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Economic impact assessment of BBSRC attributable spin-outs

Final Report

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This work was produced using statistical data accessed via the ONS SRS. The use of this data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

EXECUTIVE SUMMARY

Introduction

1. The Biotechnology and Biological Sciences Research Council (BBSRC) is part of UK Research and Innovation (UKRI), which works in partnership with universities, research organisations, businesses, charities, and government to create the best possible environment for research and innovation in bioscience to flourish. BBSRC invests in world class bioscience research and training on behalf of the UK public, with the aim to further scientific knowledge, to promote economic growth and to improve quality of life in the UK and beyond.

2. BBSRC invests over £450 million in bioscience each year. It supports research, innovation and training in universities and strategically supported institutes. BBSRC's investments underpin important UK economic sectors including agriculture, bioprocessing, chemical, food, healthcare, pharmaceutical and other biotechnological related industries.

3. In March 2022 BBSRC commissioned Cambridge Policy Consultants (CPC) to undertake an evaluation of the economic impact arising from spin-out companies that were established based on research and innovation supported by BBSRC. The economic impact assessment has been designed to consider attribution, measure Gross Value Added (GVA) and measure impact over time as BBSRC attributable spin-out companies develop and grow, collecting evidence over the spin-outs' lifecycle.

Methodology

4. A mixed-methods approach was used for this research. Interviews were conducted with a sample of Principal Investigators (PIs) who had spun out companies linked, at least in part, to the intellectual assets developed through BBSRC funded research. The results from these interviews were combined with comparison group data and matched administrative data on the employment and turnover of the spin-out companies from the Office for National Statistics (ONS) Secure Research Service (SRS) Business Structure Database (BSD). The firm-level performance over 25 years has provided a much more comprehensive analysis of performance over time and consistent data across sectors, providing a more robust record of BBSRC attributable spin-out performance.

5. In order to establish the added value generated by BBSRC attributable spin-outs the research developed a mixed method approach:

- Collation of secondary data on BBSRC attributable spin-outs – a list of 471 spin-outs included in BBSRC's spin-out database were matched where possible with data purchased from Beauhurst on the development of the business over time including grants awarded, external investment funding and changes company earnings over time. In total, 457 BBSRC attributable spin-outs were matched to Beauhurst data.
- Collation of comparison group company data – a sample of 444 comparison (non-spin-out) companies was purchased from Beauhurst. These were matched on the basis of Standard Industrial Classification (SIC) and company date of incorporation. There were insufficient non-spin-out comparison group firms in the two largest SIC sectors to undertake a pairwise comparison (where each BBSRC attributable spin-out would be paired with a non-spin-out comparison group company with the same characteristics across these criteria).

- Collation of primary data on BBSRC attributable spin-outs – a survey of 61 spin-outs to gather information on the attribution of impact to BBSRC research funding on the development of Intellectual Property (IP)[1], assessment of the continuing importance of the IP in the firms' sales, displacement and competition, recruitment and training, export sales and supply chain impacts.
- Linking the above data sources to the ONS BSD – the BSD was used to obtain data on 402 BBSRC attributable spin-outs and 251 comparison group companies.
- Data analysis – the BSD data was used to assess the economic impact of the BBSRC attributable spin-outs and of the comparison group companies for each firm. Total GVA was calculated indirectly by translating turnover or employment (depending on the data availability) into GVA using ONS estimates of sector employment cost/turnover/aGVA ratios[2].

Characteristics of BBSRC attributable spin-outs

6. Interviews were undertaken with PIs and other representatives from 61 of the BBSRC attributable spin-outs and combined with Beauhurst data. The data identified a number of key characteristics:

- **Relatively long lifecycles:** Incorporation of the BBSRC attributable spin-outs typically occurs after substantive academic endeavour, translation and in many cases translational support. PIs often attribute a 'career of support' to their discoveries, pointing out that the innovation has often only been possible with the underpinning knowledge of many years of basic bioscience research prior to the final stages of a commercial pathway.
- **Length of time to market:** BBSRC attributable spin-outs were at different stages of development – 50% of spin-outs were at pre-product stages (Technology Readiness Levels [TRL] 1 to 4). Just over two-fifths had reached the progressive roll out stage (TRL 6 and 7) and for just over a quarter the product was finalised and under general availability. The average age of companies with a product in the final stage of general availability was 8.3 years.
- **Growth & survival rates:** BBSRC attributable spin-outs grow at a faster rate than the comparison group (555% vs. 440% over five years). Currently active spin-outs (59% of total) have been operating for 13+ years on average (12.3 years median) whereas comparison group firms have been operational for shorter periods on average 11 years (9.6 median). While it can take time to get to market, the BBSRC attributable spin-outs appear to remain active for longer than their comparison group (across all sectors).
- **Predominance of Business to Business (B2B) models for bio-based tech companies:** BBSRC attributable spin-outs are engaged in a variety of markets, including health services (29%), pharma (22%), biotech (21%),

1 IP in this study includes both hard (e.g., patents) and soft IP (e.g., 'know how', trade secrets). Details of IP identified in the survey are presented in section 3.3.

2 aGVA stands for approximate Gross Value Added and is a measure of GVA in the non-financial UK economy. aGVA is derived from financial data captured in the Annual Business Survey. These estimates are published annually by ONS statistics for industries according to the SIC. For further details see: https://www.ons.gov.uk/businessindustryandtrade/business/businessservices/bulletins/nonfinancialbusinesseconomyukandregionalannualbusinesssurvey/2021results

agriculture (10%) and food manufacturing (10%)[3]. The vast majority of spin-outs were currently (or were planning to be) B2B, with sales, licencing or services to other businesses. Twenty nine percent of spin-outs identified health services as their main customer, 22% identified pharmaceutical companies and 21% biotech companies.

- This is consistent with recent work by the Innovation Caucus on market positioning that identified a strong presence of bioscience spin-outs in Health; Energy; Food; Transportation; Innovative Foods; Sustainability; Wellness/Beauty; Ag Tech; Sport markets[4]. This also triangulates with findings of the Innovation Caucus on why these spin-outs are not necessarily seen by the public given they are often "hidden" within supply chains. However, just because they are hidden from the customer base does not mean they are not absolutely critical in fuelling economic growth and meeting end customer needs.
- **BBSRC attributable spin-outs are more regionally dispersed than comparison group firms**: Almost 3 in 10 BBSRC attributable spin-outs are located in the East of England with significant concentrations in the South East, Scotland and London. However, more than a quarter are based in Midland and Northern regions (28%). Overall, BBSRC attributable spin-outs are more regionally dispersed than non-spin-out comparison group firms in the same sectors.

Criticality of BBSRC research funding

7. The survey of 61 BBSRC attributable spin-outs highlighted the contribution of BBSRC research grant support:

- **Additionality:** PIs were asked to describe the impact of the BBSRC research grant(s) on the formation and development of the spin-out. For 35% of companies, BBSRC support was considered to be 100% additional, that is the spin-out would not have formed without the BBSRC research funding. On average across the sample, additionality of BBSRC support was 64%.
- This additionality was particularly linked to BBSRC underpinning research funding that directly led to the development of technologies, fundamental to the formation of the spin-out.
- **IP Protection:** 67% of BBSRC attributable spin-outs identified a patent which had been generated in part or entirely from the BBSRC supported research. For half the spin-outs BBSRC support made a significant impact on their ability to patent their research.
- **Public and private investment:** BBSRC underpinning support for research was important in developing exploitable IP and the de-risking of future investment. The 61 spin-outs were linked to 114 BBSRC core awards and 251 further funding awards. BBSRC research funding comprised just over half (53%) of this funding. Other grant sources include Wellcome Trust, Royal Society, Leverhulme Trust, European funding and the Engineering and Physical Sciences Research Council (EPSRC).
- When all BBSRC attributable spin-outs linked to Beauhurst data are considered, a total of 190 spin-outs (42%) are recorded as receiving either

3 This analysis uses SIC codes which provide a poor proxy for market position. The spin-out firms often have more than one SIC code cited in Companies House records. Spin-out activities can often blur the boundaries between SIC sectors, for example, undertaking consultancy activities to raise revenue for product development.

4 https://innovationcaucus.co.uk/2022/06/30/bioscience-lost-in-translation/

equity based (771 fundraisings) or loan finance (20 loans). The majority of fundraising events took place at the initial seed funding round (43%), however, almost as many investments were undertaken at the venture stages (39%). Total recorded total investment is £3.95bn or an average of £20.8m for those spin-outs recording any fundraising.

- The initial investment of BBSRC funding was on average just over £1m and resulted in the establishment of a spin-out that on average subsequently attracted £20.57m of private investment[5].

Spin-out development process

8. The survey also highlighted a number of attributes subsequent to the BBSRC attributable spin-outs' establishment:

- **Employment impacts:** BBSRC attributable spin-outs employed an average of 26 employees and grew by an average of 5.5 employees per annum. The average age of the 61 BBSRC attributable spin-outs in the survey was 5.7 years.
- **Minimum viable products (MVP):** Over half of these BBSRC attributable spin-out companies had already generated some revenue from sales, licencing or service provision with the average timescale to revenue generation of 2.6 years since incorporation. In some cases firms offered other services to raise some revenue during their development phase e.g., consultancy/ advisory support.
- **Low displacement:** BBSRC attributable spin-outs offer innovative products that are very often disruptive with few like-for-like competitor products. Moreover, existing products are more often sourced from abroad. Some 40% of companies considered there was no competition in UK, 16% considered UK competition was low, 35% moderate and 9% high. Globally, the proportion of spin-outs rating competition as zero or low was 24%, with majority 65% rating it as moderate despite having a highly differentiated product.
- **Strong focus on overseas markets:** Relating to the above, many BBSRC attributable spin-outs had significant sales in overseas markets. Over the company lifetime the mean total revenue per company was £5.01m of which 51% was from overseas sales, servicing or licence agreements and 49% was from UK sales, servicing or licence agreements. These are well above standard start-up exports and an important consideration in the impact arising from the BBSRC attributable spin-outs.
- **Linkages to UK supply chain:** 38% of BBSRC attributable spin-outs provided data on their purchasing costs (excluding wage costs). Total spend across the cohort in 2019/20 was £16.46m with an average annual spend of £716k. Some £8.5m (52%) of total spend was with UK based suppliers.
- **Growth challenges:** Main challenges to growth were: raising finance; staff recruitment; dealing with paperwork/regulatory issues in relation to exports and lack of available research and development (R&D) scale up equipment and space. Despite these, just under three quarters of the surveyed spin-outs were planning to increase their UK employment numbers in the next two years.

5 Almost two-thirds of reported investment is not allocated to a specific investor type as investment totals are often published but without identifying the source of the investment. Private investment is calculated by allocating all investment funds on a pro-rata basis to those investments where the source is known.

Economic impact of BBSRC attributable spin-outs

9. The assessment of economic impact estimates was derived from the 402 BBSRC attributable spin-outs that were successfully matched to ONS BSD on individual firm employment and turnover for 1997 to 2021 from PAYE and VAT records.

- Overall in 2021/22 the 402 BBSRC attributable spin-outs employed over 8,000 people at an average of just under 30 based on data from BSD.
- Access to the BSD data on individual BBSRC attributable spin-outs and comparison group firm performance over 25 years has meant much more robust estimates of the economic impact of BBSRC attributable spin-outs. The estimates of impact have taken conservative assumptions but still arrived at a total real net GVA of £5.18bn (or just under £13m per spin-out) over their lifetime to 2021. Almost two-thirds are still operational and will continue to add value.
- The Return on Investment (ROI) compares BBSRC costs in real terms (2021 prices) against the estimates of real GVA. The total ROI on a gross basis is £4.84 per BBSRC £1. The net ROI is £3.14.
- Many spin-outs were still trading on the BBSRC attributable IP so it was important to estimate how long the market advantage might last for each firm. To do this we estimated 10 and 20 year projections to take into account the future growth of the companies. Assumptions about future UK employment are made on the basis of the current growth rate of the company combined with discussions with the PI regarding plans for expansion (or stabilisation or contraction). Estimated total real net GVA impact from 402 spinouts is £7.0bn or £17.5m per spin-out, with a gross ROI of £5.95 and a net ROI of £4.26 per BBSRC £1 (Table 4.5).
- Numerous statistical tests were carried out on performance measures for the BBSRC attributable spin-outs and those for the comparison group firms. For the most part the results of these have been inconclusive. However, there is strong statistical evidence of a clear distinction in the Compound Annual Growth Rate (CAGR) over five and ten years between BBSRC attributable spin-out companies and their comparison group counterparts, with BBSRC attributable spin-outs growing at a much faster rate (555% cf. 440% over five years and 77% cf. 44% over 10 years respectively).

1. INTRODUCTION

1.1. Research objectives

1.1.1. BBSRC is a major funder of world-leading bioscience in the UK. Its investments build and support a vibrant, dynamic and inclusive community which delivers ground-breaking discoveries and develops bio-based solutions that contribute to tackling global challenges, such as sustainable food production, climate change and healthy ageing. As part of UKRI, BBSRC plays a key role in fostering connections that enable the UK's world-class research and innovation system to flourish.

1.1.2. BBSRC's core strategic objectives are set out within its Strategic Delivery Plan 2022-2025[6].

1.1.3. CPC were asked by BBSRC to conduct an evaluation of the economic impact of spin-outs attributable to BBSRC support. Through this study we seek to address the following research questions:

- what is the GVA of the cohort of BBSRC attributable spin-out companies; and
- how does their GVA vary by subsector.

1.1.4. We also test the hypothesis, '*do academic BBSRC attributable spin-outs grow faster than (non-spin-out) start-up firms[7] in the same subsectors?*'

1.2. Research approach

1.2.1. There are a number of challenges involved in meeting the evaluation research objectives:

- *Attribution of impacts* arising from IP arising from BBSRC funded research. Spin-outs are usually the result of long and complex development paths with a range of other financial and business support also instrumental in the spin-out's success.
- *Timing of impacts over a relatively lengthy development process* and spin-out lifecycle that may span many years. The extent to which the original BBSRC funded IP remains a useful asset and provides a competitive advantage and ultimately leads to economic impact.

6 BBSRC Strategic Delivery Plan 2022-2005. Online at https://www.ukri.org/wp-content/uploads/2022/09/BBSRC-010922-StrategicDeliveryPlan2022.pdf

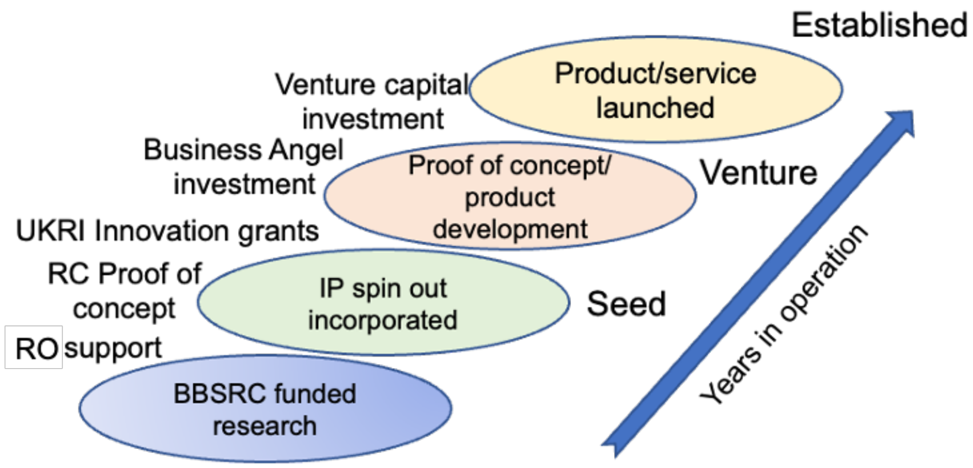
7 These firms are defined as those companies that do not conform to Beauhurst's definition of spin-outs (https://www.beauhurst.com/blog/spotlight-on-spinouts-2023-a-summary/).

- *Access to commercially sensitive data* is necessary in order to calculate the economic impact arising from spin-outs. Current UK corporate reporting requirements mean that key data required to estimate the value added generated by spin-outs is typically not published.

1.2.2. We developed a mixed-method methodology to help address these challenges that involved:

- The development of a logic chain approach to highlight the contribution from BBSRC funded research that delivers identifiable IP that can be developed into a product or service. This is set against a structured spin-out lifecycle from establishment, through seed and venture phases to established business or exit. The approach recognises the contribution of both 'hard' (e.g., patents) and 'soft' IP (e.g., 'know how' and trade secrets). It also recognises that spin-outs are not the only route to market for IP.
- Using the lifecycle to explore the relative contribution of BBSRC funded research, other spin-out support (grants, loans and equity investment) as well as business advice to assess their relative contribution and durability on the economic benefits derived from spin-outs over time.

Figure 1.1: BBSRC funded research and spin-out lifecycle



1.2.3. Table 1.1 summarises the different data sources and their relationships that ensured the research could undertake firm-level calculations within the ONS SRS.

Table 1.1: Data sources for the analysis

BBSRC attributable spin-out dataset	Details
Starting dataset	471 BBSRC attributable spin-outs. Drawn from BBSRC's spin-out database. Covers BBSRC attributable spin-outs incorporated up to 2020. Database collates data from ResearchFish submissions, BBSRC strategically supported institutes, research organisation surveys, and other sources (e.g., REF impact case studies). The dataset includes spin-outs arising from BBSRC's investments in research, innovation and training.
Beauhurst	457 BBSRC attributable spin-outs. The BBSRC attributable spin-outs from the starting dataset were matched with Beauhurst data. Beauhurst data provides additional information on the development of the business (e.g., grants awarded, external investment funding, changes to company earnings over time). The BBSRC attributable spin-outs were categorised into ten SIC groupings so that if insufficient firms were matched to BSD data, it would still be possible to undertake an analysis at this sub-group level and produce results that could be published.
Survey of PIs and spin-out officers	61 BBSRC attributable spin-outs interviewed. Survey provides additional data on additionality of BBSRC support, nature and lifetime of IP, spin-out progress and lifecycle. Sample sizes for specific analysis may vary, depending on whether individual survey questions were answered.
ONS BSD	402 anonymised BBSRC attributable spin-outs. The BBSRC attributable spin-outs from the Beauhurst dataset were subsequently matched to the ONS BSD data. Data on additionality responses from survey and benchmark values from the Annual Business Survey were also included in the upload to SRS. ONS BSD data provides additional information on firm employment and turnover from PAYE and VAT records, covering the period from 1997 to 2021.
Comparison group dataset	**Details**
Initial sample (Beauhurst)	444 comparison group companies (non-spin-outs) A random sample of 444 comparison group companies were drawn from Beauhurst database, ensuring the composition matched the characteristics of the BBSRC attributable spin-outs (i.e., SIC sector group composition, date of incorporation). These were also categorised by the 10 SIC groupings again to ensure any results could be aggregated if too few firms were matched with BSD data. The comparison group only consisted of non-spin-out companies (The Beauhurst data enabled spin-out companies to be excluded when constructing the comparison group).
ONS BSD	251 anonymised comparison group companies. The initial comparison group dataset from Beauhurst was matched to the ONS BSD data (1997-2021). The overall match rate was lower for comparison group firms, compared to the BBSRC attributable spin-outs.

- A mixed-methods approach combining survey evidence from telephone and video interviews with 61 BBSRC attributable spin-outs, and matched data on BBSRC attributable spin-out companies and comparable non-spin-outs from the ONS BSD on turnover and employment over time. A previous study we conducted of spin-outs attributable to support by the Science and Technology Facilities Council used survey evidence on employment and turnover data to estimate economic impacts. This BBSRC study has, for the first time, matched individual spin-out firms with administrative data on their employment and turnover between 1997 to 2021 to provide a more robust record of spin-out performance.
- Access to the ONS BSD dataset is restricted and subject to a research proposal that is assessed by a panel of experts according to its contribution to public understanding. At the outset of the research there was no guarantee that access would be granted and so the method provided a twin-track approach – one based on survey results and data from Beauhurst and ResearchFish and the second drawing on these but centred on 25 years of administrative data on spin-out and comparative firm employment and turnover performance.
- The following approach was used to establish the sample of 61 BBSRC attributable spin-out companies. BBSRC selected a group of 90 spin-outs for the survey from the population of 471 in order to provide sufficient contacts to achieve the original target of 60 completed interviews. This was done to provide a deliberate sample based on:
  - A review of Beauhurst data to include companies with investment from both public sector grants[8] and fundraising.
  - Currently active spin-outs to ensure officers could be contacted.
  - Mix of companies at different stages of the spin-out lifecycle e.g., seed, venture, growth and established stages (see figure 1.1).
  - Spin-outs from both universities and BBSRC's strategically supported institutes.
  - A balance of spin-outs from different sectors.
- Further data on the timing and scale of grants, loans and equity investments in BBSRC attributable spin-outs was sourced from Beauhurst for 457 of the spin-outs[9,10]. This dataset provides a baseline on the spin-outs' lifecycle and links to the data available from ResearchFish, UKRI's research outcomes data collection system, on the associated BBSRC research investments, research outcomes and further funding etc.
- A comparison group of 444 non-spin-out firms was drawn randomly in the same SIC groups by Beauhurst. There were insufficient numbers in the specific SIC groups to support a pairwise matching to the BBSRC

8 BBSRC grants have supported the research that discovered the commercially exploitable IP that subsequently led to the establishment of the spin-out. BBSRC does not award grants directly to spin-outs. Public sector grants (e.g., Innovate UK) can be awarded directly to the spin-out and form part of the overall 'investment' in the company.

