The Impact of UK Development Aid Research Spending

Briefing Note

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About the Author

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Executive Summary

The new Government has three central priorities: securing a new role for the world for Britain in the wake of Brexit, designing a forward looking Industrial Strategy and ensuring social justice. The £2.5 billion in development research spending announced in the Government's new aid strategy looks to do all three: continuing Britain's role as world leader in development, catalysing investment in new industries or technologies, and making a serious contribution to addressing global challenges like antimicrobial resistance or food shortages.

Over the next few months, Policy Exchange will be conducting a programme of work to investigate how development spending on R&D can support both the global and national interest, helping address the world's most pressing problems and supporting Britain's new Industrial Strategy.

In this briefing note, we give an overview of the current evidence on the impact of development spending in R&D, with a particular focus on life sciences, the jewel in the crown of the UK economy. In general, public investments in R&D can deliver a social rate of return of 20%, while the health spending element in the new funding could conceivably save in the order of two million lives through developing new vaccines and treatments.

The global health impact of development aid research spending

- Britain is a world leader in science and research. Today, Britain spends over £7 billion a year supporting medical research and development, has three of the top five universities for medicine in the world, two of the top four medical journals in the Lancet and BMJ, and the world's most cited interdisciplinary science journal in Nature. We have the second highest number of Nobel prizes in Physiology or Medicine, and receive 13% of all citations in life science.
- Britain is also widely recognised as a global leader in international development, praised for the quality, quantity and the range of its giving. We are the only G7 country to hit the UN target of 0.7% of GNI and the Government has announced an additional £2.5 billion for research and development, with a particular focus on health, as part of its new Aid Strategy.

The political context

- The new Prime Minister Theresa May has argued that after leaving the EU the UK will "forge a bold new positive role for ourselves in the world." Maintaining its current leading role in development is essential if the UK is to reassure the world that it remains an open, global economy. The UK is second only to the US in global soft power, with its work on aid an important part of this.
- The new Government has chosen to make a forward looking Industrial Strategy one of its central priorities, building on the work initiated by the Coalition, which identified life sciences as a key sector for Britain's future. In total, Britain currently has 5,633 health life sciences companies in biopharmaceuticals, medical technology, digital health and genomics, generating £60.7 billion in turnover and employing 220,000 people.

"Britain currently has 5,633 health life sciences companies in biopharmaceuticals, medical technology, digital health and genomics, generating £60.7 billion in turnover and employing 220,000 people"

The challenge and opportunity

- Global health pandemics are expected to cause $60 billion a year in economic loss without further global investment, while antimicrobial resistance could cost 10 million lives a year by 2050 and $100 trillion in lost economic output. However, health research is chronically underfunded, especially for diseases that principally affect the developing world. Globally only around $3 billion a year is spent on R&D targeted at infectious diseases concentrated in low and middle income countries, or just 1–2% of total R&D.
- Despite recent improvements, many believe that the commercial strength of the life sciences industry lags behind Britain'sacademic and non-commercial record. At present, the UK pharmaceuticals industry is responsible for around 6% of citations, 3.7% of patents and 6.3% of exports, a ratio of exports to citation share of 1.05 times, compared to the 6.3 ratio enjoyed by Switzerland, the international leader on this measure.
- The next decade or so will provide significant opportunities for Britain to grow its life sciences sector, taking advantage of new technologies, the NHS's unique advantages in data and the ability to strike a better balance between risk and innovation after leaving the EU.

The Global Health Impact of R&D Aid

Britain's scientific legacy

- Britain has long been a world leader in science and research, and particularly so in medical research and the life sciences. From Darwin to the discovery of DNA, many of the most fundamental advances have involved British scientists. Edward Jenner, pioneered vaccination for smallpox, which is said to have "saved more lives than the work of any other human", while the discovery of penicillin by Alexander Fleming has been described as the medicine with the "greatest impact on therapeutic outcomes."[1] The top three of the leading 100 medical scientists ranked by their mention in encyclopaedias, histories and surveys up to 1950, and a third in total, come from England or Scotland.[2]

- Today, Britain spends over £7 billion a year supporting medical research and development, with around half of this coming from the private sector and just over a third from the Government.[3] Private charity also plays a significant role, with medical research consistently the most popular target of charitable donations at 16% of the total given in 2015.

