route (140 cases v 13 cases detected). Additionally, cytosponge detected five cases of early cancer whereas only one case was detected in the usual group. Given that 85% of people diagnosed with the earliest stage of oesophageal cancer survive their cancer for one year or more, this suggests that early detection is crucial.

The research study provided above was based on a sample of the population and there are clearly future benefits from this treatment. The number of deaths from oesophageal cancer in the UK is approximately 10,000 a year. Using the assumptions provided in the next section, we can provide an indicative estimate of the benefits of the cytosponge to the UK.

As there is clearly a future benefit from the cytosponge that cannot be seen in the data yet, it can be interpreted from the research study that the cytosponge technique can detect early signs of cancer up to five times earlier than the normal way and early detection may assist in curing the cancer. As such, this will likely impact the DALYs associated with oesophageal cancer.

There is limited evidence on the specific link between the utilisation of the cytosponge technique as a detection mechanism and the reduction in DALYs. We therefore present indicative figures for the potential impact on DALYs, of the widespread introduction of the technique across the UK. This is based on the current DALYs associated with oesophageal cancer in 2019. In this, we consider the potential benefits of a 1%, 10% and 50% reduction in DALYs associated with the cytosponge technique.

Table 4: Modelling scenario for the cytosponge technique

	Current DALYs (2019)	1% reduction	10% reduction	50% reduction
Number of DALYs	189,000	1,890	18,900	94,500

Source: IMHE, Cebr analysis

Although all the scenarios above are estimates, this technique in detecting early cancer can have huge future benefits for patients' health across the UK.

Further, we have been able to monetise the total value associated with averting deaths in terms of a potential GDP gain, again using indicative figures for the number of deaths averted. We have followed a similar approach in the McKinsey Global Institute report²⁷ when analysing how fewer deaths may increase the labor supply, contributing to a potential GDP gain by the expanding the labor force. This methodology takes into account the labour force participation rates, the unemployment rates and the GDP per person for the relevant age bands associated with the data and the full methodology is presented within the McKinsey Global Institute report²⁸.

26 <https://www.cam.ac.uk/research/news/pill-on-a-string-test-to-transform-oesophageal-cancer-diagnosis>

27 McKinsey Global Institute – Prioritizing Health

28 McKinsey Global Institute – Prioritizing Health

In this, we consider the potential GDP gain of a 10%, 25% and 50% reduction in deaths associated with the cytosponge technique.

Table 5: GDP modelling scenario for the cytosponge technique

	Current deaths (2019)	Potential GDP gain from averting deaths, £		
		10% reduction	25% reduction	50% reduction
Number of deaths	10,036	14,148	35,370	70,740

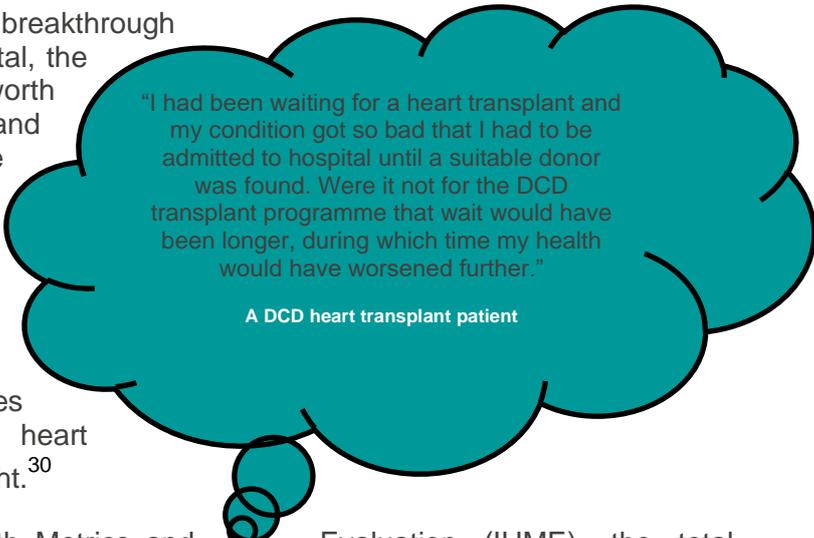
Although all the scenarios above are estimates, this technique in detecting early cancer can have huge future economic benefits for the UK.