9 Beauhurst was able to match 457 BBSRC attributable spin-outs. One of these spin-outs was set up in the United States and no data is available from Beauhurst for this case. Another business, Decima Biomed was in existence for just over 12 months before being wound up and never received an SIC classification and had not been tracked by Beauhurst.

10 Although data were available for 457 BBSRC attributable spin-outs, for some analysis a smaller sample was used to allow for better alignment with the comparison firms.

attributable spin-outs and so the sample selected comparison firms incorporated over the same time period as the BBSRC attributable spin-out sample for each SIC group[11].

- A total of 457 BBSRC attributable spin-outs were uploaded for matching to BSD data[12] in the ONS SRS over the time period 1997-2021. Data on a comparison group of 444 non-spin-outs from the same sectors were also submitted to BSD data. A pair-wise comparison method was considered but the confidentiality rules for ONS SRS preclude any disclosive information from publication. Data on anonymised individual firms can be accessed within the safe data environment but only aggregated data (at least three observations for each cell) can be extracted and published.
- This was a particular concern as the distribution of the BBSRC attributable spin-outs was heavily skewed to just two SIC codes that represented almost 64% of the population as a whole. There was a concern that not all results could be published, so individual firms were grouped into 10 broader sector groups and these were used as basis for presenting results. The calculation of the results was, however, undertaken on data for each matched firm.
- A key part of the method is to translate data on firm turnover or employment into GVA[13]. Benchmark values for aGVA are published as part of the ONS Annual Business Survey (ABS) by SIC code for 2008-2020. There are two benchmark measures of interest the ratio of aGVA to turnover and aGVA to employment. These were taken from the ABS and uploaded to ONS SRS to be included as part of the match and thereby be accessible within the secure data environment. Benchmarks change over time so values were estimated for the period 1997-2007 to ensure that all BSD years could be translated to aGVA.
- The ONS BSD confidential match was more successful for the BBSRC attributable spin-outs resulting in matched data being available for analysis for 402 of the 457 spin-outs uploaded to the Secure Research Service (88%). This was toward the high end of the estimated match rate provided by ONS SRS. In comparison, only 251 of the 444 comparison firms were matched (57%). This was below the lower range of match estimates.
- Unfortunately because the process is entirely anonymous and also protected by non-disclosure criteria it is not possible to provide a detailed analysis of why this limited match occurred and explore the potential bias that this may have introduced among comparative firms. The comparison group firms have a higher proportion of dissolved firms and this may be one reason for the lower match rate.

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11 A more restricted set of variables was purchased from Beauhurst for the matched sample in part because not all start-ups are "tracked" and have the same level of data in the Beauhurst database (all spin-outs are tracked initially but Beauhurst uses performance criteria to determine which other firms are of potential interest to the investment community) and to ensure that the cost of the data remained within budget.

12 The BSD is a snapshot of the Interdepartmental Business Register (IDBR) and provides a unique source of firm-level data on employment and turnover drawing from PAYE and VAT returns. The BSD is only accessible at firm-level using the ONS SRS. Access is granted following approval of a research proposal that makes the case for accessing data and the subsequent safe use of the results in a manner that is non-disclosive.

13 GVA is a measure of the contribution of a company to the economy and is the monetary value of the production of the company less any intermediate costs. It is often measured by proxy at an individual company level as wages plus profits.

1.2.4. Table 1.2 provides an overview of the approach for assessing impact. The method is centred on the data drawn from the ONS BSD analysis but uses the survey results to provide key information not available through the BSD or Beauhurst databases. There are six stages:

- Stage 1: Collation of BBSRC attributable spin-out data – draws on both Beauhurst and ResearchFish secondary sources (for 457 spin-outs) and a survey of 61 spin-outs to explore the characteristics of the spin-outs, their market activity (type of market approach, competitive environment and exports)
- Stage 2: Attribution of impact to BBSRC support – the extent to which the BBSRC support made a difference to the development of the spin-out including an assessment of its impact on the generation of IP from the survey of 61 spin-outs.
- Stage 3: Calculation of Gross GVA in real terms (2021 prices). This figure is calculated over the lifecycle of the BBSRC attributable spin-outs starting in 1997 to 2021 as relevant. The calculation is based either on spin-out employment (for periods when the spin-outs are not trading and have no or low turnover) or turnover when the spin-out is trading fully. aGVA estimates were deflated using a GDP deflator in line with HM Treasury guidance[14].
- Stage 4: Calculation of net additional GVA – the gross GVA figures need to be adjusted to take into account deadweight and displacement based on the survey of the 61 BBSRC attributable spin-out firms.
- Stage 5: Discussions with spin-outs in the survey highlighted that BBSRC attributable IP could make a very durable contribution to the spin-outs' economic performance over many years and would continue to do so into the future – predominately associated with the lifetime of any patent. In order to estimate the value of this future revenue stream by assuming that all IP (whether protected by a Registered Patents or not) have a lifetime of up to 20 years. The date of spin-out incorporation was taken as the starting point of this period and future benefits were calculated based on the number of years remaining in the 20 year period. The Net Present Value (NPV) of future income streams for each spin-out were estimated in accordance with HM Treasury guidance using a 3.5% discount rate and based on trendline forecasts of spin-out turnover.
- Stage 6: ROI estimates are based on the real value of BBSRC underpinning research funding (in 2021 prices) against the net aGVA benefits arising to date in real terms. The rationale for this calculation is that without BBSRC research support there would be no commercially exploitable IP.

14 While developing a product for market spin-outs tend to have low or no turnover and is dependent on investment to support its activities. Hence, the method uses employment costs as a basis for calculating GVA until the spin-out starts to trade (wages plus profits are a good proxy for GVA at the level of the firm).

Table 1.2: Economic impact assessment methodology

Collation of economic data	
Total employment over lifecycle of company and over projected timescale e.g., 20 years.	Data on past employment from BSD, Beauhurst and interviews. Projected growth in employment based on assessment of previous growth rate, interviews with BBSRC attributable spin-outs and assessment of funding.
Total wage costs over lifecycle of company and over projected timescale e.g., 20 years.	Data on wage costs from interviews with BBSRC attributable spin-outs cross checked using secondary data, either from accounts or as a residual calculation from gross margin and cost of sales purchases. Adjust wage costs to take into account leakage and displacement based on discussions with companies regarding their competitive environment.
Total turnover over lifecycle of company and over projected timescale e.g., up to a maximum of 20 years.	Data on turnover from BBSRC attributable spin-outs interviews and accounts data. Data on location of markets (UK/overseas). Projected growth in profit for up to 20-year IP scenarios based on assessment of previous growth rate, interviews with spin-outs and assessment of funding.
↓	
Calculate gross GVA of BBSRC attributable companies	
Either a) Convert wage costs to GVA by first calculating total employment costs and then using benchmark GVA to employment cost ratios from the ONS ABS. b) Convert turnover to GVA by using benchmark GVA to employment cost ratios from the OBR ONS ABS. Deflate GVA for historical years using the HM Treasury Gross Domestic Product (GDP) deflator series. For future projections inflate GDP data using Office for Budget Responsibility (OBR) forecasts. Projected GVA data will also need to be discounted to NPV by an annual rate of -3.5% in line with HM Treasury Green Book Guidance to take account of the Social Time Preference Rate.	
↓	
Calculate net additional GVA	
Assess net additional GVA.	Assessment of deadweight and displacement drawing on survey data on location of competitors and location of sales (UK/overseas).
↓	
Attribution to BBSRC support	
Assess impact of BBSRC funding on research (including research grant funding and any translational funding pre-spin-out).	Evidence from survey of impact of BBSRC funding on research: Would research have developed in same way in absence of funding. How did support for the research lead to a change in TRL. How did research support lead to the development of commercially viable IP.

Compare economic impact of BBSRC attributable spin-outs to comparison group.	Comparison group of companies sourced from the BSD selected on basis of size, sector, location and spin-out status. Compare data on employment growth and investment over time to BBSRC attributable spin-outs.

1.3. Structure of the report

1.3.1. Chapter 2 provides an overview of the characteristics of BBSRC attributable spin-outs using data from Beauhurst and ResearchFish. Chapter 3 presents the findings from the survey of 61 BBSRC attributable spin-outs. Chapter 4 details the economic impact assessment combining the survey results with the analysis of ONS BSD data. Chapter 5 presents the conclusions. Company case studies and a full technical summary are provided in the annexes.

2. CHARACTERISTICS OF BBSRC ATTRIBUTABLE SPIN-OUTS

Section summary

- BBSRC attributable spin-outs have relatively long lifecycles: the earliest spin-out in BBSRC's database was set up 40 years ago. On average BBSRC attributable spin-outs have been in existence for 12 years. Currently active spin-outs (59% of the total) have been operating for more than 13 years on average. Dissolved companies (34%) were in existence for just under 11 years on average.
- Even though a spin-out may no longer be active, this may be because it has been bought out and the BBSRC attributable IP may continue to generate economic benefits within the new owner's enterprise. Where this has occurred, it has not been possible to trace these new enterprises in the dataset and so they have not been captured in this study.

BBSRC attributable spin-out sectors

- Two-thirds of BBSRC attributable spin-outs are in just two 4-digit SIC sectors. Thirty eight percent of spin-outs are in R&D biotechnology and a further 26% in R&D natural science. No other SIC group represents more than 8% of spin-outs.

Location

- More than four in five BBSRC attributable spin-outs are based in England, with 13% in Scotland and 3% in Wales. Only three spin-outs are located in Northern Ireland.
- Data from the ONS BSD suggests that BBSRC attributable spin-outs are more likely to be located across regions outside of London and the South East than comparison group firms.

Grant support received by the BBSRC attributable spin-outs

- Just under half the BBSRC attributable spin-outs (48%) are recorded in Beauhurst data as having at least one public sector grant awarded. This funding support covers all public grants and includes funding sources such as Innovate UK, UKRI, development organisations such as Scottish Enterprise and some European funding[15]. In total, 775 grants were recorded with an average value of just under £277k.
- The average value of all grants per BBSRC attributable spin-out was £1,005,934 where the spin-out received support. On average each spin-out was awarded over three grants and one a total of 44 (£7.7m) over just under 20 years.

Fundraising and investment sources

- Total recorded (published) investment is £3.95bn or an average of £20.8m for those BBSRC attributable spin-outs that recorded any fundraising. A total of 190 spin-outs (42%) are recorded as receiving either equity (771 fundraising) or loan finance (20) including 18 that received both (meaning 773 fundraisings in total).
- A higher proportion of BBSRC attributable spin-outs in Scotland (49%) than those in England (46%) report fundraising. However, the average fundraising per spin-out was higher in England (£22.42m) compared to Scotland (£4.63m).
- Almost two-thirds of investment (by value) in BBSRC attributable spin-outs cannot be allocated to a specific source. Private equity and venture capital (VC) (16%) is the largest known investor, with 7% from commercialisation companies and 4% from corporate sources.

2.1. What is a spin-out?

2.1.1. The definition of a spin-out in this research is an early stage company which exploits IP arising from BBSRC funded research activity at a university or BBSRC strategically supported research institute. Some definitions require an equity shareholding in the spin-out by the research organisation but this is not the case in this study and all ownership structures are in scope.

2.1.2. A list of 471 spin-outs arising from BBSRC research funding has been collated from ResearchFish data and other sources. Although it is possible that a single research grant will lead to a specific spin-out, often a number of grants will contribute to the refining of research outcomes, to the point where these may be in a form where IP rights can be assigned to a corporate entity.

2.2. Spin-out sectors

2.2.1. Annex C details the process by which the BBSRC attributable spin-outs have been matched to Beauhurst data. Thirty eight percent of matched spin-outs are in the R&D biotechnology SIC group and a further 26% in the R&D natural science SIC group (Table 2.1).

Table 2.1: Spin-out sector

SIC Group	Frequency	%
Agriculture, agrochemical manufacturing & environment	15	3.3%
Manufacturing of pharmaceuticals	20	4.4%
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	33	7.3%
Information & communications, software	18	4.0%
Consultancy & engineering design	14	3.1%
Research and experimental development on biotechnology	171	38.0%
Research and experimental development on natural science	115	25.6%
Other professional, scientific and technical activities	26	5.8%
Other business support service activities n.e.c.	26	5.8%
Human health activities & personal service activities	12	2.7%
Total	450	100%

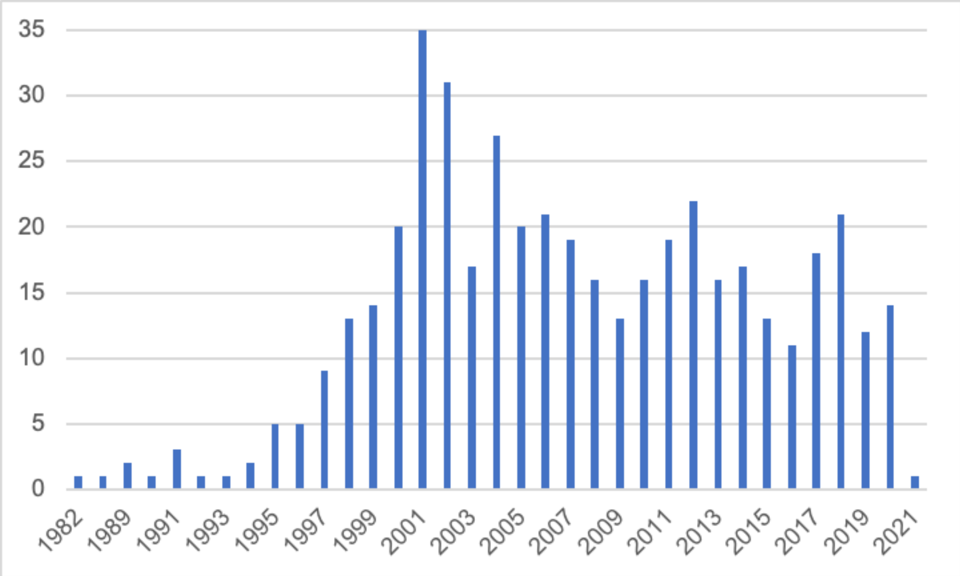
Source: Beauhurst data matched to BBSRC attributable spin-out data.

15 BBSRC and other Research Councils do not fund spin-outs directly once they are incorporated and support for their development is the domain of Innovate UK within UKRI. BBSRC does provide some indirect funding for spin-outs through its support for activities such as the UK Innovation and Science Seed Fund (UKi2S). .

2.3. Spin-out lifecycle

2.3.1. The earliest BBSRC attributable spin-out in the database was incorporated 40 years ago[16] (Figure 2.1).

Figure 2.1: Spin-out year of incorporation, all spin-outs



Source: Beauhurst data matched to BBSRC attributable spin-out data.

2.3.2. On average BBSRC attributable spin-outs have been in existence for 12 years (11.3 median)[17] (Table 2.2). Currently active spin-outs (59% of the total) have been operating for more than 13 years on average (12.3 years median). Dissolved companies (just over a third of the population 34%) were in existence for just under 11 years on average.

Table 2.2: Spin-out current status and duration (in years) since incorporation

	Mean	Median	N	%
Active	13.2	12.3	269	58.9
Company is Dissolved*	10.9	10.9	157	34.3
Dormant Company	6.0	2.9	19	4.2
In Liquidation	8.6	9.4	12	2.6
Total	12.0	11.3	457	100

Source: Beauhurst data matched to BBSRC attributable spin-out data.
* includes one company that was converted/closed.

16 BBSRC was established by Royal Charter in 1994 by incorporation of the former Agricultural and Food Research Council with the biotechnology and biological sciences programmes of the former Science and Engineering Research Council.

17 1 June 2022 has been used as a date for currently active spin-outs to provide a measure of duration 'to date'.

2.3.3. A company can become dormant at any stage by reporting that they had no significant transactions during their accounting period in their annual confirmation statement. In practice, dormant companies tend to occur from date of incorporation when presumably the spin-out is not yet ready to trade for a potential range of reasons[18]. Dormant companies represent 4.2% of BBSRC attributable spin-out companies. Spin-out companies going through a liquidation process (that will ultimately end in their status changing to dissolved) represent another 3% of the population.

2.4. Geographic location

2.4.1. More than four in five BBSRC attributable spin-outs are based in England with 13% in Scotland and 3% in Wales. Only three spin-outs are located in Northern Ireland (N Ireland). This skewed distribution means that cross-country comparisons are limited. England has relatively long-lived active spin-outs but a relatively high proportion of dormant companies with short lifetimes that reduce the overall lifespan in relation to spin-outs based in Scotland (there are too few in N Ireland and Wales to make sensible comparisons).

Table 2.3: BBSRC attributable spin-out duration by location and Companies House status

Companies House Status		Mean Years	Median Years	N	%
Active	England	13.3	12.7	225	59%
	N Ireland	16.5	19.2	3	100%
	Scotland	12.3	11.6	34	58%
	Wales	11.0	9.0	7	54%
	Total	13.2	12.3	269	59%
Company is dissolved	England	10.6	10.5	131	34%
	Scotland	13.3	13.6	21	36%
	Wales	7.4	7.2	5	38%
	Total	10.9	10.9	157	34%
Dormant Company	England	5.4	2.8	17	4%
	Scotland	9.9	9.9	1	2%
	Wales	11.0	11.0	1	8%
	Total	6.0	2.9	19	4%
In Liquidation	England	8.4	9.2	9	2%
	Scotland	9.3	9.6	3	5%
	Total	8.6	9.4	12	3%

18 There is no lifecycle tracking in the data but it is possible to infer some information from the Annual reports/Confirmation statements in Companies House. A spin-out that is incorporated and then dormant (perhaps because the business case has not been established or initial investment has not been secured) will have a different economic impact from spin-outs that are active for a period following incorporation and then become dormant.

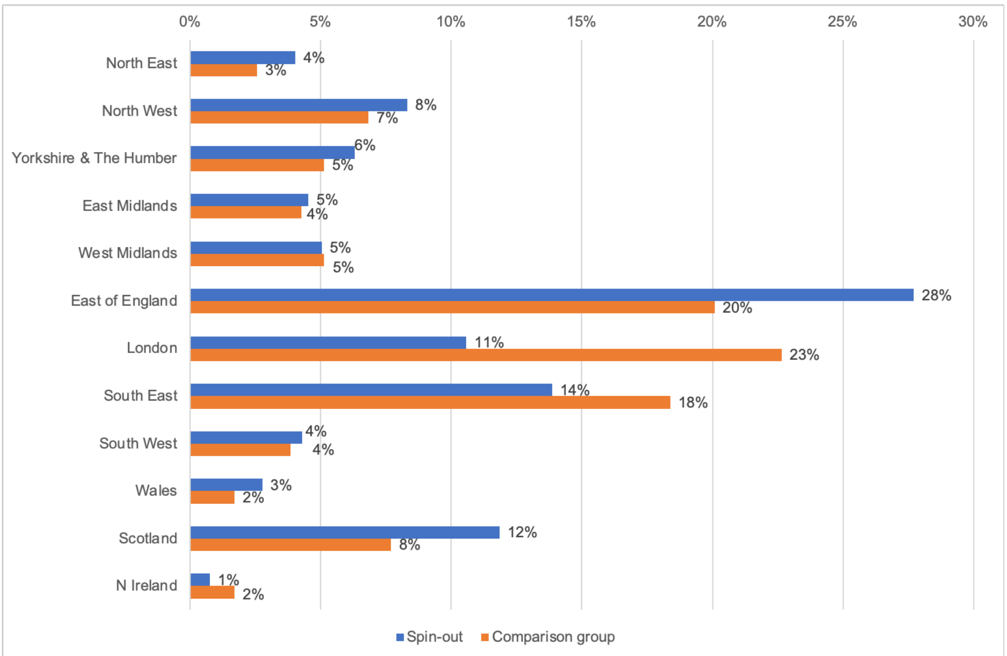
Companies House Status		**Mean Years**	**Median Years**	**N**	**%**
Total	England	11.9	11.2	382	84%
	N Ireland	16.5	19.2	3	1%
	Scotland	12.4	11.8	59	13%
	Wales	9.6	8.9	13	3%
	Total	12.0	11.3	457	100%

Source: Beauhurst data matched to BBSRC attributable spin-out data.

2.4.2. The ONS BSD provides information on the location of firms by Government Office regions[19]. The regional distribution of matched BBSRC attributable spin-outs and the comparison group firms is presented in Figure 2.2. Almost 3 in 10 BBSRC attributable spin-outs are located in the East of England with significant concentrations in the South East, Scotland and London. However, more than a quarter are based in Midland and Northern regions (28%). Overall, 47% of BBSRC attributable spin-outs were located outside of London, the South East and the East of England. The distribution of comparison group firms is similar but with proportionately more in London and South East regions. This suggests that BBSRC attributable spin-outs are more regionally dispersed than non-spin-out firms in the same sectors.

19 See Section 4 and Annex C for a detailed description of the matching process.

Figure 2.2: BBSRC attributable spin-out and comparison group location Government Office Region



Source: ONS SRS BSD 1997 – 2021.
Number of BBSRC attributable spin-outs = 397, Comparison group firms =234[20].

Table 2.4 Comparison group firm duration by Companies House status

Status	Mean Years	Median Years	N	%
Active	11.07	9.6	147	33%
Dissolved	5.97	3.9	236	53%
Dormant Company	8.65	6.7	55	12%
Liquidation	10.11	6.7	6	1%
Total	8.04	5.7	444	100%

Source: Beauhurst data

2.4.3. Comparison group firms have been operational for shorter periods on average. This is particularly the case for both active (33%) and dissolved firms (53%). Together, these two categories represent almost 9 in 10 firms of both BBSRC attributable spin-outs and comparison group firms but with fewer active firms and more dissolved firms in the comparison group when compared to the BBSRC attributable spin-outs (33% cf. 59% and 34% cf. 53% respectively).

20 Company location data in the BSD was not complete or in a number of cases was not consistent (where different locations were provided in different years). To avoid confusion the small number of such cases were excluded.

2.5. Grants and fundraising received by the BBSRC attributable spin-outs

2.5.1. Just under half the BBSRC attributable spin-outs (48%) are recorded in Beauhurst data as having at least one public sector grant awarded[21]. For those spin-outs that received any grant awards, the average value of all grants per spin-out was £1,005,934. Some spin-outs received more than one grant. On average each spin-out was awarded over three grants and one a total of 44 (£7.7m) over just under 20 years. In total, 775 grants were recorded with an average value of just under £277k.

2.5.2. Data on fundraising for each spin-out is reliant on published data including all equity investment into the companies and any debt that was announced (by the company or in press releases). Even when fundraising is announced, there is no obligation to specify the source of funding and scale of investment.

2.5.3. A total of 190 spin-outs (42%) are recorded as receiving either equity (771 fundraising) or loan finance (20) including one that received both (meaning 773 fundraisings in total). Each spin-out receiving any fundraising reported an average of just under four fundraising events. On average, each spin-out receiving any fundraising attracted £20.57m of private investment. The initial investment of BBSRC funding was on average just over £1m and resulted in the establishment of a spin-out that on average subsequently attracted £20.57m of private investment.

2.5.4. The majority of fundraising events are undertaken when the BBSRC attributable spin-out required initial seed funding (43%) with almost as many investments being undertaken at venture stage (Table 2.4). As spin-outs move into the market in the growth stage and then become established investment at these stages is in those spin-outs that have already benefited from previous rounds and so the average number of fundraising rounds (and value) increases[22].

21 The grants received includes Innovate UK, Horizon 2020 & European 7th Framework Programme for Research (FP7) and devolved administration grant programme. BBSRC and other Research Councils do not provide direct grant funding for spin-outs once they are incorporated.

22 Fundraising is still in progress for many spin-outs so these figures represent a snap shot of current investment levels.

Table 2.5: Number of investments by stage of BBSRC attributable spin-out evolution

Stage	Mean number	No of fundraising events	%	Mean value
Seed	2.06	334	43%	£1,596,650
Venture	3.95	299	39%	£2,354,296
Growth	6.13	112	14%	£13,353,588
Established	9.46	28	4%	£13,585,100
Total	3.65	773	100%	

Source: Beauhurst data.

2.5.5. Total recorded investment is £3.95bn or an average of £20.8m for those BBSRC attributable spin-outs recording any fundraising. A higher proportion of spin-outs in Scotland (49%) than those in England (46%) report fundraising. However, the average fundraising per spin-out was in England £22.42m, compared to £4.63m in Scotland.

2.5.6. Some 96% of fundraising is associated with active BBSRC attributable spin-outs (£3.2bn) and just 4.3% (£71.6m) with dissolved and liquidated spin-outs. This is not necessarily a negative reflection on spin-out performance per se, as early stage spin-outs with good prospects may secure an early exit before many fundraising rounds have been completed. Almost two-thirds of investment (by value) in spin-outs cannot be allocated to a specific source. Private equity and VC (16%) is the largest known investor, with 7% from commercialisation companies and 4% from corporate sources.

Table 2.6: Source of BBSRC attributable spin-out fundraising

Fundraising source	N	Fundraising value	%
Angel Network	56	£85,948,112	2%
Asset Management	3	£55,900,000	1%
Business Angel(s)	26	£35,729,918	1%
Central Government	12	£10,568,678	0%
Charity/Not-for-profit company	6	£46,954,550	1%
Commercialisation Company	34	£278,591,056	7%
Corporate	13	£140,209,331	4%
Crowd funding	7	£3,398,340	0%
Devolved Government	17	£17,574,527	0%
Family Office	9	£112,855,500	3%
Local and Regional Government	10	£9,957,923	0%
Private Equity and Venture Capital	112	£635,666,135	16%
Private Investment Vehicle	1	£200,000	0%
University	8	£8,624,868	0%
Undisclosed investors	363	£899,639,690	23%
Not allocated	73	£1,612,720,326	41%
Total	750	£3,954,538,953	100%

Source: Beauhurst data.

3. FINDINGS FROM THE BBSRC ATTRIBUTABLE SPIN-OUT SURVEY

Section summary

- This chapter reports on findings from the survey of 61 BBSRC attributable spin-outs.
- The spin-outs employed an average of 26 employees and grew by an average of 5.5 employees per annum.
- The average age of the spin-outs was 5.7 years. The average timeframe to initial product release was 5.6 years and the average age of spin-outs with a product in the final stage of general availability was 8.3 years.

Role of BBSRC support

- BBSRC support was considered by PIs to have made a significant difference to the formation of the spin-outs. For 35% of companies the support was considered to be 100% additional (that is the spin-out would not have formed without the support). There were no examples where the BBSRC support did not make any difference, and in the other 65% of cases the impact was partial.
- Over two thirds of spin-outs identified a patent which had been generated in part or entirely from the BBSRC supported research.
- IP was found to be crucial to the initial formation of the company and for attracting private investment. For 57% of companies the original IP also continued to play a role in the company's development.

Competition

- BBSRC attributable spin-outs offer innovative products that are very often disruptive with few like-for-like competitor products. Moreover, existing products are more often sourced from abroad. Therefore, levels of competition within the UK for the products or services offered by the spin-outs were considered to be relatively low with 56% reporting there was no or low competition. Globally the proportion rating competition as zero or low was 24%, with the majority 65% rating it as moderate despite having a highly differentiated product.

Employment and growth

- The surveyed BBSRC attributable spin-outs employed a total of 1,568 UK employees. Almost three quarters were planning to increase their UK workforce in the next two years with a projected 1,013 additional FTE jobs. Over 60% of this increase was linked to two spin-outs.
- Main growth challenges identified were raising finance, staff recruitment, trading and securing exports, lab space and manufacturing facilities.

Sales and purchasing

- Just over half the BBSRC attributable spin-outs had generated revenue from sales, licencing or service provision. The average timescale from spin-out incorporation to some form of revenue generation was 2.6 years.
- Over the company lifetime, average total revenue per company was £5m (of which 51% was from exports).
- The total spend on purchases (for the 22 companies for which we have data) was £16.46m. This averaged at £716k per company of which £8.5m (52%) was sourced from UK based suppliers including Contract Research Organisations (CRO)[23].

3.1. Profile of BBSRC attributable spin-outs surveyed

3.1.1. Interviews were undertaken with PIs and other representatives from 61 of the 471 BBSRC attributable spin-outs. We tried to ensure representation across the sub-sectors however companies in the R&D biotech and manufacturing of electronics were over-represented and those in the R&D natural science and other business support were under-represented.

3.1.2. Fifty nine percent of the spin-outs surveyed were classified as undertaking R&D on biotechnology and a further 15% were classified as undertaking manufacturing of technical products. The remaining 26% were split across the other seven sub sectors detailed in Table 3.1.

Table 3.1: Sector of BBSRC attributable spin-outs surveyed

Sector	**Survey**		**BBSRC attributable spin-outs**	
	Count	**%**	**Count**	**%**
Agriculture, agrochemical manufacturing & environment	3	5%	15	3%
Manufacturing of pharmaceuticals	3	5%	20	4%
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	9	15%	33	7%
Information & communications, software	2	3%	18	4%
Consultancy & engineering design	1	2%	14	3%
Research and experimental development on biotechnology	36	59%	171	38%
Research and experimental development on natural science	2	3%	115	26%
Other professional, scientific and technical activities n.e.c.	3	5%	26	6%
Other business support service activities n.e.c.			26	6%
Human health activities & personal service activities	2	3%	12	3%
Total	61	100%	450	100%

Source: BBSRC attributable spin-out data.

Company status and stage of development

3.1.3. All the surveyed BBSRC attributable spin-outs bar one are currently active. Two of these spin-outs had been recorded as dormant in the past. The other spin-out had been dissolved following an acquisition by a London based

23 A CRO is a company that provides support to the pharmaceutical, biotechnology, and medical device industries in the form of research services outsourced on a contract basis.

specialist virology CRO in 2014 for £4m. According to the purchasers' company accounts this purchase aimed to *'add powerful technology and key expertise for protein identification as we progress our pathomics discovery products.'*[24]

3.1.4. PIs were asked to classify their spin-out according to its TRL (Table 3.2). Just over 50% of spin-outs were at the pre-product stages (TRL1 to 4 in the table below). Just one spin-out was at the initial idealisation stage and just under a quarter were at the R&D phase. The average time to progress from the spin-out incorporation date to the R&D phase was 3.8 years.

Table 3.2: TRL by age

TRL	Count	%	Mean age	Min age	Max age
1. Idealisation	1	2%	2.0	2	2
2. R&D	13	23%	3.8	2	6
3. Pre-release	11	20%	4.6	1	11
4. MVP/Proof of concept	4	7%	4.8	1	8
5. Initial release	5	9%	5.6	2	10
6. Progressive roll out	8	14%	6.3	1	14
7. General availability	14	25%	8.9	3	16
Total known	56	100%	6.5	0	16
unknown	5	-	8.4	0	16

Source: CPC survey of spin-outs.

3.1.5. Pre-release of an initial prototype took on average 4.6 years from the incorporation date however there was a significant variance from one year to 11 years. The development of a MVP for market testing took a similar timeframe of 4.8 years, this is because some companies choose to go straight to the MVP stage to test the market before fully developing the product.

3.1.6. Just under half of all spin-outs (48%) had released their product and the average timeframe to initial product release was 5.6 years. Just over two-fifths had reached the progressive roll out stage and for just over a quarter the product was finalised and under general availability. The average age of companies with a product in the final stage of general availability was 8.3 years.

3.1.7. For all the product development phases there were a small number of newly registered companies (with an age of <2 years). In some cases this was because the initial development work was undertaken under a different

24 Hvivo Holdings Limited Group of companies' accounts made up to 31 December 2014.

company with the new company formed to commercialise the technology or to take the technology in a new direction.

3.1.8. The average age of the BBSRC attributable spin-outs who were interviewed varied widely by sub-sector and the average stage in development showed a pattern which broadly matched the age. For example, the two R&D natural science companies had the longest duration of operation at 14 years and had both reached the general availability stage of development. The majority of spin-outs in other sub-sectors had reached stages 4 or 5 proof of concept or initial product release.

Table 3.3: Age and stage in development by sector

Sector	Count	Mean age (years)	Mean stage in development (TRL)	
Agriculture, agrochemical manufacturing & environment	3	4.7	5.7	5. Initial release
Manufacturing of pharmaceuticals	3	5.7	2.5	2. R&D
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	9	6.4	4.5	4. MVP/Proof of concept
Information & communications, software	2	8.5	6.5	6. Progressive roll out
Consultancy & engineering design	1	3.0	5.0	5. Initial release
Research and experimental development on biotechnology	36	5.5	4.0	4. MVP/Proof of concept
Research and experimental development on natural science	2	14.5	7.0	7. General availability
Other professional, scientific and technical activities n.e.c.	3	6.3	5.7	5. Initial release
Other business support service activities n.e.c.	0	-	-	
Human health activities & personal service activities	2	6.0	4.5	4. MVP/Proof of concept
Total	61	6.0	4.4	

Source: CPC survey of spin-outs.

Grant funding that contributed to the establishment of the BBSRC attributable spin-outs

3.1.9. The BBSRC attributable spin-outs were established (in whole or in part) to develop innovations and commercially exploitable IP derived from BBSRC research grants[25].

25 Data on this underpinning funding associated with each spin-out was provided by BBSRC. The underpinning grants were defined as BBSRC grants in which the spin-

3.1.10. In some cases the development process received further translational support from BBSRC[26]. Grant funding from other public sources may have also contributed to the development of the IP being developed by the spin-out. This data was available for 56 of the 61 spin-outs (Table 3.4).

3.1.11. This table provides a broader context within which to consider the 'BBSRC funding' investment figure. It shows all the further funding reported against the 'BBSRC Underpinning Grants', including that from non-BBSRC funders. It should however be noted that this data is likely to be an over-estimate of the spend associated with the establishment of the spin-outs (for example Innovate UK funding typically comes later in the process post spin-out establishment and some other funding may be designed to progress the PIs other research which is not directly associated with the spin-out). As such this data may lead to an underestimate of the ROI from a wider public sector perspective.

3.1.12. Overall, just under a third of grant funding (29%) was from BBSRC.

3.1.13. European funding was the second most significant source at 12%[27] with charities[28] third at 11%. EPSRC was the most significant other source of Research Council funding at 9% whilst Medical Research Council (MRC) comprised 2%. Other public sources comprised 4% of total grant funding and included the Defence Science and Technology Laboratory, the National Institute for Health and Care Research and Department for Food, Environment and Rural Affairs.

out was reported as an outcome within the 'Spin-outs' section of the ResearchFish dataset. A spin-out may therefore be associated with more than one underpinning grant.

26 Data on follow on grant funding was provided by BBSRC. The further funding grants were defined as those BBSRC grants reported as an outcome within the 'Further Funding' section of ResearchFish for 'Underpinning Grant' dataset. A spin-out may therefore be associated with more than one further funding grant.

27 European funding included Horizon 2020 and ERC research grants.

28 Significant charitable funders included Wellcome Trust, the Royal Society, The Leverhulme Trust, National Centre for the Replacement, Refinement and Reduction of Animals in Research, British Heart Foundation and Novo Nordisk Foundation.

Table 3.4: Sources of grant funding

Grant Funding	Total funding	%	Mean per company
BBSRC initial grant	£109,958,188	29%	£1,963,539
BBSRC further funding	£93,833,270	25%	£1,675,594
Other further funding	£170,806,799		
European	£43,669,158	12%	£779,806
Charity/Non-profit	£41,687,749	11%	£744,424
EPSRC	£32,665,819	9%	£583,318
Other UK public	£13,702,752	4%	£244,692
Academic/University	£12,863,128	3%	£229,699
MRC	£8,381,534	2%	£149,670
Private	£5,891,165	2%	£105,199
Innovate UK	£5,637,280	2%	£100,666
Overseas Public	£2,204,002	1%	£39,357
Scottish Government	£1,548,000	0%	£27,643
UKRI	£1,262,090	0%	£22,537
ESRC	£658,338	0%	£11,756
NERC	£635,784	0%	£11,353
Total all sources	**£374,598,257**	**100%**	**£6,689,255**

Source: BBSRC compiled using ResearchFish data. For the funding reported as arising from 'UKRI', there is insufficient information available to assign this to a specific Council.

3.1.14. University funding was 3% of the total and included studentships and fellowships as well as a small number of research grants. Some of this funding is ultimately attributable to BBSRC as it includes BBSRC Impact Acceleration Account funding.

3.1.15. Innovate UK funding normally comes later in the process and comprised 2% of total grant funding. Schemes represented included the Biomedical Catalyst, iCURE and the Agri-tech Catalyst. A further 1% of funding was from private sources and included GSK Elion and Black Immunology Catalyst Sabbatical Awards, Google Faculty awards and some industrial collaboration funding.

3.2. Impact of BBSRC attributable support on the formation of the spin-out

3.2.1. PIs were asked to describe the impact of the BBSRC underpinning support for research on the formation and development of the spin-out. This is to provide a measure of the additionality of BBSRC's initial investment in research in terms of (future) spin-out activity for the economic impact assessment. Based on PI survey responses on the attribution to BBSRC underpinning support for research were coded for 57 of the 61 spin-outs as follows:

- 100% additional – spin-out would not have formed without the BBSRC research grant support.
- 75% additional – spin-out would probably not have formed without the BBSRC research grant support.
- 50% additional – spin-out would probably have happened but would have taken longer or would have followed a different less profitable trajectory.
- 25% additional – BBSRC research grant support made some a small impact on the development of the spin-out.
- 0% additional – BBSRC research grant support did not have any impact on the formation or development of the spin-out.

3.2.2. In 15 of these 57 cases the proportion of BBSRC grant funding was lower than the additionality percentage ascribed by the PI. We reviewed each of these cases to determine whether this percentage was still appropriate. In nine of these cases it was deemed to be accurate, this was largely because the other grant funding was awarded later and was considered by the PI to have only come about because of the initial BBSRC funding. In six cases however the other grant funding was awarded alongside the BBSRC funding and it was more difficult to fully attribute impact. In these cases the additionality percentage was adjusted down.

3.2.3. Across the 57 spin-outs for which we have data the mean additionality was 64%. For 35% of companies the BBSRC support was 100% additional (Table 3.5). Examples of companies where the support was reported as 100% additional are provided by the case studies, Solasta Bio and Amphista Therapeutics (Annex A).

Table 3.5: Impact of BBSRC support

Additionality	Count	%
100% additional	20	35%
75% additional	6	11%
50% additional	8	14%
25% additional	13	23%
0% additional	0	0%
Total known	57	100%
Unknown	4	

Source: CPC survey of spin-outs.

3.2.4. In the majority of these cases 100% additionality was linked to BBSRC providing underpinning research funding that directly led to the development of technologies which were fundamental to the formation of the spin-out:

> *'BBSRC funded the research to develop two of the three technologies which directly combined to create the patented*

technology. This research provided the evidence base for 90% of the patent and without it the patent would not have happened. Following this we were able to get a convertible loan from the University which we used as an in-kind contribution for an Innovate UK grant. We are now looking to next phase and trying to secure VC funding.' (Consultancy and Engineering Design, TRL5 Initial Release)

'We used BBSRC and Innovate UK funding from an Industrial Biotechnology Catalyst grant to develop a new technology that allows researchers to insert the genetic sequence for a required peptide into bacterial DNA, enabling the bacteria to produce the new peptide just like one of its own. Without the grants there is a good chance we would not exist, it was a good idea over dinner and just nicely fitted in with our other work, I don't think we would have been sufficiently motivated to go and look elsewhere for funding as it was not central to our existing academic research.' (R&D Biotech, TRL 4 MVP/Proof of Concept)

3.2.5. In other cases the BBSRC support was vital to attracting investment which led to the development of new IP which underpinned the company.

3.2.6. For 11% of companies the BBSRC support was considered to be 75% additional. Examples of companies are provided by the case studies, Chronomics Limited, Evox Therapeutics and C4X Discovery (see Annex A). In many cases the BBSRC funding was considered to be very important however there was another important contributing factor or additional funding stream:

'The company formed in 2019 based on two bits of IP: 1. half from a process developed by overseas partner, based on their own work. 2. based on patent filed during BBSRC-funded research. I don't think the company would have formed without the BBSRC element which got investors interested in the product.' (Manufacturing Pharma, TRL 2 R&D)

3.2.7. For 14% of companies the BBSRC support was considered to be 50% additional. Examples of companies are provided by the case studies, Oxford Nanoimaging and Kinomica. In some cases the BBSRC funding was secondary to other funding sources which led to the development of the IP:

'The company was cofounded with a PI who was supported by a EPSRC fellowship whereas I received BBSRC support. The majority of the funding was EPSRC. EPSRC supported the development of the core underlying technology which was used to develop the instrument and was directly relevant to the IP whereas as BBSRC supported the direction and application of the technology and highlighted that there was a problem that the instrument could solve. Without the BBSRC funding I think the company would have formed however it would have taken

> *longer to get where we did.'* (Other professional, TRL 7 General Availability)

3.2.8. In other cases the BBSRC funding was received at a later stage in the process and was used to develop proof of concept rather than the core IP:

> *'We received the BBSRC grant in 2015 and the company was formed in 2016. However the patents were filed before the BBSRC funding in 2013 and 2015. The BBSRC-funded research contributed to the proof of concept of the technology, proving that it worked well. We wouldn't have got the seed funding in 2020 without proving the technology worked well so the BBSRC grant was vital for this.'* (R&D biotech, TRL 3 Pre-release)

3.2.9. For 23% of companies, for example the case study Newcells Biotech (see Annex A), the BBSRC support was considered to be a contributory factor rather than core to the development of the spin-out and 25% additional.

> *'The BBSRC funding gave us the opportunity to establish clearly what needed to be done and what the principal issues were to be in setting up a company. It helped us to fill out the technologies but not in any way to articulate it via a patent. It was very much contributing to the know-how of the individuals in the company.'* (R&D biotech, TRL 2 R&D)

3.2.10. There were no cases among the 61 surveyed companies where it was considered that the BBSRC support did not have any impact on either the initial formation or the development of the spin-out.

3.3. Role of IP

Use of IP

3.3.1. The survey also asked PIs about the different mechanisms (if any) they employed to protect their market advantage arising from the BBSRC attributable research outputs. It also provides evidence on the likely sustainability of any market advantage over the lifetime of the IP protection. Just over two thirds (67%) of the spin-outs identified a patent which had been generated in part or entirely from the BBSRC supported research (Table 3.6). For 51% of the spin-outs the BBSRC support made a significant impact on their ability to patent their research.

> *'BBSRC funded research provided the evidence base for 90% of the patent. We received three grants, the third was most relevant to the technology that led to the development of the company. We developed a 4D multi-spectral imaging approach to monitor the health of agricultural crops. Similar existing*

technology was passive, e.g., attached to drones and suffering from problems such as sunlight, signalling issues, etc. The University created an active system based on manipulating light around a crop. The problem to overcome was that the imaging would be affected by the orientation of the leaf, meaning two cameras would need to be used in stereo, therefore doubling the cost. The BBSRC funding allowed us to work with a Robotics Laboratory to develop the technology to use just one camera. The University then added another step, using structured light/a distance measuring system. These technologies were combined to create the patent to launch the business.' (Consultancy and engineering design, TRL 5 initial release)

Table 3.6: Patents held by spin-outs derived from BBSRC funded research

Patent linked to BBSRC funded research	Spin-outs	%
Yes – significant link with BBSRC research	30	51%
Yes – moderate to minor link with BBSRC research	10	17%
No – patent linked to other research	5	8%
No – trade secret	2	3%
No – no hard IP/ know how	11	19%
Total	59	100%
Unknown	2	-

Source: CPC survey of spin-outs.