Case study: Donation after circulatory death (DCD)

DCD is the donation of organs by patients who have a non-survivable illness. These patients are typically unconscious in intensive care and following discussions with the family regarding organ donation, the process of DCD will commence.

Prior to DCD transplants, the more common approach had been donation after brain stem death (DBD) transplants that use hearts from a donor who are brain-stem dead, but their heart is still beating. As there had been a critical shortage of suitable DBD donors, the DCD heart transplant enabled more patients across to the treatment which began in 2015.

In the six years following that breakthrough transplant at Royal Papworth Hospital, the retrieval team at Royal Papworth Hospital undertook 86 transplants and this represents more than 40% of the global total of transplants.²⁹ This revolutionary method has increased the number of heart transplants at Royal Papworth Hospital by 40% and now will undoubtedly have a transformative impact on transplantation services globally. A quote from a DCD heart transplant patient is shown to the right.³⁰



"I had been waiting for a heart transplant and my condition got so bad that I had to be admitted to hospital until a suitable donor was found. Were it not for the DCD transplant programme that wait would have been longer, during which time my health would have worsened further."

A DCD heart transplant patient

According to the Institute for Health Metrics and Evaluation (IHME), the total number of deaths from ischemic heart disease³¹ has generally decreased since the 1990s in the UK, but then increased from 2015 to 2019. The DALYs follow a similar pattern, generally decreasing from 1990 but increasing from 2015 to 2019. Specifically, the number of deaths

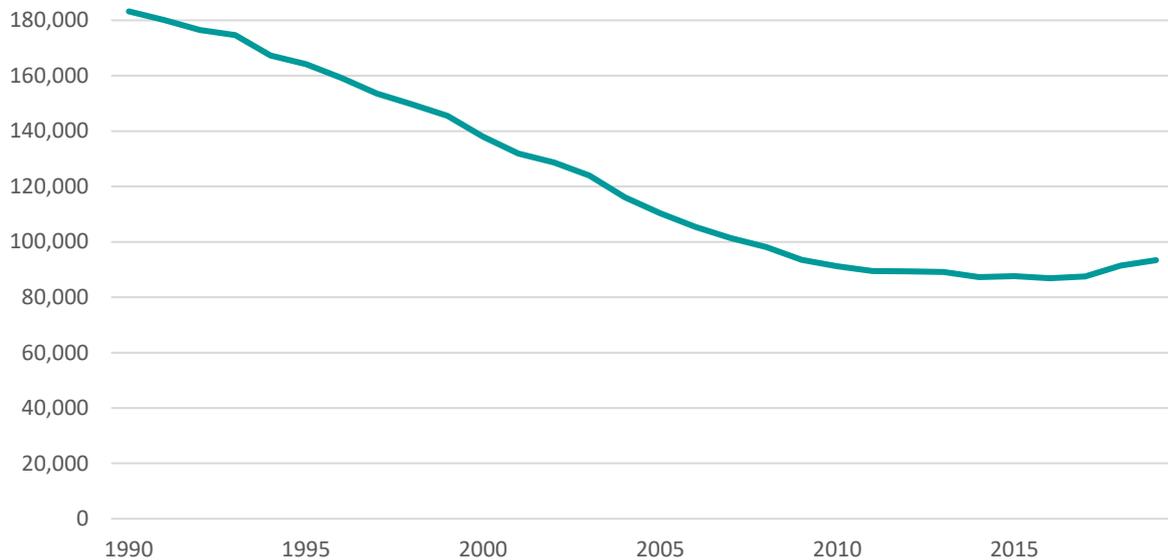
29 <https://royalpapworth.nhs.uk/our-hospital/latest-news/world-first-paediatric-heart-transplant-DCD-technique>

30 <https://royalpapworth.nhs.uk/our-hospital/latest-news/dcd-heart-transplants-five-year-results>

31 Although the database outlines other heart diseases, we understand that ischemic heart disease is caused by narrowed heart arteries. As such, a heart transplant may be required.