3.3.2. For a further 17% the impact of the BBSRC support was more moderate, for example by helping to develop previous technology:

'The BBSRC funded research provided some of the underpinning technology but the basic IP came out of work that was carried out after the termination of the grant.' (R&D Biotech, TRL 3 pre-release)

3.3.3. For 8% the patent was considered to be wholly linked to other non-BBSRC funded research. However, in some of these cases the formation of the company was still attributable to BBSRC support:

'Although our retinal and lung patents are not directly linked to the original research grant, if we had never had the BBSRC funding we would not have formed the company. The data from the 2011 grant was essential to developing the studies which attracted the investment.' (R&D Biotech, TRL 7 General Availability)

3.3.4. Two companies used trade secrets[29] to protect their IP instead of patents. In one case this was because there was no protectable IP as their microbial

[29] Under UK legislation, the Trade Secrets Regulations, trade secrets refer to information held by a business which is: secret; likely to have commercial value; and

culturing technology was originally developed in the 1980s. Their market strategy was around being first to market and continual innovation. The other company treats their production route (manufacturing pheromones for insect control) as a trade secret.

3.3.5. Nineteen percent of companies did not have any hard IP. All bar one of these companies was at an early stage in development (TRL 1-3) and many were hoping to patent their research at a later stage.

> *'We don't have hard IP but BBSRC funded research developed all the know-how. Before undertaking the research, we were not aware how valuable the findings would be and how many multiple variations could be created. There will be IP coming up and we would've done it earlier if had more support from the university.'* (R&D Biotech, TRL 3 pre-release)

3.3.6. Some companies had been dissuaded by the complexity of the patenting process:

> *'The expense of patenting, the complexity of the processes that need to be described and the way that the understanding of what needs to be done evolves continually makes patenting completely unattractive.'* (R&D Biotech, TRL 2 R&D)

3.3.7. A smaller group of companies did not seek to protect their IP for market reasons. One spin-out which was at a late stage in development (General Availability) used open source licences modified on a regular basis to add further capability to their platform and keep ahead of their market. This company was founded to provide exclusive rights to issue commercial licences to others to use the software.

Ongoing contribution of original IP to BBSRC attributable spin-out performance

3.3.8. For many BBSRC attributable spin-outs the IP was more crucial to the initial formation of the company than its ongoing development and it was evident that as the spin-outs had evolved their original IP had become less and less relevant. Table 3.7 details the remaining timeframe over which PIs considered the IP would continue to underpin company performance. For 43% of spin-outs the IP had already ceased to underpin performance at the time of interview.

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is kept secret, or that you have taken reasonable steps to ensure that information remains secret.

Table 3.7: Remaining duration of impact of IP on company performance

	Count	%
20+ years	6	10%
11 - 20 years	15	26%
5 - 10 years	3	5%
1 - 4 years	5	9%
0 years	25	43%
Unknown duration	4	7%
Total	58	100%
Unknown	3	-

Source: CPC survey of spin-outs.

3.3.9. In a significant number of cases the IP was key to attracting private investment and scaling up the company:

> *'The technology we use now is based on different technical options and new patents that were filed in 2018, after the grants had ended (six patents filed so far and a further fourteen to come). But getting to this stage wouldn't have happened without the original research, the IP was crucial from a commercial perspective, to attract the investment.'* (R&D biotech sector)

3.3.10. There was one example where a company was revisiting the original technology to develop a second product:

> *'We used this technology for six to seven years and then changed direction. Our current product is different but we are currently developing a second product which will be based on original tech, this is some way off.'* (R&D biotech sector)

3.3.11. For 57% of companies the original IP was continuing to underpin performance. There was some variation in spin-outs' views of the sustainability of the IP in future. Around 36% of companies considered it would last at least another 11 years, generally linked to the lifetime of the patent. In 14% of cases the lifespan was much shorter, this was generally because the technology had moved on and eroded the impact of their IP on their market position.

3.4. Competition

3.4.1. In order to calculate displacement, the surveyed spin-outs were asked to describe the current level of competition for the supply of their product. Spin-outs offer innovative products that are very often disruptive with few like-for-like competitor products. Moreover, current competitor products are more often sourced from abroad. Displacement measures are a key component in the translation of gross additional impacts arising from BBSRC attributable spin-outs to net additional impacts.

3.4.2. Displacement was estimated to be 0% if there were no UK based competitors, 25% if the amount of UK competition was very low or the project was extremely niche, 50% if there was one or two competitors in the UK, 75% if there was direct competition in the UK and 100% if the market was saturated with a very high level of UK competition.

3.4.3. Five percent of companies (three spin-outs) considered they did not have any competitors globally. Two of these spin-outs had released a product (the other was still in the R&D phase). All three considered that their product filled a unique technical niche.

3.4.4. Two fifths (40%) of companies considered there was no competition in the UK. Around a third of these companies considered that worldwide competition was low because other competitors were doing things differently so the market was quite distinct, for example:

> *'Others overseas [competitors] make pheromones, however, these are targeted at different insect populations. Our competitive advantage is also the scalability and relative ease of producing the product compared to competitors.'* (Agriculture, TRL 5 initial release)

Table 3.8: UK and overseas competition

	UK	%	Overseas	%
None	23	40%	3	5%
Low	9	16%	11	19%
Moderate	20	35%	37	65%
High	5	9%	6	11%
Total	57	100%	57	100%

Source: CPC survey of spin-outs.

3.4.5. Although two thirds of companies rated global competition as moderate the majority of these indicated their product offered sufficient differentiation to set them apart from their competitors:

> *'There are a few US companies offering inferior technology - based on cloudiness analysis, not a direct cell count.'* (R&D Biotech, TRL 6 Progressive roll-out)

> *'Larger companies have pulled out of the field as have invested a lot of money in failed research. Pfizer marketing one drug but debatable if it works. Some smaller companies entering the*

field. Only one that know about developing a similar receptor.' (R&D Biotech, TRL 1 Idealisation)

'There are competitors overseas but not directly - they have other technology to solve the same problem. We employ unique technology and the simplicity of our technology sets us apart from our competitors.' (Other professional, TRL 7 General Availability)

'We have an edge of competitors due to safety and ease of use of material - injectable and allows for templating.' (R&D Biotech, TRL 2 R&D)

3.5. Employment in BBSRC attributable spin-outs

3.5.1. Employment data over the company lifecycle was obtained for 60 of the 61 BBSRC attributable spin-outs surveyed. These companies grew by an average of 5.5 employees per annum (Table 3.9).

Table 3.9: Employment

	Count	Average age	Mean employees (latest year)	Average annual growth rate (employees)
Agriculture, agrochemical manufacturing & environment	3	4.3	12.7	3.3
Manufacturing of pharmaceuticals	3	5.7	3.3	2.5
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	9	5.8	12.8	3.1
Information & communications, software	2	12.5	8.0	0.8
Consultancy & engineering design	1	3.0	5.0	1.7
Research and experimental development on biotechnology	35	4.8	25.0	5.6
Research and experimental development on natural science	2	14.5	27.0	1.9
Other professional, scientific and technical activities n.e.c.	3	6.0	144.0	25.6
Other business support service activities n.e.c.	0	-	-	-
Human health activities & personal service activities	2	5.5	11.5	3.1
Total (known)	60	5.7	26.1	5.5

Source: CPC survey of spin-outs.

3.5.2. Overall in 2021/22 the 60 spin-outs (for which data are available) employed 1,568 employees with an average per company of 26 employees. This varied significantly by sector:

- As noted above the agricultural sector companies were relatively well developed with two at TRL 5 initial release and one at TRL 7, general availability. However the company at TRL 7 only employed one person and was involved in the specialist production of seeds for the brewing industry and did not have any expansion plans. The other two companies had 35 and two employees respectively. Both these companies were involved in the manufacture of pesticides and were currently fundraising to enable the spin-out to scale up of production. One was considering using a third party for production.
- Three companies in the pharmaceutical sector were at relatively early TRLs and had one, seven and two employees respectively. The first company was founded in 2019 and was seeking funding to recruit staff to support production of renewable oils for the lubricant industry. The second company with seven employees was founded in 2021 and develops hardware and software tools to give scientists and clinicians a more detailed picture of underlying biology. This company was currently aiming to complete series A funding to enable further expansion. The third company commercialises a broad range of life sciences research products including cell culture media and provides research services. This company has been trading for 15 years and during this time its employment had fluctuated between one and six employees. There were no immediate plans for expansion.
- Half of the companies in the manufacturing tech sector had started to roll out their products. These companies had an average of 13 employees with two showing particularly strong growth of 26 and 44 employees respectively. The first of these had been manufacturing electronic products since 2018 and was looking to raise series B funding to enable expansion to 50 employees in the next two years. The second manufactures optical precision instruments and was closing series B with the aim of setting up two more teams in Asia and the US. All of the other seven companies were currently looking to raise finance to support their expansion.
- The two information and communications sector companies were at progressive roll out/general availability stage. The first provides diagnostic techniques to assess anaemia in aquaculture. This company has only been incorporated for one year and employs 10 people. The company is currently seeking capable managers and finance to support its expansion overseas. The second develops and licences bioimaging software. This company is 16 years old and had steadily grown to six employees in the UK (10 in the US).
- The consultancy/engineering company was founded three years ago and has five employees and is at initial release stage. The company develops robotic units to go through fields to monitor crop health. The company is seeking investment to support further development, marketing and roll out.
- Around a third of the R&D biotech companies are at progressive roll out/general availability stage. Six of the biotech companies have significant employment numbers (above 50 employees) and significant expansion plans. Seven companies show flat or declining employment. For several this was linked to delays in expansion plans due to Covid.

  > *'We originally set up as a virtual company and our main work was outsourced. In 2015 we got some funding which enabled a lab and tech team which grew to 15 by 2017. In 2019 we managed to finalise the production process. In 2020 we spoke*

to buyers but conversations froze in 2020 due to covid. We had to downsize and go back to a virtual model with two people working from home but now have demonstratable product and can look for funding.'

- The two R&D natural science companies are at general availability stage. These companies are 14 and 15 years old. One has shown steady employment growth to just under 50 employees. The other has shown a decline in employment over the past. This is because of changes to the medical device regulatory market which has increased the need for more money to take products to market. Also this company has been impacted by Covid halting the surgical marketplace when hospitals stopped elective surgeries.
- Two of the companies in the other business support sector have high employment at 350 and 80 employees respectively. The third has two employees (a decline from five registered three years ago). The company with 350 employees is developing cancer therapies. This company is currently funded from investment and is investing in manufacturing facilities in the UK in readiness for the conclusion of a Phase 2 trial in two years. The second company which produces mass photometry products has recently been successful in raising finance and is looking to grow its UK manufacturing base further. The third company is looking to raise finance for its genetic analysis product to enable further marketing and sales.

3.6. BBSRC attributable spin-out growth plans

3.6.1. Forty five of the 61 surveyed BBSRC attributable spin-outs were planning to increase their UK employment numbers in the next two years (of the remaining 16, three said they had no plans to grow and the remaining 13 did not know). Of the 45 companies who planned to increase their employment, 80% were able to quantify this and estimated a total increase of 1,013 jobs in the next two years. This represents an increase of 165% from the 1,568 employees in 2021/22.

3.6.2. Over 60% of this increase is accounted for by two companies. One is at the progressive roll out phase expected to double its workforce each year following a $50m funding round. The second, Oxford Nanoimaging (see case study Annex A), has a post money valuation between $300 and $450m and has recently closed a $75m funding round which will be used to scale up production and increase overseas markets.

3.7. Development challenges

3.7.1. All surveyed spin-out companies were asked to identify the main growth challenges preventing their expansion. These are summarised below.

Raising finance

3.7.2. Bridging the 'valley of death' between the discovery of an innovation and where is it sufficiently developed to provide the basis for a commercially successful business of product has long been recognised as the challenge to commercialisation of research. BBSRC is able to provide translational support to help fund the further development of the research idea to a point where investors consider the investment will provide sufficient returns such that the risk is worthwhile.

3.7.3. Access to finance at different growth stages was not surprisingly a common issue among BBSRC attributable spin-outs:

> *'The main issue for us is cashflow, a smaller amount of funding is easier to obtain but accessing scalable capital is very difficult. Covid has helped us as it has shown that there is money to be made in diagnostics. It would be much easier if located in the west coast of the US. It is much harder in the UK (and other parts of the US). We thought about relocating but family ties prevented this.'* (Manufacturing tech company, TRL3 pre-release)

3.7.4. This also seemed to be an issue at earlier stages and two early stage companies (at R&D and idealisation stages), both in the tissue manufacturing sector, considered that translational support[30] was lacking:

> *'Nobody else has done this (there is a lot of work around cell manufacturing, but not tissue manufacturing), so no off-the-shelf technology/ no bioreactors that produce tissues, so [we] have to invent one. There is a lack of BBSRC funding/support for tissue manufacturing to develop a new technology and no help to get to the next stage.'* (R&D Biotech, Idealisation stage)

3.7.5. According to data from Beauhurst, supplemented by data from PIs, all bar three of the 61 surveyed companies were dependent on raising external funds to support their growth:

- An agricultural company producing seeds was not seeking funding because they did not want to grow further as they had already expanded the varieties they could comfortably cope with.
- A health sector company providing software for genetic animal selection did to require external funding because of a partial acquisition the previous year.

30 It should be noted that BBSRC are explicitly prevented from funding spin-outs directly. In this case, the development of the technology would require funding from other sources such as Innovate UK.

- An information and communications sector company generated sufficient revenue from licences to support its expansion.

3.7.6. The majority of companies were looking to raise more funding in the next two years. Funding required varied considerably from £1.5m (to put an early stage production facility in place) to $75m for a manufacturing tech company to expand operations overseas.

Staff recruitment

3.7.7. Recruiting and retaining the right staff was a significant challenge for the majority of surveyed BBSRC attributable spin-outs. Many companies were trying to sponsor overseas staff as they considered the UK market was weak:

> *'The main issue for us is attracting the right staff. We have had difficulties recruiting product development engineers - three offers were all refused. We are looking at sponsoring staff from overseas as UK market is weak for R&D staff - huge pain. Other challenge is getting early adopters and generating traction.'* (Manufacturing tech company, TRL 6 progressive roll-out)
>
> *'Talent is a huge challenge, especially since Brexit. We relied on EU talent, and some did leave.' (Other professional, TRL 3 pre-release)*
>
> *'Most of our employees are recruited from abroad. Only five are UK-born. As there is a dearth of home-grown talent. The government is supportive with getting tier 2 visas and we have French, Dutch, Italian, Greek and Mexican staff. We also work closely with The Roslin Institute (funded by BBSRC) and use as a potential source of staff so BBSRC also has a positive impact here. Our location is isolated but a good area for quality of life so we do not have issues with staff retention.'* (Health sector, TRL 7 general availability, Scotland)

3.7.8. There appeared to be geographical differences in recruitment. For example, two companies in North East England spoke of a relative ease in recruiting technical staff but more difficulties in finding operational staff:

> *'We have no issues finding technical staff - NE/Newcastle area has the highest density of PhD students outside London. It is more difficult on the operational side - not a big eco-system of bio-companies in the NE, although it's growing rapidly. Due to our remote location it is difficult to find sales staff, etc.'* (R&D biotech company, TRL 7 general availability, NE England)
>
> *'We generally recruit from the university research group. Otherwise it is difficult to compete with the likes of Cambridge, due to location. Retaining staff is also difficult as many move on to study for PhDs.'* (R&D biotech company, TRL 7 general availability, NE England)

3.7.9. Companies outside the South East spoke of difficulties attracting the right staff, while those in the South East spoke of competition from other sectors and greater wage pressure:

> *'We (Greater Manchester) are in competition with Greater South East. We don't have the same accessibility of talent and have to try and relocate people.'* (R&D Natural Science, TRL 7 general availability)

> *'It is hard to get good people who fit with the company culture. It is especially difficult to recruit hardware R&D staff and software engineers as there is a lot of competition for skills.'* (Other professional, TRL 7 general availability, South East)

3.7.10. One PI highlighted the growing importance of using CROs to overcome the management and access to highly skilled staff:

> *'We had a relatively well-defined development pathway and considered that compared to the challenges of finding, recruiting and retaining some very skilled staff and paying for premises and equipment etc, it would make more sense to contract with a reputable CRO. This has worked to date but was not popular with some public sector investors as the jobs have in effect been transported down South.'* (R&D biotech company, TRL 3 Pre-release, Scotland)

3.7.11. Some companies also commented on shortages of lower skills staff:

> *'Our only issue has been the recent shortage of low-skilled operator staff. In 2020, an advert received 400 applications. In 2021, an advert for two operators received just 14 applications. The pool of low skilled workers has declined due to Brexit and Covid (workers leaving UK) whilst demand from food industry has increased.'* (R&D biotech company, TRL 7 general availability, Wales)

Trading and exports

3.7.12. BBSRC attributable spin-outs that were importing, exporting or planning to export spoke of frustration with the addition paperwork and regulation caused by the UK's exit from the European Union:

> *'Brexit has been a huge barrier for us, trading with other places is now much more difficult, logistically and administratively and a big burden for the company, e.g., we needed to recruit an EU representative, shipping/paperwork, slow customs process.'* (Manufacturing tech company, TRL 6 progressive roll-out)

> *'Covid and Brexit have had negative impacts – we couldn't do lab work during lockdowns. Shipping became very difficult. We have to receive/dispatch samples and courier costs soared. Cost of shipping a package to the US rose from £30 to £1,000.*

> *As a result we have had to make redundancies.'* (R&D biotech company, TRL 7 general availability)

Lab space and manufacturing facilities

3.7.13. A small number of BBSRC attributable spin-outs spoke of difficulties finding lab space:

> *'Finding lab space is an increasing issue for us as we will outgrow the University but Cambridge/Oxford full/over-subscribed. There's a need for more scalable space for R&D across the UK.'* (R&D biotech company, TRL 2 R&D)

3.7.14. Companies further up the TRL scale spoke of difficulties scaling up and finding manufacturing partners and facilities in the UK:

> *'Our main challenge at the moment is scaling up and being able to manufacture at scale in the UK – space, expertise, etc. We have manufacturing partners abroad (Ireland, Portugal, etc). Looking for more manufacturing to be done in UK as gear up for clinical trials.'* (R&D biotech company, TRL4 MVP/proof of concept)

3.8. Revenue generation and development models

Business model and customer base

3.8.1. PIs were asked to describe the spin-out's customer base and business model. The vast majority of BBSRC attributable spin-outs were currently (or were planning to be) B2B with sales, licencing or services to other businesses. Three of the 61 spin-outs had some element of Business to Consumer (B2C) although this was secondary in two of the three cases. For example:

- A food ingredient company which produced low glycaemic fibre derived sugars. Although these are predominantly supplied to the food industry it does sell a small range of chocolate online directly to the consumer.
- A spin-out which was developing in-vitro diagnostic tests for diseases. These were still at the developmental stage although plans were to make these available to customers directly.
- The third spin-out was solely B2C and provided personalisation of workouts using DNA data.

3.8.2. Table 3.10 details the main customers across the 61 surveyed spin-outs. There are 68 records because some spin-outs recorded multiple categories of customer. Health services (for example the NHS) or organisations that supply directly to health services were recorded by 29% of spin-outs. For example a company which was developing a diagnostic platform to help clinicians prescribe the right drug, for the right patient at the right time.

Table 3.10: Core customer base

	Count	%
Health services/health care suppliers	20	29%
Pharmaceutical companies	15	22%
Biotech companies	14	21%
Agriculture/aquiculture companies	7	10%
Food manufacturing	7	10%
Research/University	3	4%
Consumers (personalisation of workouts)	1	1%
Other manufacturing (lubricants)	1	1%
Total	68	100%

Source: CPC survey of BBSRC attributable spin-outs.

3.8.3. Twenty two percent of spin-outs identified pharmaceutical companies as their main customer. In the vast majority of these cases they were working either in partnership with a pharmaceutical company to develop the product and/or had a licencing agreement. Some early stage spin-outs were looking for a pharmaceutical partner to commercialise their project.

3.8.4. A similar proportion of spin-outs listed biotech companies as their main customer. In the majority of cases they were producing technology for biotech companies (for example a device to detect bacteria, a solution for storing and transporting cells and tissues).

3.8.5. Ten percent of spin-outs were supplying farmers and other agriculture and aquaculture businesses. This included the development of software for the genetic selection of fish to inform fish breeding and the production of pheromones for insect control.

3.8.6. A further 10% were supplying the food industry including the production of cultured meat, the development of sugar from fibre and the production of high value chemical flavourings.

3.8.7. Just 4% identified universities/academics as a customer. Products here included the supply of mass photometers and gene editing tools for academic customers.

3.8.8. The findings above are consistent with recent work by the Innovation Caucus on market positioning that identified a strong presence of bioscience spin-outs in Health; Energy; Food; Transportation; Innovative Foods; Sustainability; Wellness/Beauty; Ag Tech; Sport markets. This also triangulates with findings of the Innovation Caucus on why these spin-outs are not necessarily seen by the public given they are often “hidden” within supply chains. However, just because they are hidden from the customer base does not mean they are not absolutely critical in fuelling economic growth and meeting end customer needs.

Revenue sources

3.8.9. Overall 55% of the surveyed spin-outs had generated some revenue from sales, licencing or service provision. The average timescale to some form of revenue generation was 2.6 years and revenue was common in the pre-release and MVP stages as well as post product release. In the early stages, however, revenue streams tended to be volatile, for example a one-off sale of an early stage product.

Table 3.11: Revenue generation

Stage in development	Total interviewed	Companies generating revenue	% generating revenue	Time to revenue (years)
1. Idealisation	1	0	0%	-
2. R&D	13	0	0%	-
3. Pre-release	11	5	56%	3.0
4. MVP/Proof of concept	4	2	50%	5.0
5. Initial release	5	3	75%	1.3
6. Progressive roll out	8	8	100%	2.9
7. General availability	14	13	100%	1.9
Total known	56	31	55%	2.6
Unknown	5	5		-

Source: CPC survey of BBSRC attributable spin-outs.

3.8.10. Revenue came from three main sources: product sales; the provision of services and licencing agreements (Table 3.12). 39% of companies were generating revenue derived at least some of this from product sales, 11 from service agreements and eight from licencing.

Table 3.12: Revenue sources

Revenue source	Number of companies	Mean time to revenue (years)
Product sales	24 (39%)	2.7
Service agreements	11 (18%)	1.5
Licencing	8 (13%)	3.5
Any of the above	36 (59%)	2.6

Source: CPC survey of BBSRC attributable spin-outs.

Table 3.13: Revenue sources by sector

Sector	Total	Any revenue	Sales	Services	Licencing
Agriculture, agrochemical manufacturing & environment	3	2 (67%)	2 (67%)	0 (0%)	0 (0%)
Manufacturing of pharmaceuticals	3	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	9	6 (67%)	5 (56%)	3 (33%)	2 (22%)
Information & communications, software	2	2 (100%)	0 (0%)	2 (100%)	1 (50%)
Consultancy & engineering design	1	1 (100%)	0 (0%)	1 (100%)	0 (0%)
Research and experimental development on biotechnology	36	19 (53%)	14 (39%)	2 (6%)	3 (8%)
Research and experimental development on natural science	2	2 (100%)	1 (50%)	1 (50%)	1 (50%)
Other professional, scientific and technical activities n.e.c.	3	3 (100%)	2 (67%)	1 (33%)	1 (33%)
Human health activities & personal service activities	2	1 (50%)	0 (0%)	1 (50%)	0 (0%)
Total	61	36 (59%)	24 (39%)	11 (18%)	8 (13%)

Source: CPC survey of BBSRC attributable spin-outs.

3.8.11. Revenue from product sales took an average of 2.7 years from company registration. An example is provided by the case study of Chronomics which is a tech-bio company which provides individuals with actionable information to improve their health and wellbeing (see Annex A). The company was incorporated in 2017 and started to generate revenue a year later from the sale of home test kits and testing services to both individuals and businesses. Another case study, Oxford Nanoimaging was founded in 2016 and since 2018 has generate revenue from its sales of the Nanoimager, a desktop version of a super-resolution single-molecule light microscope about 30 times smaller and less expensive than existing devices.

3.8.12. Revenue from service agreements was the quickest, with a mean time of 1.5 years from company registration. An example is provided by the case study Kinomica which provides computational analysis of biological data – via its KScan diagnostic platform – to enable accurate predictions of patient responders to drug therapies, identifying which drugs have the greatest chances of being successful, facilitating personalised drug treatments, and improving patient outcomes. The company was founded in 2016 and in 2019 started to generate revenue through service agreements with several blue-chip pharma companies to explore mode of action, potential causes of resistance and off-target effects and identify patient selection biomarkers to predict responses to their drugs.

3.8.13. Revenue from licencing took an average of 3.5 years from company registration. An example is provided by the case study C4X Discovery which was founded in 2007 following BBSRC-funded research to look at the 3D shape of drug molecules and how they interacted with receptors as an alternative way to perform drug discovery leading to the filing of a patent in 2008 covering a method for determining the 3D structures of molecules. Since 2018 the company has signed several multi-million licencing deals with pharmaceutical companies to inform drug design using experimental data.

3.9. Revenue from exports

3.9.1. Revenue data over the lifetime of the company (until 31 March 2022) was available for 54 of the 61 surveyed spin-outs using a combination of interview data and Companies House records. Over the company lifetime the mean total revenue per company was £5.01m of which 51% was from overseas sales, servicing or licence agreements and 49% was from UK sales, servicing or licence agreements. In the R&D biotech sector the proportion of revenue from overseas sales appears relatively low at 38%[31]. In the current year this proportion has decreased to 60% and in the future, the percentage of total revenue from overseas markets is expected to continue to increase.

31 The limited number of interviews across some sectors (and very skewed distribution) does mean that sectoral level analysis is less robust, especially as different sectors take longer to reach the market.

Table 3.14: Revenue from exports

Sector	Count known cases	Mean revenue/ company	% from overseas	Net overseas mean
Agriculture, agrochemical manufacturing & environment	3	£97,000	100%	£97,000
Manufacturing of pharmaceuticals	2	£0	-	£0
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	8	£2,976,534	80%	£2,374,144
Information & communications, software	1	£7,864,766	100%	£7,864,766
Consultancy & engineering design	1	£0	-	£0
Research and experimental development on biotechnology	32	£6,253,277	38%	£2,346,436
Research and experimental development on natural science	2	£7,064,000	98%	£6,923,430
Other professional, scientific and technical activities n.e.c.	3	£6,187,333	95%	£5,881,083
Other business support service activities n.e.c.	0	£0	-	£0
Human health activities & personal service activities	2	£2,952,000	90%	£2,656,800
Total	54	£5,012,350	51%	£2,574,788

Table 3.15: UK purchasing

Sector	Count (known)	Total purchasing	Mean per company	% of UK purchasing
Agriculture, agrochemical manufacturing & environment	2	£158,000	£79,000	61%
Manufacturing of pharmaceuticals	0	unknown	unknown	90%
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	3	£2,262,000	£754,000	12%
Information & communications, software	1	unknown	unknown	90%
Consultancy & engineering design	0	unknown	unknown	-
Research and experimental development on biotechnology	15	£12,790,000	£852,667	54%
Research and experimental development on natural science	0	unknown	unknown	-
Other professional, scientific and technical activities n.e.c.	1	£1,000,000	£1,000,000	100%
Other business support service activities n.e.c.	0	unknown	unknown	-
Human health activities & personal service activities	1	£250,000	£250,000	80%
Total	23	£16,460,000	£715,652	52%

Source: CPC survey of BBSRC attributable spin-outs.

3.10. Purchasing and imports

3.10.1. Twenty three of the surveyed spin-outs were able to provide data on their purchasing costs (which excludes wage costs) (Table 3.15). Across these companies the total spend on purchasing in 2019/20 was £16.46m with an average spend of £716k. Just over half of spend (52%) was on UK based suppliers[32].

3.10.2. Purchasing patterns varied significantly across these companies:

- Five companies used CROs as an additional support. A manufacturing tech company used a CRO on a one off basis to support the development of an instrument; a bio tech company used an overseas CRO to go through development stage and run animal studies; another biotech company used multiple CROs for chemistry support, to make molecules, provide in vivo support and biological discovery support and manufacturing. Two further biotech company used CROs for manufacturing drugs. These CROs were based in the UK and worldwide.
- Over 90% of companies who manufactured a non-pharmaceutical product had kept this production in house. A small number of companies spent money on external manufacturing. An agricultural company which focussed on pre-breeding and seed production for the distilling industries purchased the services of contract growers. A biotech company which specialises in medical engineering undertakes 95% of its manufacturing in China for cost reasons.
- The majority of companies kept most of their development in house. For these companies the bulk of purchasing was on set up costs including IT and lab equipment. Ongoing purchases included lab rental costs, raw materials and administration and accountancy support.

3.10.3. One company had plans to start their manufacturing outside of the UK in Europe due to stronger capabilities for running fermentations, however, the majority planned to build manufacturing capability within the UK.

32 Although it was not possible to fully explore second and third order supply chain impacts, the data we have allowed us to confidently exclude UK based distributers who import all or the majority of their products from this total. Areas of significant UK based spend included administrative, legal and accountancy costs. Around 50% of lab equipment and chemicals were sourced and produced in the UK. IT equipment and raw materials tended to be largely imported. Approximately half of spend on CROs accrued to the UK.

4. ECONOMIC IMPACT ASSESSMENT OF BBSRC ATTRIBUTABLE SPIN-OUTS

Section summary

- This chapter reports on the assessment of economic impact from the match of 402 BBSRC attributable spin-outs to the restricted ONS BSD that provides data on individual firm employment and turnover for 1997 to 2021 from PAYE and VAT records.

Impact over company lifetime

- Estimated total real GVA impact from the 402 BBSRC attributable spin-outs of £7.96bn or £19.8m per company over their lifespan to 2021. The estimated total real net GVA is £5.18bn or £12.9m per spin-out over their lifetime to 2021.
- Using additionality calculations from the spin-out survey, the assessment of displacement based on the assessment of UK competitors and a supply chain multiplier gives real net GVA estimate of £9.5bn attributed to BBSRC support or £23.6m per spin-out. Compared to the survey based calculations of impact, the more robust evidence covering most of each spin-out's lifetime, gives a significantly larger impact.
- There is strong statistical evidence of a clear distinction in the CAGR over five and ten years between BBSRC attributable spin-out companies and their comparison group counterparts with spin-outs growing at a much faster rate (555% cf. 440% over five years and 77% cf. 44% over ten years respectively).
- Statistical differences in the performance between BBSRC attributable spin-outs and comparison group firms were not significant across other dimensions, such as sectors. We think that this is due to (i) similar firm level activities even if they are nominally in different SIC classifications and (ii) variation in spin-out turnover over the lifecycle, suggesting that more detailed analysis of spin-outs across different stages of development might reveal greater insight.
- BBSRC expenditure on the original research that generated the IP and any subsequent translational support pre-spin-out was drawn from BBSRC records for the survey companies and then deflated into real terms (2021 prices). Average spend per spin-out was then applied to data on ONS BSD spin-outs at sector level.
- ROI compares BBSRC costs in real terms (2021 prices) against the estimates of GVA impact. The total ROI on a gross basis is 4.84 per BBSRC £1. The net ROI is 3.14.

Impact over IP lifetime

- Future projections take into account that the BBSRC-funded IP may make a contribution to firm performance for up to 20 years. The NPV of the remaining years of IP protection in GVA terms were calculated by a trendline forecast of current GVA over their lifetime to date and using HM Treasury discount rate of 3.5%.
- The 20 year projection gives a total real net GVA of £7.0bn (£17m per spin-out) with a gross ROI of 5.95 and a net ROI of 4.26.

4.1. Characteristics of matched data from ONS BSD

4.1.1. As noted in the introduction, the data on the 457 BBSRC attributable spin-outs was matched with 444 comparable non-spin-out companies sourced from Beauhurst data. The comparison group were selected randomly in proportion to the BBSRC attributable spin-out sectors and between the earliest and latest incorporation dates of spin-outs in that sector. Although individual firm records can be accessed these are anonymous and cannot be published in any way that may be disclosive of their identity so this ruled out any pairwise comparison from the research design. The details of the matching process are set out in Annex C.

4.1.2. Table 4.1 sets out the uploaded companies by sector and the rate at which each group was matched with ONS BSD for the years 1997 to 2021. The overall match rate was high for BBSRC attributable spin-out companies with 402 firms matched. The overall match rate was much lower for comparison group firms at 56% (or 251 firms)[33]. However, both groups have sufficient matches to support a sector-level analysis of firm performance.

Table 4.1: Match of ONS BSD data to ingest file

	Ingest data	Matched Spin-out firms	Matched Comparison group
Agriculture & related	15	80%	60%
Pharmaceuticals	20	85%	65%
Manufacturing Tech	33	97%	70%
Info Comms & software	18	78%	61%
Technical Engineering	14	93%	79%
R&D Biotech	171	91%	46%
R&D Science	115	90%	58%
Other business support	26	77%	73%
Professional Scientific Technical	26	88%	38%
Health & related	12	100%	75%
Total	450	89%	56%

Source: ONS SRS BSD 1997 – 2021. Number of BBSRC attributable spin-outs = 402, number of comparison group firms = 251.

4.1.3. Almost two-thirds of BBSRC attributable spin-out companies were still active in 2021 (64%) compared to under half (48%) of comparison group firms. This is despite proportionately more spin-outs having earlier incorporation dates. Compared to the characteristics of spin-out and comparison group firms uploaded to the SRS, there are proportionately more active firms and fewer

33 The anonymisation of BSD records means it is difficult to explore why the comparison group match rate is much lower than that out spin-out companies.

dissolved companies suggesting the lower match rate is due to fewer matches among dissolved firms. This is consistent with the significantly shorter lifetimes of active and dissolved comparison group firms when compared to their spin-out counterparts noted in Tables 2.3 and 2.4[34].

Table 4.2: BBSRC attributable spin-out and comparison group Companies House status

	Spin-outs	Comparison group
Active	63%	48%
Dissolved	32%	43%
Dormant	2%	7%
Liquidation	3%	2%
Total	402	251

Source: ONS SRS BSD 1997 – 2021.

4.1.4. Data for each BBSRC attributable spin-out was drawn from the annual ONS BSD datasets from 1997 to 2021 but employment and turnover data was only available for those years in which the firms operated. There are two circumstances where the economic impact of BBSRC attributable IP may be under-reported and the economic impact estimates set out below are an under-estimate of total potential impacts:

- A total of 21 BBSRC attributable spin-outs firms and 22 comparison group companies had been incorporated prior to the start of the database in 1997 but we have no data covering these years[35].
- BBSRC attributable spin-outs that are taken over by other corporate entities most often cease trading but the economic activity will continue within a different corporate structure that is not possible to track through ONS BSD data.

4.1.5. The following sections set out how we have used this much more robust and complete dataset to provide an estimate of the economic impact of BBSRC attributable spin-outs.

34 Given that the matched data is anonymised it is not possible to investigate the lower match rate for comparison group firms. Discussions with ONS SRS staff suggest that the matching process may not be as effective with dissolved firms.

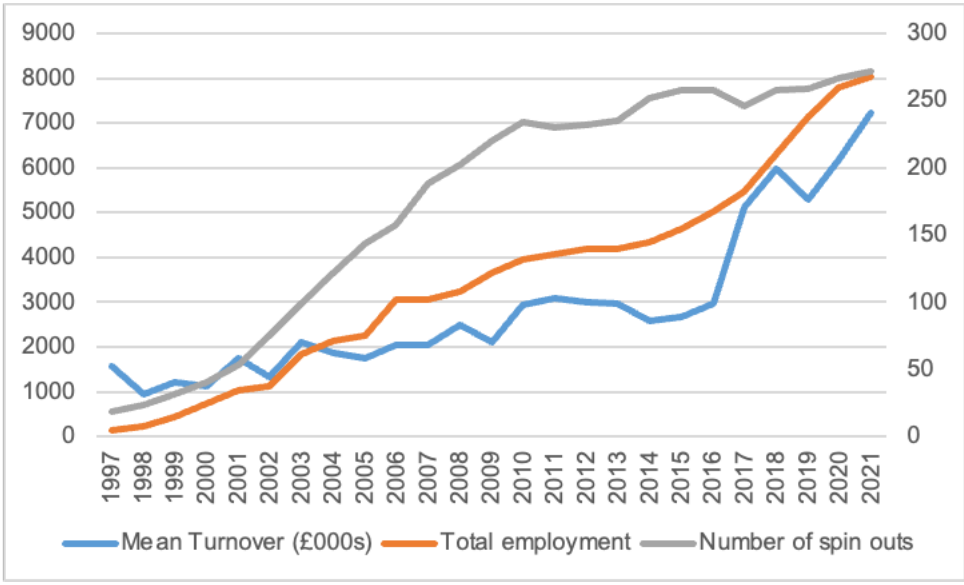
35 The number of spin-out years of operation amount to just 1.8% of the total number of years captured in BSD data so we judge the impact of this to be marginal.

4.2. BBSRC attributable spin-out and comparison group performance

Performance over time

4.2.1. Figure 4.1 presents average turnover, total employment and the number of BBSRC attributable spin-outs over the period 1997-2021 for the 402 matched spin-out firms. Total employment increases in line with the number of spin-out firms in operation over the period with average turnover also increasing but at a lower rate. This is a typical spin-out development pattern as investor funds support employment for a period until firms can get their product or service into the market when the economic impact of the spin-outs is more fully reflected in company turnover.

Figure 4.1: BBSRC attributable spin-out Average Turnover, Total Employment and number of firms over time



Source: ONS SRS BSD1997 – 2021. Number of BBSRC attributable spin-outs = 402.

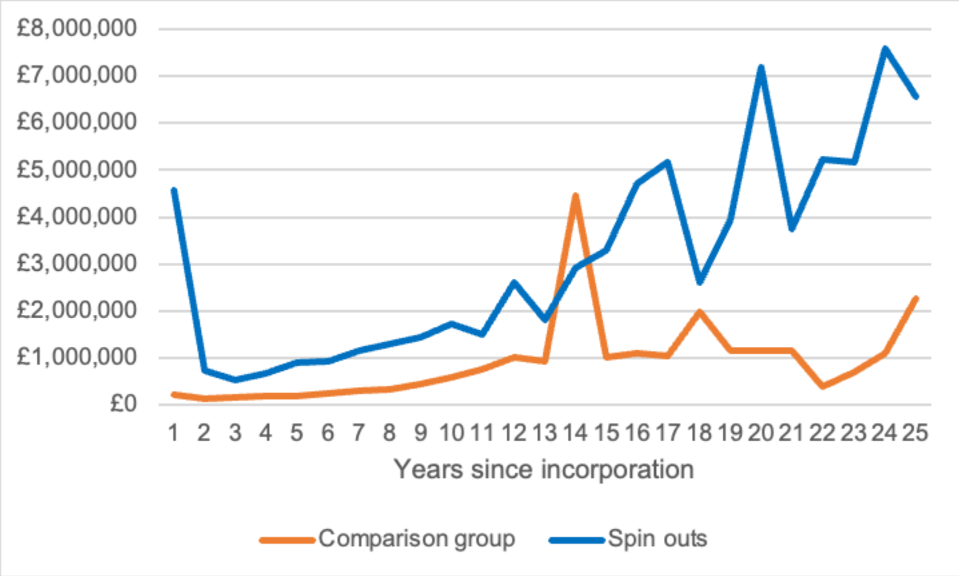
4.2.2. At no stage are all 402 matched BBSRC attributable spin-outs in operation at the same time, newly incorporated firms join the group of active spin-outs and others exit. In order to provide a more consistent basis for the analysis, the turnover and employment data from ONS BSD has been put on a lifecycle basis for each spin-out and comparison group firm. So for each firm Year 0 = year of incorporation, whatever date that may be. This allows the changes in firm employment and turnover data to be analysed on an equivalent basis as they move from start up towards the market[36].

4.2.3. Much of the following analysis has been carried out using the lifecycle presentation of BBSRC attributable spin-out and comparison group performance. Moreover, the ONS BSD data on turnover has undergone a number of transformations to prepare data for the estimation of economic impact and conform to HM Treasury Green Book standards. These are:

- ONS BSD turnover data has been translated into GVA by using aGVA/turnover benchmark ratios from the ABS at 4 digit SIC sector level.
- However, because spin-out turnover some sectors such as R&D Biotech and R&D Natural Science (the largest group of BBSRC attributable spin-outs) often do not fully reflect total economic activity during its early pre-market stage, comparisons were made between the turnover based GVA estimates and those generated from ONS BSD employment and ABS aGVA/employment benchmarks. This analysis suggested that the turnover-based GVA estimates were somewhat below GVA estimates generated from employment during years 1-8 post after spin-out incorporation. This aligns with spin-out survey responses that suggest initial product release around 5-6 years and general roll-out 8-9 years. As a result the GVA estimates from year 1 to year 9 were increased to match those of the employment-based estimates of GVA but turnover-based estimates match or exceed these from year 9 onwards as sales become the main driver of economic impact.

36 While this does ignore any impacts arising from the economic cycle, we believe that this format provides greater insight in the company development transition from incorporation to full market entry.

Figure 4.2: Real mean annual GVA per firm over lifecycle



Source: ONS SRS BSD 1997 – 2021 adjusted by CPC calculations of GVA/Turnover ratios from ONS ABS and deflated by OBR GVA deflator. GVA in 2021 prices. Number of BBSRC attributable spin-outs = 402, Comparison group firms = 251.

4.2.4. Figure 4.2 shows average real GVA for BBSRC attributable spin-outs and comparison group firms over their lifecycle (to 2021[37]). The average GVA figures do vary reflecting variation in turnover in spin-outs highlighted in the survey (periodic licencing fees and one off sales etc). GVA estimates for comparison group firms are more consistent apart from one year when substantially more turnover is reported in one sector just in that year. There is a clear trend of increasing average real GVA over a spin-out's lifecycle, with a more divergent trend after year 11 onwards.

Do spin-out businesses perform better than comparison group firms?

4.2.5. Prima facie evidence suggests that while the BBSRC attributable spin-outs take some time to develop, they then do grow faster than their comparison group counter parts. We have undertaken numerous statistical tests to establish whether the performance of spin-outs is significantly different to that of the comparison group firms. The results have been mixed:

- By and large these results have not proven statistically significant at the 95% confidence level. We think that this is due to the significant variation in performance measures within each group – particularly the BBSRC attributable spin-outs – so for example, turnover can be intermittent at various stages in the lifecycle, etc.