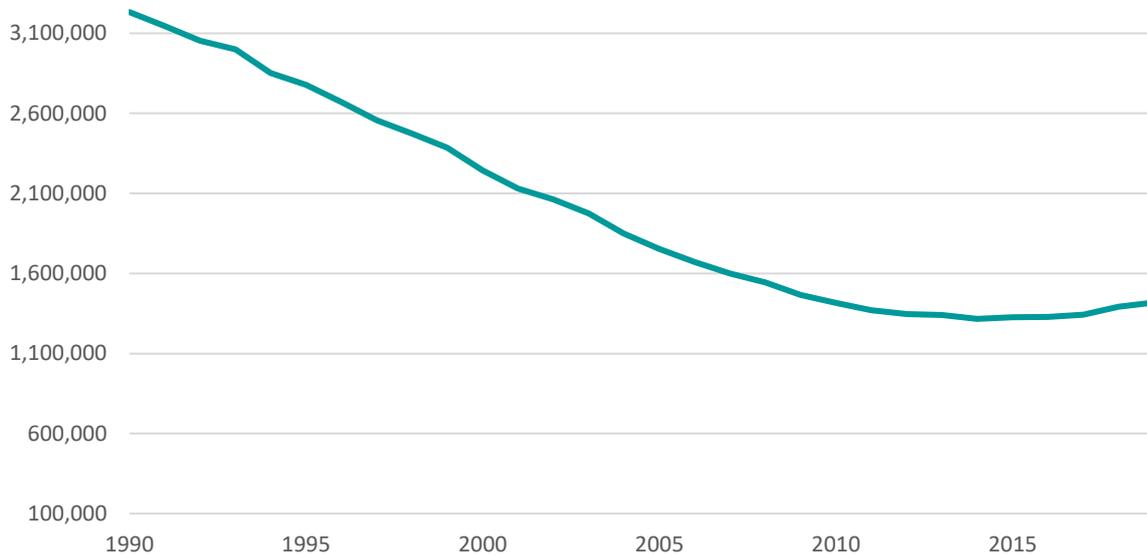
from ischemic heart disease in 2019 was approximately 93,000 and the number of DALYs was approximately 1.4 million. This is illustrated further below.³²

Figure 28: Deaths per year attributable to ischemic heart disease, 1990-2019



Source: IMHE, Cebr analysis

Figure 29: Disability-Adjusted Life Years from ischemic heart disease, 1990-2019



Source: IMHE, Cebr analysis

Figure 28 demonstrates that deaths are rising from 2015 and is a cause for concern. Worldwide, there haven 200 DCD heart transplants; 86 of them have been performed at Royal

³² <http://ghdx.healthdata.org/gbd-results-tool>

Papworth Hospital.³³ Although there are benefits, albeit on a smaller scale, through directly providing the DCD treatment at Royal Papworth Hospital, there are much more significant potential benefits through the utilisation of the technique developed at Royal Papworth Hospital on both a national and international scale.

As there is a clear future benefit from the DCD heart transplant which cannot be seen in the data yet, particularly if the technique is replicated on a national scale, an indicative scenario is again illustrated below for the purposes of the analysis. In this, we again consider the potential benefits of a 1%, 10% and 50% reduction in DALYs associated with ischemic heart disease.

Table 6: Modelling scenario for the DCD heart transplant

	Current DALYs (2019)	1% reduction	10% reduction	50% reduction
Number of DALYs	1,400,000	14,000	140,000	700,000

Source: IMHE, Cebr analysis

Although all scenarios above are estimates, the DCD heart transplant can have huge future benefits for patients' health across the UK.

Further, we have been able to monetise the total value associated with averting deaths in terms of a potential GDP gain, again using indicative figures for the number of deaths averted. We have followed a similar approach in the McKinsey Global Institute report³⁴ when analysing how fewer deaths may increase the labor supply, contributing to a potential GDP gain by the expanding the labor force. This methodology takes into account the labour force participation rates, the unemployment rates and the GDP per person for the relevant age bands associated with the data and the full methodology is presented within the McKinsey Global Institute report³⁵.

In this, we consider the potential GDP gain of a 10%, 25% and 50% reduction in deaths associated with the DCD heart transplant.

Table 7: GDP modelling scenario for the DCD heart transplant

	Current deaths (2019)	Potential GDP gain from averting deaths, £		
		10% reduction	25% reduction	50% reduction
Number of deaths	93,398	127,547	318,869	637,737

Although all scenarios above are estimates, the DCD heart transplant can have huge future economic benefits for the UK.