37 N.B. This is not a completed spell analysis and most spin-outs are still active.

- Nor have the results proved positive at the sector level[38]. Only one sector, Other Business Support where the average GVA generated by BBSRC attributable spin-outs was significantly different from that of the comparison group at the 95% confidence level (on average spin-out firms generated almost four times the GVA of comparison group firms).
- GVA compound growth rates over a five year and ten year period are statistically significant at the 99% level. Over five years average BBSRC attributable spin-out CGAR was 555% compared to 440% for comparison group firms. Over ten years spin-out CGAR was 77% compared to 44% for comparison group firms. These results appear to reinforce the finding that once spin-outs move into their market they grow at a rate which is substantially above that of their comparison group firms[39].

4.2.6. Further investigation of the data may identify other significant differences but this would require significant effort to re-categorise the data according to the duration the BBSRC attributable spin-outs were operating, before then exploring potential differences at sectoral level. However, this approach would potentially reduce the sample sizes to the point where detailed results could not be published because of disclosure issues.

4.3. Economic impact assessment based on ONS BSD data

4.3.1. Table 4.3 presents the summary results from the real GVA generated by BBSRC attributable spin-outs over their lifecycle. These estimates are for aggregate real GVA over the spin-outs lifecycle to date (2021). It is worth noting that the majority of spin-out companies are still active (59%) and so will continue to generate GVA in future. With the majority of spin-out firms still active it has not been possible to draw any robust conclusions from the smaller proportion of firms which have exited for some reason.

4.3.2. Access to data on turnover for up to 25 years does mean that the overall estimate for the real GVA from 402 spin-out firms is considerably larger than that estimated from the more limited data secured from the survey. Total real GVA for the period 1997-2021 is £7.96bn, at an average of £19.8m per spin-out company.

38 The spin-out firms often have more than on SIC code cited on Companies House records (it is possible to have up to three SIC codes to describe company activity). We have assumed the spin-out belongs the first cited SIC code but many have cited other SICs in the sample framework. Interviews with spin-outs have also demonstrated that spin-out activities can often blur the boundaries between SIC sectors, for example, undertaking consultancy activities to raise revenue for product development.

39 There is no statistically significant difference between the three year CAGR or lifetime CAGR between spin-outs and comparison group firms.

Table 4.3: Estimated net real GVA from ONS BSD data

Sector	Spin-outs
Total Real GVA	£7,961,138,820
Mean per company	£19,849,097
Net total real GVA	£3,506,085,536
Net mean	£8,741,542
Net mean per company incl. multiplier	£12,893,775
No of spin-outs	402

Source: ONS SRS BSD 1997 – 2021 adjusted by CPC calculations of GVA/Turnover ratios from ONS ABS and deflated by OBR GVA deflator. GVA in 2021 prices. Number of spin-outs = 402. Additionality ratios from CPC survey of spin-outs.

4.3.3. Using additionality and displacement estimates from the spin-out survey gives a net additional impact of just over £3.5bn or £8.7m per firm. Using supply linkages and income multipliers this increases a total real net GVA of £5.18bn or almost £12.9m per spin-out[40]. These are significant benefits and reflect the availability of data on spin-out turnover from the ONS BSD dataset (on average just under 12 years per spin-out) providing a much more comprehensive coverage of their economic activity over their lifecycle.

4.3.4. Table 4.4 presents the GVA estimates by sector. These are generated in the same way as the total GVA estimate but using ONS BSD sectoral data. Although R&D in Biotechnology and R&D in Natural Science are by far the largest in terms of the number of spin-outs, they do not generate most GVA. The largest sectors are Information, Communications and Software and Consultancy and Design. We cannot investigate the reasons for this in detail due to confidentiality/ disclosure issues. However, a number of factors appear to contribute:

- Spin-outs in these sectors move into the market more quickly than those in R&D where products can take longer to develop and require piloting and testing, so they generate GVA earlier in their lifecycle.
- The benchmark value of aGVA per employee is considerably higher in these sectors (60-100%) higher than their counterparts in R&D. In part this is due to many R&D firms being funded by investment capital in their early years until they are ready to launch their products into market around 8-10 years after incorporation. It is also possible that senior employees do not take a "full" wage at this stage as they are earning shares in the spin-out and expect to gain compensation through the spin-out trade sale or market floatation.

40 A Type 1 multiplier was applied to take into account of indirect (supply chain effects). This was sourced from ONS (2019) UK input-output analytical tables. Online at https://www.ons.gov.uk/economy/nationalaccounts/supplyandusetables/datasets/ukinputoutputanalyticaltablesdetailed

Table 4.4: Estimated real net GVA from ONS BSD data

Sector	Spin-outs	Total Real GVA	Mean per spin-out	Total real net GVA	Net mean per spin-out	Net mean per spin-out incl. multiplier
Agriculture	12	£11,358,130	£946,511	£5,002,120	£416,843	£614,844
Manufacturing pharma	17	£68,936,047	£4,055,062	£30,359,435	£1,785,849	£2,634,125
Manufacturing tech	32	£58,744,419	£1,835,763	£25,871,042	£808,470	£1,192,493
Info & comms software	14	£2,269,914,802	£162,136,772	£999,670,479	£71,405,034	£105,322,432
Consultancy & design	13	£2,244,423,563	£172,647,966	£988,444,137	£76,034,164	£112,150,339
R&D biotechnology	155	£1,684,978,191	£10,870,827	£742,064,395	£4,787,512	£7,061,581
R&D natural science	104	£1,179,872,225	£11,344,925	£519,615,728	£4,996,305	£7,369,551
Other business support	20	£149,509,009	£7,475,450	£65,843,768	£3,292,188	£4,855,978
Other professional,	23	£132,556,755	£5,763,337	£58,377,995	£2,538,174	£3,743,805
Human health	12	£159,194,762	£13,266,230	£70,109,373	£5,842,448	£8,617,610
Total	402	£7,961,138,820	£19,849,097	£3,506,085,536	£8,741,542	£12,893,775

Source: ONS SRS BSD 1997 – 2021 adjusted by CPC calculations of GVA/Turnover ratios from ONS ABS and deflated by OBR GVA deflator. GVA in 2021 prices. Number of BBSRC attributable spin-outs = 402. Additionality ratios from CPC survey of spin-outs.

N.B Table columns may no sum due to rounding.

Table 4.5: Projected ROI

	Total BBSRC real funding per company	Total real net GVA	Real Net GVA per company	Gross ROI	Net ROI adjusted for additionality & displacement	Net ROI as left including multiplier
Company lifetime	£4,100,241	£5,183,297,513	£12,893,775	4.84	2.13	3.14
20 year projection incl. above	£4,100,241	£7,021,711,403	£17,466,944	5.95	2.89	4.26

Source: ONS SRS BSD 1997 – 2021 adjusted by CPC calculations of GVA/Turnover ratios from ONS ANS and deflated by OBR GVA deflator. GVA in 2021 prices. Projection based on trendline forecast based on existing GVA performance except for some 12 spin-outs which had only two years operation which assumed 2% growth. Number of BBSRC attributable spin-outs = 187. Additionality ratios and BBSRC costs from CPC survey of spin-outs.

ROI over company lifetime

4.3.5. ROI calculations involved a number of steps:

- Total BBSRC investment was not available for the 402 spin-out firms so the mean value for each sector from the survey results was used.
- Costs were translated into real terms using an average GVA deflator for the whole period of the grant, assuming that grant expenditure was even over the eligible period. In almost all cases grants were used in the past, real costs (in 2021 prices to match the real GVA calculations) were higher than nominal costs.

4.3.6. Table 4.5 presents an assessment of the ROI over the lifetime of the BBSRC attributable spin-outs. This is based on total 'real terms' BBSRC funding of just over £250m (in 2021 prices) which comprises both the BBSRC initial research grant and any BBSRC follow-on funding (see Table 3.4 for details). The data on BBSRC expenditure was provided by BBSRC for 59 spin-outs who answered the survey. Average real expenditure per spin-out at sector level from the survey was applied to data on the 402 BBSRC attributable spin-outs matched within the ONS BSD to provide an estimate of total BBSRC expenditure on research and translational support. Across the 402 BBSRC-attributable spin-outs BBSRC research funding and translation support is estimated to be a total of £1.648bn. The gross return on BBSRC investment is £4.84 per £1 invested. The net ROI on £1 BBSRC expenditure including multipliers is £3.14.

ROI over 20 year projections

4.3.7. As with the sample economic impact an analysis of the expected impact if the benefit from the IP were to last for (say) the full 20 years of a patent has been undertaken. Based on the survey of BBSRC attributable spin-outs 20 years represents the upper limit of IP protection. The 20 year period was assumed to start at the date the spin-out was incorporated. This may well be a conservative assumption. Discussions with spin-outs suggest that this is not always the case and many in the biotech sector seek to maximise their market protection as long as possible by delaying filing for patents until the last possible stage. A number of steps were necessary to calculate the NPV of each BBSRC attributable spin-out's future GVA over their remaining term of the 20 years:

- The time remaining in their 20 year time period was calculated for each of the 402 ONS BSD matched BBSRC attributable spin-outs (on average this was around 10.6 years). It should be noted that the sample spin-outs were on average younger and so had more time before reaching the 20 year time limit.

- Future GVA is generated using the trendline Forecast function in excel using ONS BSD data on firm GVA performance on earlier years to create a forecast for each of the remaining years of IP protection. The trend results are more varied between spin-outs as they depend on the pattern of GVA earnings, and do not assume a notional increase in spin-out performance in future[41].
- A small number of spinouts had only been trading for one year and in these cases real turnover was inflated by 2% per annum.
- The NPV of the future GVA was calculated using HM Treasury discount rate of 3.5%.

4.3.8. The results are presented in Table 4.5. The gross ROI is £5.95 per £1 expenditure by BBSRC and the net including multiplier is £4.26.

41 This is a conservative assumption across the 402 BBSRC attributable spin-outs. The survey suggests a high proportion of BBSRC attributable spin-outs expect increases to employment on 2021/22 levels over the next two years (see Section 3.6).

5. CONCLUSIONS

BBSRC attributable spin-out characteristics

5.1. BBSRC attributable spin-outs have relatively long lifecycles: the earliest BBSRC attributable spin-out in the database was incorporated 40 years ago. Spin-outs are relatively long-lived. On average BBSRC attributable spin-outs have been in existence for 12 years. Currently active spin-outs (59% of the total) have been operating for more than 13 years on average. Dissolved companies (34%) were in existence for just under 11 years on average.

5.2. More than four in five BBSRC attributable spin-outs are based in England with 13% in Scotland and the remainder in Wales (3%) and Northern Ireland (1%). Assessment of the regional location of matched BBSRC attributable spin-outs and comparison group firms highlights that the spin-outs are much more likely to be located in the East of England and less likely to be in London and the South East. All other regions host proportionately more spin-outs than comparison group firms suggesting that BBSRC attributable spin-outs have a wider distribution than these sectors as a whole.

5.3. While it can take time to get to market, BBSRC attributable spin-outs appear to remain active for longer than the comparison group. Currently active spin-outs (59% of the total) have been operating for more than 13 years on average (12.3 years median).

5.4. For the surveyed spin-outs, the average age of progression to the R&D phase in development was 3.8 years from the spin-out incorporation date. Just over half the spin-outs interviewed were at the pre-product stages . Just one spin-out was at the initial idealisation stage and just under a quarter were at the R&D phase.

5.5. Pre-release of an initial prototype took on average 4.6 years from the registration date however there was a significant variance from 1 year to 11 years. The development of a MVP for market testing took a similar timeframe of 4.8 years, this is because some companies choose to go straight to the MVP stage to test the market before fully developing the product. Some firms have been set up specifically to develop products and so can appear to be moving more rapidly towards the market.

5.6. The majority of BBSRC attributable spin-outs are in two sectors. Thirty eight percent of these spin-outs are in the R&D biotechnology SIC group and a further 26% in the R&D natural science SIC group.

5.7. BBSRC attributable spin-outs offer innovative products that are very often disruptive with few like-for-like competitor products. Moreover, current competitor products are more often sourced from abroad. Two fifths (40%) of survey spin-outs considered there was no competition in the UK. Around a third of these companies considered that worldwide competition was low because other competitors were doing things differently so the market was quite distinct. A small proportion reported that they currently had no competitors worldwide and were operating (or about to) in a unique technical niche.

The role of BBSRC attributable IP in spin-out success

5.8. BBSRC support for research was considered by PIs to have made a significant difference to the formation of the spin-outs. In 35% of cases the support was considered to be 100% additional (that is the spin-out would not have formed without the BBSRC support). In the majority of cases this was linked to BBSRC providing early stage funding (that was not available elsewhere) which directly led to the development of technologies which were fundamental to the formation of the spin-out. In other cases the BBSRC support was vital to attracting investment which led to the development of new IP which underpinned the company.

5.9. There were no examples where the BBSRC support made no difference, and in the other three-fifths of cases the impact was partial. Overall, the additionality of BBSRC support was 64%.

5.10. Just over two thirds of BBSRC attributable spin-outs identified a patent which had been generated in part of in entirely from the BBSRC supported research. IP and patents were found to be crucial to the initial formation of the company and for attracting private investment. However for 57% of companies the original IP also continued to play a role in the company's development.

5.11. In other cases the spin-outs secured other BBSRC funding at a later stage in the process that was used to develop proof of concept rather than the core IP.

5.12. Nineteen percent of BBSRC attributable spin-outs did not yet have any hard IP. All bar one of these companies was at an early stage in development (TRL1-3) and many were hoping to patent their research at a later stage.

5.13. Inevitably, spin-outs noted that the market power of their IP was waning in some cases. For 43% of BBSRC attributable spin-outs the IP was more crucial to the initial formation of the company than its ongoing development and it was evident that as the spin-outs had evolved such that their original IP had become less and less relevant. That said, 36% reported that their IP would sustain its impact on company performance for more than 10 years into the future.

BBSRC attributable spin-out growth challenges

5.14. The primary challenge identified by the BBSRC attributable spin-outs was raising finance. According to data from Beauhurst, supplemented by data from PIs, all except three of the 61 surveyed companies were dependent on raising external funds to support their growth. While there is more of a focus on the relatively costly stages of development, this also seemed to be an issue at earlier stages and two early stage companies (at R&D and idealisation stages) considered there was a gap in support.

5.15. The majority of BBSRC attributable spin-outs were looking to raise more funding in the next two years. Funding required varied considerably from £1.5m (to put an early stage production facility in place) to $75m for a manufacturing tech company to expand operations overseas.

5.16. Recruiting and retaining the right staff was a significant challenge for the majority of BBSRC attributable spin-outs. Many companies were trying to sponsor overseas staff as they considered the UK market was weak. A small number of PIs had decided to contract out either some or in one case all their development work as this was seen to be more cost-effective and removed potential management, staff recruitment and retention issues.

5.17. Recruitment of appropriately skilled staff appears to be an issue in all regions. Companies outside the South East spoke of difficulties attracting the right staff, while those in the South East spoke of competition from other sectors and greater wage pressure.

BBSRC contribution to GVA

5.18. This report has analysed the results of the 61 spin-out interviews to provide an assessment of their contribution to the economy. Overall in 2021/22 the 61 spin-outs employed 1,568 employees with an average per company of 26 employees. In the same year, the 402 BBSRC attributable spin-outs employed over 8,000 people at an average of just under 30 based on data from the ONS BSD. Employment varied significantly by sector. Almost three quarters of the surveyed spin-outs were planning to increase their UK employment numbers in the next two years with 36 of these expecting to recruit an additional 1,013 employees in the next two years.

5.19. Overall 55% of the BBSRC attributable spin-outs in the survey had generated some revenue from sales, licencing or service provision. The average timescale to some form of revenue generation was 2.6 years and revenue was common in the pre-release and MVP stages as well as post product release. In the early stages, however, revenue streams tended to be volatile, for example a one-off sale of an early stage product. Revenue from licencing took an average of 3.5 years from company registration, while revenue from service agreements was the quickest, with a mean time of 1.5 years from company registration.

5.20. Over the company lifetime the mean total revenue per company was £5.01m of which 51% was from overseas sales, servicing or licence agreements and 49% was from UK sales, servicing or licence agreements. These are well above standard start-up exports and an important consideration in the impact arising from the BBSRC attributable spin-outs[42].

5.21. Access to the ONS BSD data on individual BBSRC attributable spin-out and comparison group firm performance over 25 years has meant that much more robust estimates of the economic impact of BBSRC attributable spin-outs have been evidenced. The estimates of impact have taken conservative assumptions but still arrived at a substantial total real net GVA of £5.18bn (or just under £13m per spin-out) over their lifetime to 2021. Almost two-thirds are still operational and will continue to add value. Some of those that have exited will continue to add value through other commercial operations and this

42 BEIS Longitudinal Small Business Survey: SME Employers – UK, 2021, August 2022 reports 18% of SMEs export and for 19% of these exports accounted for more than half total sales.

analysis cannot follow through where the BBSRC-funded IP is now owned by other corporate entities.

5.22. ROI compares BBSRC costs in real terms (2021 prices) against the estimates of GVA impact. Over the lifetime of the BBSRC attributable spin-outs the total ROI on a gross basis is £4.84 per BBSRC £1. The net ROI is £3.14.

5.23. Future projections take into account that the BBSRC attributable IP may make a contribution to firm performance for up to 20 years. The NPV of the remaining years of IP protection in GVA terms were calculated by a trendline forecast of current GVA over their lifetime to date and using HM Treasury discount rate of 3.5%. The 20 year projection gives an estimated total real net GVA impact from 402 BBSRC attributable spin-outs of £7.0bn or £17.5m per company with a gross ROI of £5.95 and a net ROI of £4.26 per BBSRC expenditure of £1.

5.24. There is some variation in performance at sector level which cannot be fully explained. The R&D Biotechnology and R&D natural science sectors are core to BBSRC attributable spin-outs but the measurement of their performance suffers because company turnover in the early development stage of spin-outs is not an accurate measure of economic impact. When comparing an employment cost-based estimate of GVA to that derived from company turnover the latter is consistently lower over the first nine years of the spin-outs lifecycle. This is understandable as during this period such firms draw on investor funds to support employment until they are in a position to launch their product to market.

5.25. Even so the GVA/employment cost benchmarks for these sectors are well below those of the two largest sectors (Information, communications and software and Consultancy) by between 60-100%, so a job in these sectors notionally generates up to twice the GVA of one in an R&D sector. A likely assumption which cannot be proven is that this may reflect staff in the R&D sectors taking lower wages during the development phase but also receiving share options as compensation.

Do BBSRC attributable spin-outs perform better than comparison group firms?

5.26. Numerous statistical tests have been carried out on different performance measures for BBSRC attributable spin-outs and comparison group firms. For the most part these have been inconclusive. However, there is strong statistical evidence of a clear distinction in the CAGR over five and ten years between spin-out companies and their comparison group counterparts with spin-outs growing at a much faster rate (555% cf. 440% over five years and 77% cf. 44% over ten years respectively). The distinction can be seen graphically in Figure 4.2.

5.27. Statistical differences in the performance between BBSRC attributable spin-outs and comparison group firms were not significant across other dimensions, such as sectors. This is likely to be due to (i) similar firm level activities even if they are nominally in different SIC classifications[43] and (ii) significant variation in spin-out turnover over the lifecycle, suggesting that more detailed analysis of spin-outs across different stages of development might reveal greater insight.[44] This might involve careful analysis of different stages of spin-out growth across shorter periods and perhaps focusing on completed spell companies (where firms have come to the end of their lifecycle).

5.28. Accessing ONS SRS BSD data does provide a more robust estimate of spin-out economic impact – the availability of data covering an extended period has added considerably to the evidence base for the estimate of impacts.

43 Firms can nominate up to three SIC codes for their business and detailed analysis of these for the sample firms suggest that there is a high degree of overlap between the sectors depending on which SIC code is chosen.

44 We did not have access to data on the stage of development for each spin-out and how this then changes over the lifecycle to compare with ONS BSD performance data on each firm.

ANNEX A SPIN-OUT CASE STUDIES

Case Study: SOLASTA Bio

Overview of spin-out

SOLASTA Bio was co-founded in May 2020 by Professor Shireen Davies of the University of Glasgow, Professor Julian Dow, Paul Bernasconi and Professor Robert Liskamp. SOLASTA Bio develops environmentally friendly insect control products, which by targeting specific species, preserve the ecosystem by protecting beneficial insects such as bees.

The global insecticides market is currently dominated by synthetic chemicals, accounting for 94% of insect control solutions, with a projected 2022 value of $22 billion. While 75% of food crops are dependent on pollinator insects, other insects cause enormous social, health and economic damage. However, the insecticides market is under increasing pressure from widespread insect resistance, lack of species specificity, increasing regulatory controls and consumer preferences for non-chemical residues. Based on insect neuropeptides, SOLASTA Bio is developing a unique product which provides an alternative to environmentally damaging crop protection agents.

Overview of BBSRC support and how it helped lead to development of spin-out

The focus of Professor Davies' research has been on understanding cell signalling systems in insect models. Between 2004-2016 with Professor Julian Dow, she worked on funded projects with Ag-Tech companies to investigate mechanisms of action which could inform the development of new insecticides.

From March 2017 to March 2020 BBSRC provided a £850,000 responsive mode research grant aimed at further developing this research by providing a functional analysis of insect neuropeptide G protein-coupled receptors (GPCRs). Drugs impacting insect GPCRs have the potential to be new, more selective insect control agents. An aim of the research was to develop new small protein 'mimetics' which act on GPCRs that may be developed towards a new class of insect control agents which do not engender insect resistance, and which do not threaten the environment.

Professor Davies considers that BBSRC support was fundamental to the development of the company, Solasta Bio and stated that 'BBSRC allowed us to fund our own chemistry workstrands and develop cutting edge technology targeting peptides'.

In 2019 the research team submitted a patent application for insect neuropeptide analogues and their use as insect control agents which is currently pending. Without the BBSRC support Professor Davies considers that this application would not have been able to be filed.

SOLASTA Bio was founded in May 2020 following commercialisation support from Scottish Enterprise's High Growth Spin-out Programme which ran alongside a BBSRC Royal Society of Edinburgh Enterprise Fellowship to Professor Davies (2019-2021). The Spin-out programme provided support with technical de-risking and business plan development whilst the fellowship provided direct support and training for commercialisation.

Impact of spin-out and future development

In 2021 the company secured seed funding of £1.3m to further develop its nature-inspired bioinsecticides and aims to bring its first biopesticides to market in 2027, less than half the time traditionally taken by synthetic pest control products. Professor Davies considers that the BBSRC and Scottish Enterprise support was key in attracting seed funding and stated that 'without a well-funded programme it is extremely difficult to develop collaborations and attract industrial interest'.

SOLASTA Bio will expand its operations in Glasgow later this year with a Seed+ funding round. Additionally, the company has its own small peptide synthesis facility on-site which will be scaled up during 2022. The longer-term plan is to also expand operations overseas, including a base in America in 2024.

Case Study: Oxford Nanoimaging

Overview of spin-out

Oxford Nanoimaging (ONI) was founded in 2016 by Professor Achillefs Kapanidis, Jeremy Warren and Bo Jing of the University of Oxford. ONI was founded to commercialise the Nanoimager, a highly miniatured yet extremely powerful high-resolution optical microscope that detects single fluorescent molecules. The small size of the Nanoimager, about 30 times smaller than devices currently available, allows it to be used on regular laboratory benches, including even office desks, allowing this cutting-edge technology to "escape" from laboratories in Physics departments and reach chemists, biologists, and biomedical scientists who are keen to exploit the use of ultrasensitive detection and super- resolution microscopy.

The company employs around 150 people in Oxford and San Diego working in a range of disciplines including software engineering, biology, mathematics, biochemistry and physics. At its Oxford Headquarters ONI designs, manufactures and supports high end desktop microscopes, software and reagents for single-molecule imaging and super-resolution microscopy.

Overview of BBSRC support and how it helped lead to development of spin-out

Professor Kapanidis joined Oxford Physics in 2004 to start a research group using ultrasensitive microscopy to study biological machinery involved in gene expression. In 2012 he was awarded a BBSRC research grant of £120,000 to develop a range of intelligent biosensors for the rapid and sensitive detection of pathogenic microbes and in parallel, further develop a compact and affordable single-molecule fluorescence microscope to perform such tests.

Professor Kapanidis considers that the BBSRC funding was key in allowing the time and resources for the initial development of single-molecule fluorescence microscopes and their software as other sources of funding for 'blue skies' research are scarce. The funding enabled the microscope to be developed more quickly than would otherwise have happened and a patent application for the microscope was licenced by ONI (and was successfully granted).

In May 2016 ONI raised £1.2m in seed funding to further develop the microscope and launch the product to market. In April 2017 ONI raised another £3m followed by a $25m Series A funding round in July 2018.

Impact of spin-out and future development

Since its creation, ONI has raised $109.4 million of investment. ONI is currently in a period of rapid growth and closed a $75m Series B round at the start of 2022, putting its post money valuation between $300-$450m. The company's series B proceeds will help staff commercial and R&D teams in the U.S. and Asia as well as fund the development of new consumables and software programs.

The first two applications are in the space of extracellular vesicles and cell therapy, especially chimeric antigen T-cell (CAR-T) therapy. These data will help biotech and pharma companies create more efficacious and better targeted therapies and identify spatial scales across large complex structures down to single molecules. This ability to put the building blocks of life into large scale context will generate breakthroughs across the life sciences spectrum, including neuroscience, epigenetics, virology, immuno-oncology, drug development, diagnostics and vaccine development.

The company hopes to grow its UK workforce substantially over the next few years as well as expanding its operations in the US and Asia.

Case Study: Newcells Biotech Ltd

Overview of spin-out

Newcells Biotech Ltd was founded in January 2015 by academics from Newcastle University. The company sells induced pluripotent stem cell (iPSC) lines for application in research and development and builds 3D in-vitro models of human organs (retinas, kidneys, lungs, and livers), including those suffering from various conditions, to demonstrate and predict drug outcomes. “Newcells mission is to de-risk the decision-making process in drug development by providing the best in class in-vitro models that most accurately predict in-vivo outcomes.” The company is located in Newcastle-upon-Tyne and currently employs 44 people. Originally renting laboratory space from Newcastle University, it has since moved to the Newcastle Helix science park.

Overview of BBSRC support and how it helped lead to development of spin-out

Newcells originated from Newcastle University, where research began in 2011 to reprogramme iPSCs. iPSCs can be derived from human tissues, can be grown in a laboratory, and can differentiate into almost all cell types found in the adult body. The University received two BBSRC grants in August 2011 and February 2012. The grants were used to create human iPSC lines to optimise cell transplantation into degenerated retinas and to test the mitochondrial function of iPSCs. The spin-out company was formed in 2015 to develop its stem cell products commercially.

The company has since moved on from iPSC reprogramming and currently develops in-vitro kidney, liver, lung and retinal models to test drug outcomes. Newcells has developed two patents for its retinal and lung models. These patents were not directly linked to the original research but the work to get to this stage would not have happened without the initial research grants.

In 2017, Newcells became part of the StemBANCC consortium, a pan-European consortium made up of major pharmaceutical and academe groups, with the aim of generating iPSC lines and making them available to researchers for toxicology testing and disease modelling. The data from the 2011 grant was essential to developing the studies which attracted the StemBANCC funding.

Impact of spin-out and future development

The health benefits from Newcells’ research and technology are significant, improving the ability to generate data on the safety, efficacy, and pharmacology of drugs prior to human trials.

To date, the company has attracted £10 million of non-dilutive and equity funding. Its latest investors included Mercia Asset Management and NorthStar Ventures, who provided over £5 million to support the company’s growth plans by enabling its expansion into the US, fast tracking the commercialisation and launch of its kidney and retina treatment models in North America, and accelerating the development of its models for lung and liver conditions. Due to its rapid expansion in recent years, the company is outgrowing its current facilities and is in the process of setting up additional laboratory space in the US. Newcells’ markets are largely overseas, with bulk of sales being made to EU customers. Most spend is also with EU suppliers, particularly those in Germany.

The company has experienced rapid employment growth. After recruiting its first technician in 2016, employment has grown to 44 today, including 32 PhD level scientists, four managers, six marketing staff and two clerical support workers. The company expects to employ a further six marketing staff and two apprentices by the end of 2022, and has ambitions to grow its workforce to 100 employees by 2025.

Case Study: Kinomica

Overview of spin-out

Kinomica was founded in 2016 by Dr Pedro Cutillas, Dr David Britton and Professor John Gribben at Barts Cancer Institute, Queen Mary University of London (QMUL). Kinomica is a proteomic-data science and diagnostics company specialising in cell signalling. Based on technology developed at QMUL, the company provides computational analysis of biological data – via its KScan® diagnostic platform – to enable accurate predictions of patient responders to drug therapies, identifying which drugs have the greatest chances of being successful, facilitating personalised drug treatments, and improving patient outcomes. KScan® involves measuring the simultaneous activity of kinases within a patient's cells and can predict whether certain kinase-inhibitor drugs will destroy those cells. This technology more than doubles the prediction of drug responders versus genomic, state-of-the-art diagnostic biomarkers and has broad spectrum utility as diagnostics and therapeutic development tools for blood cancers, sold malignancies, inflammatory disease and autoimmune disorders. Kinomica has worked with a number of pharmaceutical companies to explore mode of action, potential causes of resistance and off-target effects and identify patient selection biomarkers to predict responses to their drugs. The company is based in Alderley Park, Macclesfield and currently employs 15 people, the majority of which work in high-skilled research and development roles.

Overview of BBSRC support and how it helped lead to development of spin-out

Dr Pedro Cutillas joined the Barts Cancer Institute (QMUL) in 2013 as Reader in Cell Signalling and Proteomics. Dr Cutillas uses machine learning and other computational methods to investigate how the biochemistry of cancer cells affects their responses to treatment, focusing on a group of drugs named kinase inhibitors. Kinomica was spun out of QMUL in 2016 based on technology which quantified the activity of protein modifying enzymes in cells in a way that isn't possible with traditional genomics approaches. Dr Cutillas developed a computer programme to make sense of biological data and provide readouts of biological activity to predict responses to anti-cancer drugs. Two patents were filed in 2013 and 2015. In 2015, Dr Cutillas was awarded a £496,000 grant from BBSRC to undertake further research which provided the proof of concept for the technology. Dr Cutillas claims that this proof of concept was vital in securing its initial £970,000 million seed funding in July 2019.

Impact of spin-out and future development

To date, the company has been funded by a combination of equity investment, grant funding and revenue from pharmaceutical companies. Following initial seed funding led by Biocity in 2019, Kinomica secured £3.9 million of funding in December 2020, led by BGF and Longwall Venture Partners LLP to finance the rapid up-scale of operations. Kinomica has secured commercial agreements with several blue-chip pharma companies including AstraZeneca and started to generate revenue in 2019. In the year to June 2021, the company achieved revenue of almost £500,000 representing growth of 165% on the previous year, with two-thirds generated from UK clients, and one-third from overseas clients, mainly in the US. The company anticipates strong future growth, with workforce levels expected to double within the next two-to-three years.

Case Study: Evox Therapeutics

Overview of spin-out

Evox Therapeutics was founded in March 2016 by Professor Matthew Wood of Oxford University, and Assistant Professor Samir EL Andaloussi and Dr Per Lundin of the Karolinska Institutet. The company develops protein-, RNA- and DNA-based drug therapies using exosomes – the body's natural vesicular delivery system – to facilitate drug delivery and treat genetic diseases, e.g., by silencing or editing disease-causing genes. "Backed by leading venture capital groups and leveraging a comprehensive dominant intellectual property portfolio, Evox's mission is to positively impact human health by creating novel exosome-based therapeutics for the treatment of rare and severe diseases with limited treatment options for patients and their families." The company, which currently employs 145 people, is located on Oxford Science Park, and has a small research site in Stockholm.

Overview of BBSRC support and how it helped lead to development of spin-out

Professor Matthew Wood's research in exosome biology began in 2007, culminating in 10 patents and a landmark publication in 2011 detailing how exosomes could be developed into a therapeutic drug modality. Many drugs are delivered to the body encapsulated in synthetic particles to prevent the drug from degrading while being transported to cells. This research discovered that naturally occurring exosomes could form the same function, with the advantages of being derived from the human body and already incorporating the intelligent design features that need to be added to the synthetic particles. The research gained significant interest from investors, although questions remained about how easy and efficiently big drugs could be incorporated into natural particles. In 2015, Professor Wood received a £412,000 grant from BBSRC to investigate the ease of incorporating genetic drugs, based on RNA and DNA, into exosomes to treat genetic diseases. The data gained from this research catalysed the investment that led to the creation of spin-out company, Evox Therapeutics.

Impact of spin-out and future development

Since its creation in 2016, Evox Therapeutics has attracted more than £115 million in investment and grant funding, including Series A investment of £10 million in 2016, led by Oxford Sciences Innovation, Series B investment of £35.5 million in 2018, and Series C investment of £69.2 million in 2021, both led by the San Francisco-based Redmile Group. The company has also formed multi-million-dollar partnerships with two pharmaceutical companies, Tekada and Eli Lilly, to develop drug therapies for neurodegenerative diseases and rare diseases, such as Niemann-Pick Type C1.

Evox has developed a comprehensive intellectual property portfolio, including granted and pending patent applications in major pharmaceutical markets, including US, Europe, Japan and China. The company has experienced significant employment growth since its creation, with the number of employees growing from less than 10 in 2016 to 145 in 2022. The majority of employees are highly-skilled scientists.

Evox Therapeutic's drug therapies are currently in R&D stage and are expected to be used in clinical trials in 2023. A priority for the company over the next 18 months is to gear up its UK manufacturing base in preparation for its next stage of growth. Once fully developed and trialled, the company's drug therapies will address the huge gap in treatments for genetic diseases (at present more than 95% of all 8,000 genetic diseases do not have any treatments) and have the potential to be used in the treatment of a wider range of diseases.

Case Study: Chronomics

Overview of spin-out

Chronomics was founded in 2017 by Tom Stubbs, a BBSRC-funded PhD student at the Babraham Institute. Chronomics is a tech-bio company, using biomarkers and biomarker diagnostics – delivered through a digital bio-infrastructure platform – to provide individuals with actionable information to improve their health and wellbeing. Starting with an epigenetic test looking at biological age and being the first company to develop a saliva-based test for COVID-19, Chronomics now partners with a range of large clinical, medical health and wellness companies, radically simplifying and expediting how they integrate biomarker diagnostics at scale, whether it be for use in at-home diagnostics for telehealth or to better-personalise their products. The company is headquartered in London and has subsidiaries globally, including the US, Ireland, Spain, Canada, and Australia.

Overview of BBSRC support and how it helped lead to development of spin-out

The science know-how behind Chronomics' initial technology and vision originated from BBSRC-funded research at Professor Wolf Reik's laboratory at the Babraham Institute, Cambridge. Professor Reik was awarded two BBSRC grants in April 2017, funding research into epigenetic states that operate during ageing. During this time, BBSRC-funded PhD student, Tom Stubbs, applied to work at the laboratory. Tom studied the DNA methylation ageing clock in a mouse, showing how both chronological age and biological age can increase risk of diseases. This led to a patent for a novel method for calculating the age of a biological sample obtained from a mouse and a kit comprising biosensors capable of detecting ageing biomarkers. In addition, he studied the inter-relationship of ageing clocks and reprogramming. This led to a patent for novel methods of reprogramming somatic cells which have a reduced DNA methylation age or epigenetic age while retaining their lineage identity. Using the knowledge gained during his PhD, Tom founded Chronomics later that year. Both patents have also been retained by the Babraham Institute and are responsible for further commercial initiatives.

Impact of spin-out and future development

Chronomics initially developed a handful of novel biomarkers that could be used for a range of purposes, from human and animal health to lifestyle decision-making, and produced a series of testing kits, the flagship product being the epigenetic test to measure biological age. The company received initial funding from California-based venture capitalist, SOSV, and just one year after launching, raised £1.12 million seed funding, led by London based VC Anthemis Exponential Ventures. During the pandemic, Chronomics expanded to include Europe's first saliva test for COVID-19 and entered into partnerships with airlines and travel companies, while developing its bio-infrastructure platform. The company has since grown rapidly, employing 130 permanent staff and 50 temporary staff today in a range of scientific, product engineering, sales, support and customer experience roles. Employment is expected to double annually. Chronomics has expanded operations across three continents, with hubs in the US and Europe. Revenue is outpacing projections this year with potential for further significant growth over the next few years: the global biomarker market is expected to reach $150 billion by 2028, with Chronomics unlocking additional opportunities like the $1.5 trillion Health and Wellness market.

Case Study: C4X Discovery

Overview of spin-out

C4X Discovery (C4XD) aims to become the world's most productive drug discovery and development company by exploiting cutting-edge technologies to design and create best-in-class drug candidates. The company has the only technology in the world that can generate accurate, experimentally-derived dynamic solution 3D structures of drug molecules in a matter of days, independently of techniques such as X-ray crystallography and computational chemistry. Through its enhanced DNA-based target identification and candidate molecule design capabilities, the company generates small molecule drug candidates across multiple disease areas that can be easily delivered to the affected area of a patient's body, particularly in areas where there is high unmet medical need, including inflammation, oncology, neurodegeneration and addictive disorders. Its portfolio ranges from early-stage novel target opportunities to late-stage drug discovery programmes ready for out-licensing to partners. The company is headquartered in Manchester, has 50 employees and a highly experienced management team, including CEO, Clive Dix, who was appointed Deputy Chair of the UK's Vaccine Taskforce in June 2020 to help lead efforts to find and manufacture a Covid-19 vaccine.

Overview of BBSRC support and how it helped lead to development of spin-out

C4X Discovery was founded by Dr Andrew Almond and Dr Charles Blundell in 2007 following research conducted during a BBSRC David Phillips Fellowship at the University of Manchester between 2005 and 2007. Its underpinning technologies and prototypes were also developed during projects funded by BBSRC follow-on funds from late-2007. This research looked at the 3D shape of drug molecules and how they interacted with receptors as an alternative way to perform drug discovery, leading to the filing of a patent in 2008 covering a method for determining the 3D structures of molecules. This patent was subsequently transferred to C4XD. The technology developed by BBSRC-funded research continues to underpin the company's activity today and is expected to continue to underpin its activity for the lifetime of the patent (up to 2028).

Impact of spin-out and future development

Since its creation, C4XD has raised $6.7 million of investment over two funding rounds and successfully floated on the London Stock Exchange in 2014. The company was initially valued at £31 million, rising to a current value of £63 million in July 2022. Over the past five years, C4XD has generated almost £13 million of revenue, mainly from licensing deals. In 2018, the company signed a $10 million licensing deal with FTSE 250-listed pharmaceutical company, Indivior, for its addiction behaviour suppressant, C4X_3256, with a further $284 million in potential development milestones. This is currently progressing through Phase I clinical trials. And in 2021, C4XD signed an exclusive worldwide licensing agreement with French healthcare company, Sanofi, for its IL-17A oral inhibitor programme to treat autoimmune diseases, with a €7 million upfront payment and €407 million in potential development, regulatory and commercialisation milestones. Its first milestone payment (€3 million) was received in July 2022, after progressing pre-clinical trials. The company is now in advanced commercial discussions with multiple partners for its NRF2 activator programme for inflammatory diseases with pre-candidate nomination, preliminary safety and efficacy studies completed, and has expanded its portfolio with six new early phase programmes to build scale for future out-licensing deals. The market value of C4XD's key therapeutic areas was estimated at $83.7 billion in 2020, rising to $89.3 billion by 2025.

Case Study: Amphista Therapeutics

Overview of spin-out

Amphista Therapeutics was founded in December 2017 by Professor Alessio Ciulli of the University of Dundee and Advent Life Sciences. Amphista is a biopharmaceutical company, leading in the discovery and development of next generation targeted protein degradation (TPD) therapeutics. Unlike therapies that transiently inhibit a single function of a protein associated with disease, TPD medicines are engineered to destroy and remove disease-causing proteins. Amphista has identified novel approaches to molecular design that overcome the challenges and limitations of first generation TPD therapeutics. The company's pipeline of novel TPD based medicines is focused on challenging diseases in, but not limited to, oncology and immunology, and will expand to include central nervous system disorders. Its therapeutics offer the potential to improve quality of life, either with more effective treatments or by accessing disease targets for which there are currently no treatment options. The company currently employs 50 people at BioCity Glasgow and, more recently, Granta Park, Cambridge.

Overview of BBSRC support and how it helped lead to development of spin-out

Professor Ciulli's independent research career began in January 2010 with a BBSRC David Philipps fellowship at the University of Cambridge. He was also awarded two BBSRC research grants in 2010 and 2011, totalling £641,000, to investigate how small molecules could target protein-protein interactions and degrade disease-causing proteins. He moved his laboratory to the University of Dundee in 2013. This research led to some significant breakthroughs, particularly those evidenced in his ground-breaking 2015 paper, 'Selective Small Molecule Induced Degradation of the BET Bromodomain Protein BRD4'. Following further discoveries, three successful patent applications, and the publication of his 2017 Crystal Structure paper, Professor Ciulli founded Amphista Therapeutics. According to Professor Ciulli and the company's CEO, Nicki Thompson, the BBSRC-funded research was vital to making these discoveries and for attracting the seed funding from Advent Life Sciences that enabled the company's formation.

Impact of spin-out and future development

Since its creation, Amphista Therapeutics has attracted $60.5 million (£45 million) of investment: $7.5m Series A funding, led by Advent Life Sciences, in April 2020, and $53m Series B funding, co-led by co-led by Forbion and Gilde Healthcare, in March 2021. The Series B investment was oversubscribed, catalysed the company's expansion into Cambridge, and was awarded 'Financing Deal of the Year' award at the Scrip Awards 2021. The company hopes to secure a further £60 million of Series C investment in the near future.

This year, the company has also partnered with Bristol Myers Squibb and Merck Healthcare to develop its targeted protein degraders. These partnerships involve upfront investment of $74 million (£60 million), with a potential deal value of approximately $2.4 billion in milestone payments. The company is developing an impressive intellectual property portfolio, with 21 patent applications currently pending across 10 distinct patent families, and at least a further three patent applications to be filed this year. Employment growth has also been strong, from five employees in 2019, to 50 today and approximately 80 employees by the end of 2022. Employment is highly-skilled, with most employed in scientific research and drug discovery. The company hopes to grow its workforce to 100-120 over the next two years, and is exploring the potential for expansion into the US.

ANNEX B SPIN-OUT TELEPHONE SURVEY

Spin-out Questionnaire

Cambridge Policy Consultants has been asked by the Biotechnology and Biological Sciences Research Council (BBSRC) to undertake research on the economic and social impact of spin-outs that have arisen as a result of past support from BBSRC.