33 <https://royalpapworth.nhs.uk/our-hospital/latest-news/new-national-retrieval-service-launches-adult-dcd-heart-transplants>

34 McKinsey Global Institute – Prioritizing Health

35 McKinsey Global Institute – Prioritizing Health

Case study: Triage methodology for sepsis

Sepsis is a life-threatening condition that arises when the body responds to an infection by attacking its own tissues and organs. Every year in the UK, approximately 250,000 people are affected by sepsis, and it accounts for around 52,000 deaths, more than bowel, breast and prostate cancer combined.³⁶

In 2016, a Sepsis Action Group at Cambridge University Hospitals was created – consisting of clinicians from the emergency department, acute medicine, infectious diseases, rapid response and the eHospital digital team.

The triage methodology for the treatment for sepsis involves using digital technology to alert clinical staff to sepsis patients when they arrive at the Accident and Emergency ward in the hospital. The technology evolves around an electronic alert and action which is set out in the electronic patient record. As a result, this electronic alert is brought to the attention of nurses' and doctors' that sepsis could be a possibility. If a sepsis alert is triggered for a particular patient, a series of electronic prompts guide clinicians to take several actions and tests, linked to national guidance, to effectively diagnose, care for and treat the patient with sepsis.³⁷

Research shows that for every hour delay in receiving antibiotics, the risk of sepsis mortality increases by 8%.³⁸ As such, this demonstrates the benefits of early potential detection from sepsis from triage method implemented at the hospitals. This alert feature has led to a 42% reduction in sepsis mortality across the Trust.

Since implementation across all adult inpatient areas at both hospitals (Addenbrooke's and The Rosie) in June 2017, there has been a 50% increase in patients receiving antibiotics for sepsis within 60 minutes of the sepsis alert being triggered in the electronic patient record. Considering the above, there is a clear benefit in the early detection of sepsis on mortality rates. To quantify this benefit, we will use an indicative scenario to demonstrate the impact this process could have on a national level. In this, we consider the potential benefits of a 42% reduction, as the alert has led to a 42% reduction in sepsis mortality. However, in a more prudent scenario, we could assume a proportion of hospitals across the UK are using this technique and therefore consider a 20% and 10% reduction as well.

Table 8: Modelling scenario for sepsis

	Current	42% reduction	20% reduction	10% reduction
Deaths per year from sepsis	52,000	21,840	10,400	5,200

Source: Sepsis Trust, Cebr analysis

5.3 Wider contribution of research

Research and discoveries on the CBC improve health and from the above analysis, we can infer that health contributes positively to economic growth. In the following section, we have taken a few examples of research that has been developed from organisations on the CBC.

36 <https://sepsistrust.org/wp-content/uploads/2019/01/UKST-volunteer-speaker-notes-2019.pdf>

37 https://buckupcuh-production.s3.amazonaws.com/documents/Brochure_eHospital_Website_Version_September_2019.pdf

38 https://buckup-cuh-production.s3.amazonaws.com/documents/Brochure_eHospital_Website_Version_September_2019.pdf

Beginning in 1953, Francis Crick and James Watson discovered the structure of the DNA, followed by the first genome sequencing by Fred Sanger in 1977.

The next major step that occurred on the CBC was the development of a new approach to DNA sequencing in 1997 through the pioneering work of Shankar Balasubramanian and David Klenerman.³⁹

Within a year, the pair had co-founded the spin-out company Solexa to make the technology more broadly available to the world; in 2007, the company was acquired by US biotech company Illumina.⁴⁰

Today, Solexa-Illumina's 'next-generation sequencing' is used to sequence one million genomes per year. It is responsible for as much as 90% of the total DNA and RNA sequences produced worldwide. In 2000, sequencing of one human genome took more than 10 years and cost more than a billion dollars; today, the human genome can be sequenced in a single day at a cost of \$1,000.⁴¹

Alongside genomics has been the development of Monoclonal Antibodies beginning in 1975 with the work of George Kohler and Cesar Milstein. The next big step forward was the invention by Greg Winter in 1986 of the first humanised monoclonal antibody.⁴² In 1989, Greg Winter and David Chiswell established Cambridge Antibody Technology (CAT). By 2006, CAT had developed Humira, the first monoclonal antibody drug. CAT was bought by AstraZeneca in 2006, which then went on to buy Medimmune in 2007.⁴³

Along with these historical examples, as part of our primary research, we asked the organisations questions on the current research emanating from the CBC. The table below shows the total number of patents, publications, and citations for the organisations on the CBC in the latest financial year end.

Table 9: Patents, publications, and citations

Number of healthcare patents in the latest financial year	152
Number of healthcare related publications in the latest financial year	4,214
Number of healthcare citations in the latest financial year	88,080

Source: Cebr survey and analysis

5.4 Agglomeration economics

Agglomeration economies describe the mechanisms that cause employees and firms to co-locate geographically. Agglomeration economies occur when a number of firms producing

³⁹ 'Genomics' – Cambridge University Health Partners

⁴⁰ 'Genomics' – Cambridge University Health Partners

⁴¹ 'Genomics' – Cambridge University Health Partners

⁴² 'Antibodies' – Cambridge University Health Partners

⁴³ 'Antibodies' – Cambridge University Health Partners

similar or complementary goods locate near one another, which, in turn, produces positive externalities for those firms.⁴⁴

There are two primary types of agglomeration economies: those that result from industry concentration (localisation economies) and those that result from the density of economic activity in an area (urbanisation economies) (Cohen, et al., 2008). Within the CBC, urbanisation economies occur, given that organisations are located near each other on the Campus. The implication of this is that firms are able to share infrastructure and develop a specialised labour pool for their industry. Additionally, localisation economies occur on the CBC, given that there are cost savings for organisations in the same industry. The implication of this is that organisations within the CBC are able to develop a specialised labour pool for the industry.⁴⁵

Considering the definition above, Silicon Valley is often referred to⁴⁶ as a location where there are major high technology firms collaborating and working together. The positive benefits and innovations that have come out of the Silicon Valley have been evident, with more than 30 businesses now in the Fortune 1000.

The organisations on the CBC have wider benefits particularly given that the organisations are clustered in one area. However, these wider benefits are often harder to quantify. As such, as part of the bespoke survey, we asked organisations to answer qualitative questions, to evidence the wider benefits associated with being located on the CBC.

Most notably, 80% of organisations believe that their organisation would have developed slower or significantly slower without location on the CBC.

In terms of health outcomes, all the organisations on the CBC believe that their organisation is effective at improving health outcomes. More significantly, 80% of organisations on the CBC believe that they would have been less effective or significantly less effective in improving health outcomes had it not been located on the CBC. This further emphasises the importance of organisations locating on the CBC.

In terms of the clustering of organisations within the CBC, it was interesting to analyse the extent to which organisations collaborate with different organisations on the CBC, with the potential to develop training sessions and skills together. This was a potential theorised benefit of organisations clustering together, which was broadly borne out in the primary research conducted.

From the bespoke survey, 60% of organisations undertake daily or weekly training and of these organisations, 40% of organisations collaborate with other organisations on the CBC.

Where organisations on the CBC share skills and collaborate in training sessions, this can create a wider benefit where skills are shared to other organisations on the CBC, on the basis that they are located closely together. It is interesting to note that 60% of organisations described the development of employees being more effective, given its location on the CBC, as opposed to being located elsewhere. The statistics from the survey strongly evidence the CBC as an integral part of both employee and organisation development. This further aligns

44 Porter. (1998). 'Clusters and the New Economics of Competition'

45 [https://research.upjohn.org/cgi/viewcontent.cgi?article=1256&context=reports#:~:text=Agglomeration%20economies%20describ%20the%20mechanisms,firms%20\(Porter%2C%201998\).](https://research.upjohn.org/cgi/viewcontent.cgi?article=1256&context=reports#:~:text=Agglomeration%20economies%20describ%20the%20mechanisms,firms%20(Porter%2C%201998).)

46 <https://medium.com/@RussellMoopa/silicon-valley-innovation-hub-of-the-world-1925278c6289>

with the idea of agglomeration economies where it decreases the cost of generating new ideas and exchanging information.⁴⁷ Knowledge spillovers occur when close proximity and face-to-face contact among individuals and firms leads to the faster spread of new ideas, which in turn leads to innovation and are consistent with the statistics from the survey.⁴⁸

Agglomeration economies tends to be knowledge intensive and highly concentrated locations that can attract and retain a talented and specialised labour force. Within the CBC, there are several organisations within a specified location that are collaborating with other organisations on the CBC and therefore benefitting from agglomeration economies.

A few examples of the organisations that are collaborating on the CBC are below.