BBSRC collects information about its research funding in UK universities using an online system called ResearchFish. The system allows its university partners to log a range of outputs from their research for at least five years after the end date of their award. This includes any spin-out companies that have arisen following support from BBSRC.

This company was identified on ResearchFish as having arisen following BBSRC support and we would like to ask you to complete the following questions to help us measure its economic and social impact in order to help demonstrate the value that BBSRC funding can add to our economy and society.

All responses are anonymous and no individual company will be identified in the research.

Questions for active companies

Before interview (look up names of research grants and dates in Researchfish spreadsheet)

A) Background to company	
1. Please can you describe the formation and initial trajectory of the business? a. When did the original research grant start/end? b. When was the business legally formed? c. Did the business locate in an incubator and over what period? d. Did the business file for a patent or other IP, if so when? e. When was the patent granted? f. How long will the IP last for?	*Contextual question – information from secondary data and check timeline with respondent*
2. What was the impact of the BBSRC research grant on this timeline? a) to what extent did this research support impact on the ability to successfully file for a patent or other IP b) to what extent did it impact on your ability to attract further funding?	*Assessment of impact of support*
(ask if 1c = yes) 3. What was the impact of the BBSRC incubation support on this timeline? PROBE for impacts e.g., flexibility/cost of lease, on collaborations with incumbent businesses, professional support, reputation/image benefits, locational benefits, mentoring etc	*Assessment of impact of support*
4. Which of the following most closely describes your company's current business model? a. Directly developing and commercialising technology b. Developing technology which is commercialised and developed in collaboration with other organisation(s) c. Consultancy service to support customers in the adoption of your technology d. Consultancy service not related to your technology e. Other (please specify)	*Contextual question*

5. To what extent is this technology or service related based on the IP generated from the original BBSRC supported research? a. Not at all b. A little c. A great deal d. Wholly	*Assessment of impact of support*
6. How long do you believe the original IP will continue to underpin your company's performance?	*Contextual question*
7. What are the main technologies or services being developed/provided by this company? (detail)	*Contextual question*
8. What stage are they at in development? (code as below) a. Ideation b. R&D c. Pre-release d. MVP/Proof of Concept e. Initial release f. Progressive roll out g. General availability	*Contextual question*
B) Revenue & purchasing	
9. In what year did your company first start generating any revenue? How has the revenue changed over time? In the year from April 2019 to March 2020 what was your company's total revenue? How has revenue changed since this year?	*Ask in case unable to source from BSD*
10. What were the main revenue sources? a. Product sales b. Software licencing c. Technology licencing d. Other (please specify)	*Key Q for Economic Impact Assessment (EIA), not available in BSD*
11. Approximately what proportion of this revenue was generated from a) sales in the UK b) sales overseas c) licencing d) other? How has this balance changed over time?	*Key Q for EIA, not available in BSD*
12. In the year from April 2019 to March 2020 how much did your company spend on purchases from a) UK suppliers b) overseas suppliers? How has spend on purchases changed since company formation?	*Key Q for EIA, not available in BSD*
C) Employment & wage costs	
13. When did your company first recruit employees? How has employment changed since company inception?	*Ask in case unable to source from BSD*
14. In the year from April 2019 to March 2020 on average how many people did your company employ? (if some were part time please enter total full time equivalent jobs) How has employment changed since this year?	*Ask in case unable to source from BSD*

15. In what occupational areas do your employees work in? (enter number of employees in each category) a. Managers b. Professionals c. Technicians and associate professionals d. Clerical support workers e. Service and sales workers f. Crafts and related trades workers g. Plant and machine operators and assemblers h. Other	*Key Q for EIA, not available in BSD (can be used to estimate wage costs)*
16. In the year from April 2019 to March 2020 what were the total wage costs for these employees? How have wage costs changed over time?	*Ask in case unable to source from BSD*
D) Competition	
17. Which of the following best describes your company's current competition? a. A crowded market with many competitors in the UK and overseas b. Some competition in the UK and overseas c. A handful of competitors overseas only d. There is no competition	*Key Q for EIA, not available in BSD*
E) Questions for companies who are no longer trading	
18. When did the company cease trading? What were the reasons for ceasing trading?	*Key Q for EIA, not available in BSD*
19. Do you consider there to be any future potential for the IP or technologies developed?	*Key Q for EIA, not available in BSD*
F) Questions for companies who were acquired	
20. When did the acquisition take place? Which company purchased your company? Where are they head quartered?	*Key Q for EIA*
21. What was the total acquisition value?	*Key Q for EIA*
22. At the time of the acquisition roughly what proportion of total equity in your company was owned by a) Overseas VCs and other overseas investors b) UK based investors	*Key Q for EIA, not available in BSD*
23. How has UK based employment in the company changed since acquisition? Are you aware of any future plans to grow or reduce the UK employment base?	*Key Q for EIA, not available in BSD*
E) Other questions not key to EIA (ask all if have time)	
Market potential & Future development plans 24. In the next two years are you planning to raise any finance? 25. In the next two years is the company planning to employ any additional staff? If so, how many? 26. What is the size of your addressable market? (enter £) 27. What are the major challenges to scaling the business? a. Competition	*Of interest but not used in EIA calculation*

b. Consumer acquisition & sales c. Regulation d. Internationalisation e. Improving processes and internal operations f. Manufacturing challenges g. Attracting and retaining talent h. Product development & innovation i. Cash flow and liquidity management j. Other (please specify)	
Skills & recruitment 28. What types of training do you provide for your staff? Approximately what do you spend on training each year? 29. Do you experience any issues in attracting/retaining talent? a. Lack of appropriate skills of applicants b. Too high salary demands of applicants c. Applicants decide to work for bigger/established companies d. Locational issues – unattractive city region e. Other (please specify)	

ANNEX C TECHNICAL ANNEX

Distribution of BBSRC attributable spin-outs across sectors

The majority of BBSRC attributable spin-outs (71%) are, not surprisingly, in the professional, scientific and technical activity SIC group. Manufacturing represents the other significant cluster of spin-outs (Table C1).

Table C1: BBSRC attributable spin-outs by SIC Groups

Sector	Frequency	%
A - Agriculture, forestry and fishing	2	0.4%
C - Manufacturing	62	13.6%
E - Water supply, sewerage, waste management and remediation activities	3	0.7%
F - Construction	1	0.2%
G - Wholesale and retail trade / repair of motor vehicles and motorcycles	1	0.2%
I - Accommodation and food service activities	1	0.2%
J - Information and communication	18	3.9%
K - Financial and insurance activities	1	0.2%
L - Real estate activities	1	0.2%
M - Professional, scientific and technical activities	324	70.9%
N - Administrative and support service activities	26	5.7%
Q - Human health and social work activities	9	2.0%
S - Other service activities	3	0.7%
U - Activities of extraterritorial organisations and bodies	5	1.1%
Total	457	100.0%

Source: Beauhurst data matched to BBSRC spin-out database.

A more detailed analysis at the lowest level 4/5 digit SIC code classes and subclasses reinforces the highly skewed distribution. Just two SIC subclasses contain almost 62% of the spin-outs and four contain 73% of the total. We therefore needed to combine SIC classes and subclasses in order to:

- provide sufficient observations so that we can use the resultant economic impact data analysis[45].
- ensure that these groupings are economically appropriate such that similar activities are included together. Diverse groups will not be as robust in providing benchmark values.

The detailed SIC classes and subclasses are presented in the following table with the combinations summarised in the subsequent table.

45 The actual number of spin-outs in each group will need to be greater than 10 as the matching to ONS BSD data will not be perfect – previous published studies suggest that the match rate could be between 80-95%. So if we need a category with at least 10 observations after matching this implies at least 13 observations in each group to be matched.

Table C2: BBSRC attributable spin-outs by SIC

	SIC Description	Code	Nº	%
Agriculture, agrochemical manufacturing and environment	Growing of cereals (except rice), leguminous crops and oil seeds	1110	1	0.2%
	Support activities for crop production	1610	1	0.2%
	Processing and preserving of fruit and vegetables n.e.c.	10390	1	0.2%
	Butter and cheese production	10512	1	0.2%
	Manufacture of prepared feeds for farm animals	10910	1	0.2%
	Finishing of textiles	13300	1	0.2%
	Manufacture of other organic basic chemicals	20140	2	0.4%
	Manufacture of pesticides and other agrochemical products	20200	2	0.4%
	Manufacture of perfumes and toilet preparations	20420	1	0.2%
	Water collection, treatment and supply	36000	1	0.2%
	Sewerage	37000	1	0.2%
	Remediation activities and other waste management services	39000	1	0.2%
	Construction of water projects	42910	1	0.2%
Manufacturing of pharmaceuticals	Manufacture of other chemical products n.e.c.	20590	7	1.5%
	Manufacture of basic pharmaceutical products	21100	10	2.2%
	Manufacture of pharmaceutical preparations	21200	3	0.7%
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	Manufacture of electronic components	26110	1	0.2%
	Manufacture of consumer electronics	26400	1	0.2%
	Manufacture of electronic instruments and appliances for measuring, testing, and navigation, except industrial process control equipment	26511	11	2.4%
	Manufacture of electronic industrial process control equipment	26512	3	0.7%
	Manufacture of optical precision instruments	26701	3	0.7%
	Manufacture of other electrical equipment	27900	2	0.4%
	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	28110	1	0.2%
	Manufacture of plastics and rubber machinery	28960	1	0.2%
	Manufacture of other special-purpose machinery n.e.c.	28990	1	0.2%
	Manufacture of medical and dental instruments and supplies	32500	5	1.1%
	Other manufacturing n.e.c.	32990	4	0.9%

	SIC Description	Code	Nº	%
Info & Comms, software	Other software publishing	58290	2	0.4%
	Business and domestic software development	62012	6	1.3%
	Computer consultancy activities	62020	5	1.1%
	Other information technology and computer service activities	62090	3	0.7%
	Data processing, hosting and related activities	63110	2	0.4%
Consultancy & engineering design	Activities of head offices	70100	3	0.7%
	Management consultancy activities other than financial management	70229	3	0.7%
	Engineering design activities for industrial process and production	71121	2	0.4%
	Technical testing and analysis	71200	4	0.9%
	Activities of venture and development capital companies	64303	1	0.2%
	Management of real estate on a fee or contract basis	68320	1	0.2%
Research and experimental development on biotechnology	Research and experimental development on biotechnology	72110	171	37.4%
Research and experimental development on natural science	Other research and experimental development on natural sciences and engineering	72190	111	24.3%
	Research and experimental development on social sciences and humanities	72200	4	0.9%
Other professional, scientific and technical activities n.e.c.	Other professional, scientific and technical activities n.e.c.	74909	26	5.7%
Other business support service activities n.e.c.	Other business support service activities n.e.c.	82990	26	5.7%
Human health activities & personal service activities	Specialists medical practice activities	86220	1	0.2%
	Other human health activities	86900	8	1.8%
	Other personal service activities n.e.c.	96090	3	0.7%
Not classified	Activities of extraterritorial organisations and bodies	99999	5	1.1%
	Other retail sale not in stores, stalls or markets	47990	1	0.2%
	Other accommodation	55900	1	0.2%
Total			457	100%

Source: Beauhurst data matched to BBSRC spin-out database.

There are individual SIC classes and subclasses that do not fit. Firstly, five companies who all undertake their activities abroad and will not contribute directly to economic impacts in the UK. Secondly, one company in the retail sector and another in the 'other accommodation' sector. This leaves 450 BBSRC attributable spin-outs that are available to match to restricted data from ONS BSD and each group should retain sufficient observations to be disclosed.

Table C3: BBSRC attributable spin-outs allocated to SIC groups for matching to ONS SRS BSD

SIC Group	Frequency	%
Agriculture, agrochemical manufacturing & environment	15	3.3%
Manufacturing of pharmaceuticals	20	4.4%
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	33	7.3%
Information & communications, software	18	4.0%
Consultancy & engineering design	14	3.1%
Research and experimental development on biotechnology	171	38.0%
Research and experimental development on natural science	115	25.6%
Other professional, scientific and technical activities n.e.c.	26	5.8%
Other business support service activities n.e.c.	26	5.8%
Human health activities & personal service activities	12	2.7%
Total	450	100%

Source: Beauhurst data matched to BBSRC spin-out database.

Profile of BBSRC attributable spin-outs surveyed

Interviews were undertaken with PIs and other representatives from 61 of the 450 BBSRC attributable spin-outs. We tried to ensure representation across the sub-sectors however companies in the R&D biotech and manufacturing of electronics were over-represented and those in the R&D natural science and other business support were under-represented.

Table C4: Profile of BBSRC attributable spin-outs surveyed

	BBSRC spin-outs		Sample	
	Count	%	Count	%
Agriculture, agrochemical manufacturing & environment	15	3%	3	5%
Manufacturing of pharmaceuticals	20	4%	3	5%
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	33	7%	9	15%
Information & communications, software	18	4%	2	3%
Consultancy & engineering design	14	3%	1	2%
Research and experimental development on biotechnology	171	38%	36	59%
Research and experimental development on natural science	115	26%	2	3%
Other professional, scientific and technical activities n.e.c.	26	6%	3	5%
Other business support service activities n.e.c.	26	6%	0	0%
Human health activities & personal service activities	12	3%	2	3%
Total	450	100%	61	100%

Source: BBSRC spin-out database.

Selection of comparison sample

We used data on firms from Beauhurst database to generate a non-spin-out sample of firms who operate in the same SICs as the population of BBSRC attributable spin-outs. This was primarily because Beauhurst is one of the few datasets with a comprehensive analysis of UK spin-outs (and so we could exclude these from the comparison group).

We considered whether it would make sense to attempt a pair-wise match between individual spin-outs in the BBSRC population and the non-spin-out firms identified by Beauhurst. This approach was rejected because of the challenges in ensuring that any match was as far as possible a like-for-like comparison. For example, neither dataset (spin-out or non-spin-out) contained information on firm ownership structure etc. Previous research has highlighted that to get as close as possible to a directly comparable pairwise match, some consideration of firms' management approach and strategic business objectives etc also need to be as similar as possible.

So we adopted a stepped approach to creating a non-spin-out comparison group:

- Total number of firms in the Beauhurst database by the 46 4 and 5 digit SIC codes in which BBSRC attributable spin-outs operate were identified across the ten SIC groupings.
- Firms in each of the 10 SIC groups were restricted by earliest and latest incorporation dates that match those of the BBSRC attributable spin-out firms in that SIC group. So that each group draws on firms started within the same timeframe. This produced a total of 1.3m non-spin-out firms.
- To have information on Companies House status and other data on the non-spin-out firms (latest report and accounts etc) we further restricted this group to those actively being 'tracked' by Beauhurst. This provided just over 21,500 non-spin-out firms.
- A total of 450 non-spin-out firms were randomly selected from this group to match the number of BBSRC attributable spin-outs in each 4 or 5 digit SIC sector. So, for example 171 non-spin-out firms were selected in SIC 72110 Research and Experimental development on biotechnology to compare with the 171 BBSRC attributable spin-outs in this sector.

Table C5 shows that the BBSRC attributable spin-outs and comparison group were matched very closely. Originally, 453 BBSRC attributable spin-out and 450 comparison group companies were uploaded to the SRS confidential data server.

Table C5: Sectoral profile

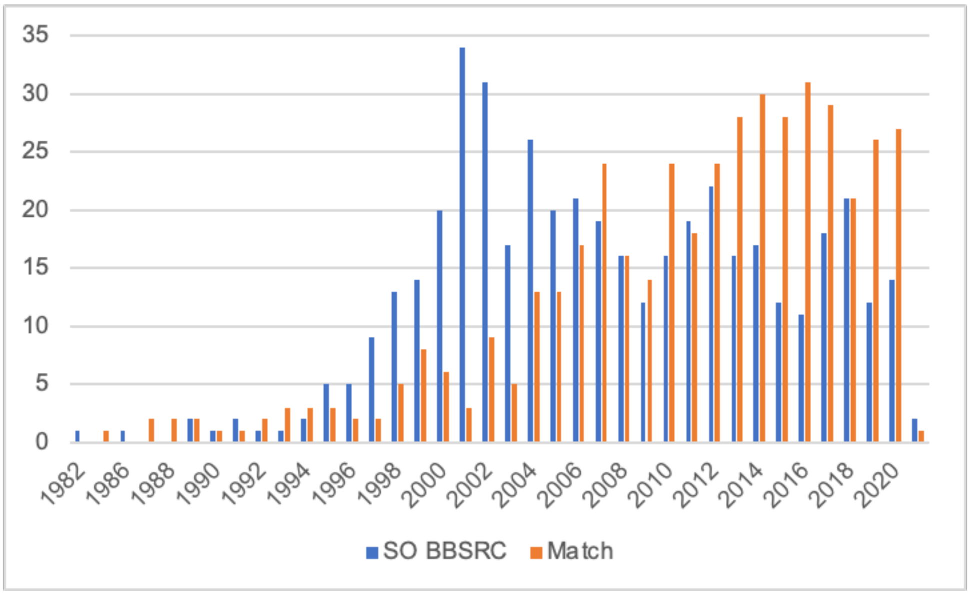
	BBSRC spin-outs		Comparison firms	
	Count	**%**	**Count**	**%**
Agriculture, agrochemical manufacturing & environment	15	3.3%	15	3.4%
Manufacturing of pharmaceuticals	21	4.6%	20	4.5%
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	33	7.3%	33	7.4%
Information & communications, software	18	4.0%	18	4.1%
Consultancy & engineering design	14	3.1%	14	3.2%
Research and experimental development on biotechnology	173	38.2%	166	37.4%
Research and experimental development on natural science	115	25.4%	114	25.7%
Other professional, scientific and technical activities n.e.c.	26	5.7%	26	5.9%
Other business support service activities n.e.c.	26	5.7%	26	5.9%
Human health activities & personal service activities	12	2.6%	12	2.7%
Total	453	100%	444	100%

Source: Beauhurst data matched to BBSRC spin-out database.

The number of firms in the comparison group was reduced when after the ONS matching process identified that six comparison group firms were also included in the BBSRC spin-out population. This was not apparent prior to uploading the file and appears to have been the result of a small number of firms that do not have a university shareholding (a key criteria in the Beauhurst definition of a spin-out). Given the timescales in securing ONS SRS approval for another data upload it was decided that these companies should be removed from the comparison group so that the spin-out sample was preserved, increasing the chances that the results of the match would meet ONS data disclosure thresholds.

Comparing the incorporation date of BBSRC attributable spin-outs to the comparison group of firms although the spread of dates is similar proportionately more comparison group firms are younger (Figure C1). As a result the mean duration of spin-outs is 12 years compared to just over 8 for the comparison group.

Figure C1: Incorporation date of BBSRC attributable spin-outs compared to matched comparison group firms



Source: Beauhurst data matched to BBSRC spin-out database.

Table C6: Time since company incorporation, years

	BBSRC spin-outs		Comparison firms	
	St. dev	Median	St. dev	Median
Agriculture, agrochemical manufacturing & environment	5.31	6.47	5.29	3.14
Manufacturing of pharmaceuticals	8.17	10.34	5.90	6.20
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	6.44	12.45	7.13	7.84
Information & communications, software	6.10	11.62	5.46	5.55
Consultancy & engineering design	8.28	18.24	7.86	7.18
Research and experimental development on biotechnology	7.02	11.95	5.69	4.73
Research and experimental development on natural science	6.66	12.78	7.61	6.74
Other professional, scientific and technical activities n.e.c.	7.87	13.31	6.99	6.32
Other business support service activities n.e.c.	7.84	13.06	7.90	5.45
Human health activities & personal service activities	4.99	14.55	3.90	5.04
Total	6.99	12.66	6.70	5.70

Source: Beauhurst data matched to BBSRC spin-out database.

Table C7: Proportion of companies which are currently active*

	BBSRC spin-outs % active	Comparison firms % active
Agriculture, agrochemical manufacturing & environment	67%	7%
Manufacturing of pharmaceuticals	56%	50%
Manufacturing of computer, electronic and optical products/ electrical equipment/ machinery & equipment	54%	42%
Information & communications, software	63%	39%
Consultancy & engineering design	62%	43%
Research and experimental development on biotechnology	68%	37%
Research and experimental development on natural science	36%	27%
Other professional, scientific and technical activities n.e.c.	57%	35%
Other business support service activities n.e.c.	46%	8%
Human health activities & personal service activities	30%	42%
Total	54%	33%

Source: Beauhurst data matched to BBSRC spin-out database.
*Active excludes those that are dissolved, dormant or liquidated.

ANNEX D ACRONYMS

aGVA	Approximate Gross Value Added
ABS	Annual Business Survey
BBSRC	Biotechnology and Biological Sciences Research Council
B2B	Business to Business
B2C	Business to Consumer
BSD	Business Structure Database
CAGR	Compound Annual Growth Rate
CPC	Cambridge Policy Consultants
CRO	Contract Research Organisation
EIA	Economic Impact Assessment
EPSRC	Engineering and Physical Sciences Research Council
ESRC	Economic and Social Research Council
GDP	Gross Domestic Product
GVA	Gross Value Added
IP	Intellectual Property
MRC	Medical Research Council
MVP	Minimum Viable Product
NERC	Natural Environment Research Council
NPV	Net Present Value
OBR	Office for Budget Responsibility
ONS	Office for National Statistics
PI	Principal Investigator
R&D	Research and Development
ROI	Return on Investment
SIC	Standard Industrial Classification
TRL	Technology Readiness Level
UKRI	UK Research and Innovation
VC	Venture Capital