- The Joint Cancer Research UK – AstraZeneca Functional Genomics Centre. This centre is dedicated to realising the full potential of functional genomics in the discovery and development of new drugs for patients with cancer.
- Cambridge and Peterborough NHS Foundation Trust, the University of Cambridge, and Cambridge University Hospitals NHS Foundation Trust to develop the Cambridge Children’s Hospital.
- The AstraZeneca – MRC LMB Blue Skies Programme. Projects supported by the fund are not specifically targeted towards drug development but feed into existing research and development activities of the two organisations.
- AstraZeneca have moved their nuclear magnetic resonance laboratory to the MRC LMB in the CBC.
- Royal Papworth Hospital and Philips (a global leader in health technology) have signed an agreement to explore new healthcare innovations.
- In 2015, GSK, the University of Cambridge and Cambridge University Hospitals formed a strategic partnership, with the aim to jointly deliver new medicine to patients in the next 5-10 years.
- The Milner Therapeutics Consortium has been active since June 2015 and is based on a research agreement signed by three academic centres in the CBC and eleven pharmaceutical companies.

As the number of organisations on the CBC continues to grow, particularly later this year when AstraZeneca are moving onto the Campus, the clustering of firms and collaboration between organisations will continue to grow in the future.

⁴⁷[https://research.upjohn.org/cgi/viewcontent.cgi?article=1256&context=reports#:~:text=Agglomeration%20economies%20describ%20the%20mechanisms,firms%20\(Porter%2C%201998\).](https://research.upjohn.org/cgi/viewcontent.cgi?article=1256&context=reports#:~:text=Agglomeration%20economies%20describ%20the%20mechanisms,firms%20(Porter%2C%201998).)

⁴⁸[https://research.upjohn.org/cgi/viewcontent.cgi?article=1256&context=reports#:~:text=Agglomeration%20economies%20describ%20the%20mechanisms,firms%20\(Porter%2C%201998\).](https://research.upjohn.org/cgi/viewcontent.cgi?article=1256&context=reports#:~:text=Agglomeration%20economies%20describ%20the%20mechanisms,firms%20(Porter%2C%201998).)

6. Conclusion

This report has assessed the economic contributions made by organisations on the CBC. We find that in 2021, the organisations on the CBC directly contributed:

- **£1,91b in operating income and funding**
- **£1.09b in Gross Value Added**
- **16,041 FTE jobs**
- **£977m in employee compensation**
- **£292m in Exchequer contributions**

As noted in the analysis, we expect AstraZeneca to move operations to the CBC later this year. This will positively impact the economic contribution of the CBC in the forthcoming years, contributing direct, indirect, and induced impacts to the UK economy. We understand that approximately 2,200 employees will move to the CBC, representing 27.9% of all AstraZeneca's UK employees.

The contributions made by the organisations on the CBC are not constrained to these direct impacts alone. Further demand is supported along the supply-chains (induced impacts) and when employees spend their earnings in the wider economy (indirect impacts).

We estimate that once these additional impact layers are considered, the organisations on the CBC supported the following aggregate economic footprint in 2021:

- **£4.10b in operating income and funding**
- **£2.20b in Gross Value Added**
- **30,762 FTE jobs**
- **£1.57b in employee compensation**

From a regional and local authority perspective, the direct impacts can be attributed directly to the respective regions, as all the activity occurs in the CBC. The extent to which the indirect and induced impacts occur within the respective regions and local authorities differ in nature and in the East of England, the aggregate footprint in 2021 is as follows:

- **£2.79b in operating income and funding**
- **£1.66b in Gross Value Added**
- **22,371 FTE jobs**
- **£1.24b in employee compensation**

In turn, the local authority aggregate footprint is as follows:

- **£2.59b in operating income and funding**
- **£1.51b in Gross Value Added**
- **20,378 FTE jobs**
- **£1.15b in employee compensation**

The report highlights the important economic contribution that the CBC is making on a local authority, regional and UK-wide level.

The above illustrates the economic impact of the organisations on the CBC to the UK economy. However, the CBC produces further benefits linked with the economy through the health sector. These wider health benefits are important to the economy and a recent example of how important health is to the economy is through the pandemic. The pandemic has demonstrated the importance of health for individuals, society, and the global economy. The organisations on the CBC produce wider health benefits in the form of research and treatments that have been developed by organisations within the Campus and have provided benefits to patients both within the CBC as well as on a national level.

Appendix A: Methodology

Appendix A outlines our methodology in estimating the economic impact of the CBC in the UK.

Our starting point was to identify the contributions directly made by the organisations on the CBC to the UK economy. Our analysis considered five key performance indicators:

- **Operating income and funding** – This operating income and funding can be thought of as either the reported turnover, or the total budget of organisations on the CBC for each of the financial years.
- **Gross Value Added (GVA)** – GVA contributions represent the ‘value-added’ to the economy by the organisations on the CBC. It avoids double counting by subtracting intermediate consumption. GVA is also commonly known as income from production and is distributed in three directions – to employees, to shareholders and to government.
- **Employment** – Refers to the number of workers employed by the organisations on the CBC. We typically present results as full-time equivalent (FTE) employees. FTE refers to the hours worked by one employee who is employed on a full-time basis and is used to standardise the hours worked by several part-time employees to one full-time worker. This is important for comparisons across industries or businesses, where the share of employees who work full-time varies.
- **Employee Compensation** – Refers to the total compensation paid to employees in return for work done. This includes wages, benefits and employer pension and tax liabilities.
- **Tax Contribution** – Refers to the total contribution to tax revenues by organisations on the CBC, where appropriate. This includes personal taxes (Income Tax, Employees’ NICs, Employers’ NICs) as well as business taxes (Corporation Tax, Business Rates, VAT, Apprenticeship Levy).

To compute the impacts above, we relied predominantly on survey data from the organisations on the CBC. We ran a survey of organisations on the CBC, asking questions on core financials from the years 2019 to 2021. This included questions on operating income and funding, operating profits, depreciation, full and part-time employment, and employee compensation, as well as taxes and procurement spend in the year.

Where only a part of an organisation’s activity was on the CBC, we asked respondents to estimate the share of this that was attributable to their site on Campus. Where this was not feasible, best estimates were made to apportion this, based on the share of the organisation’s wider workforce that was on the CBC.

Where applicable, we used publicly available financial data to assist in gathering the necessary financial metrics for the analysis.

Aggregate footprint of organisations on the CBC

The wider footprint supported by the CBC is not constrained to these direct impacts alone. Our approach conceptualises two further impact layers:

- **Indirect impacts** – The organisations on the CBC place demands on their supply chains, that feed into day-to-day operations. Further economic activity is supported when the CBC purchases goods and services from suppliers. This impact layer looks at the knock-on impact of upstream activity to show the wider impact of the expenditure of organisations within the Campus, on the UK and regional economies.

- **Induced impacts** – Economic activity supported when direct and indirect (supply chain) employees spend their earnings on goods and services in the wider UK economy, thus facilitating induced impacts that provide further layers of support.

Summing these direct, indirect, and induced impact layers allows us to estimate the aggregate footprint supported by organisations on the CBC.

To model the relationships that exist between these impact layers, we use bespoke input-output models. These models examine the structure of a firm or industry's supply-chain, allowing us to quantify the economic activity supported along them. In addition, by considering the typical distribution of household spending, the model allows us to calculate the output and employment associated with the induced impact layer.

Our modelling produces multipliers, which calculate the total footprint supported for a given level of direct contributions. By combining these multipliers with the calculated direct impacts, we form our estimates for the aggregate footprint supported by organisations on the CBC. Note that within the survey we asked questions on the spending of CBC organisations on other CBC organisations, in order to strip out any double counting of impact layers within the input-output modelling.

Regional and local authority multipliers

In addition to the national-level multipliers, we also compute regional estimates of the direct economic contributions made by the CBC. This breaks down the UK-wide direct impacts for the same key metrics: operating income and funding, GVA, employment, employee compensation and income-related exchequer contributions).

The computed regional multipliers are based on the national multipliers but are adjusted to account for differences in the structure of the economy in different regions. The London economy for instance has a proportionally higher concentration of service industries, which means that the national multiplier is not fully applicable to operations that occur solely within London. Given this, the regional multipliers augment the national multipliers, accounting for the different disaggregation of economic activities in different regions.

The indirect and induced impacts are more insightful, on a regional basis than consideration of solely the direct impacts, where the national level impacts are solely attributed to the East of England and the Cambridge City Council and South Cambridgeshire District Council local authority respectively, given that this is the location of the work done.

The local authority that the CBC falls into is split between the Cambridge City Council and South Cambridgeshire District Council and as such, we have combined the two for modelling purposes.