- On most measures of impact, Britain is second only to the US. With Oxford, Cambridge and Imperial College it has three of the top five universities for medicine in the world, two of the top four medical journals in the Lancet and BMJ and the world's most cited interdisciplinary science journal in Nature. Britain has the second highest number of Nobel prizes in Physiology or Medicine,[4] and the UK receives 13% of life science citations and 19% of the top 1% of citations.[5] Out of the G7, the UK is ranked top for citation impact in pre-clinical sciences, clinical medicine, infection and immunology, and second in epidemiology and public health and health services research.[6]

The impact of medical aid

- Both in Britain and globally, life expectancy has more than doubled since the mid nineteenth century.[7] Improvements in health are estimated to be equivalent in value to 30% of British growth between 1780 and 1979, 1.15% a year.[8] While broad economic growth and improved public sanitation have played a big part in improved health, advances in medical science have also played a significant role. In the 1870s, around 28% of deaths came from infectious diseases like smallpox, measles and scarlet fever.[9] While it is difficult

1 Penicillin: the medicine with the greatest impact on therapeutic outcomes, N. Kardos & AL Demain, Applied Microbiology and Biotechnology, 2011

2 Human Accomplishment: The Pursuit of Excellence in the Arts and Sciences, 800 B.C. to 1950, Charles Murray, 2003

3 Life Science Competitiveness Indicators, BIS, 2016

4 The UK's Contribution to Health Globally, Nadeem Hasan, Sarah Curran et al., All-Party Parliamentary Group on Global Health, 2015

5 Life Science Competitiveness Indicators, BIS, 2016

6 The UK's Contribution to Health Globally, Nadeem Hasan, Sarah Curran et al., All-Party Parliamentary Group on Global Health, 2015

7 Life Expectancy, Max Roser, Our World in Data, 2016

8 Global health 2035: a world converging within a generation, Jamison, Summers et al, Lancet, 2013

9 Health and Welfare, Bernard Harris, The Cambridge Economic History of Modern Britain: Volume 2, 2014

to be precise, most studies suggest somewhere between a quarter and two thirds of improvements in the standard of living come from investments in medical research.[10]

> "Both in Britain and globally, life expectancy has more than doubled since the mid nineteenth century"

- Britain is widely recognised as a global leader in international development. We are the only country to meet the UN's target, with official development assistance increasing in relative terms from 0.24% of GNI to 0.7% of GNI by 2013.[11] In absolute terms, spending quadrupled in real terms from £3 billion to £12 billion. As well as sheer quantity, the UK is often praised for the quality of its giving, with DfID at the forefront of innovative funding, accountability and evaluation mechanisms such as the recent performance agreement tied to the UK's donation to the multilateral Global fund.[12]

- In comparison to the causes of growth, we have a much better understanding of the mechanisms lying behind disease, and the risk of encouraging corruption is much lower with medical than pure economic aid, making it an especially good use of development resources. It is much easier to eliminate polio or smallpox than to create an open economic order. As even many aid critics acknowledge, many health aid programmes have been an unqualified success, with smallpox eradication estimated to have saved 50 million lives at the cost of only $300 million.[13]

- Overall, child mortality has fallen faster than absolute poverty in developing Sub-Saharan Africa, with the proportion of children dying before their fifth birthday falling from 18% in 1990 to 10% in 2012,[14] compared to a drop in the absolute poverty rate from 57% to 43%.[15] While per-capita income in Sub-Saharan Africa is only half the English average from 1870, child mortality is two thirds lower.[16] Although some worry about a Malthusian future where decreased mortality leads to overpopulation, historically improved survival rates have preceded slower fertility rates. This was traditionally interpreted as being the result of parents becoming more confident their child will survive. However, overall most evidence actually suggests that life-saving health interventions have no net effect on population growth.[17]

10 Evaluation of Health Research: Measuring Costs and Socioeconomic Effects, Kerstin Roback, Koustuv Dalal and Per Carllsson, 2011; The Best Public Health Interventions of the 20th Century, John Halstead, Giving What We Can, 2015

11 ODA as per cent of GNI, Compare Your Country, 2015. Unlike most economic statistics, ODA is calculated as a ratio of GNI rather than GDP as it is ability to pay rather than domestic economic activity that we are most interested in

12 A New DFID-Global Fund Performance Agreement: 10 Benchmarks to Achieve Maximum Impact, Amanda Glassman, Centre for Global Development, 2016

13 The Best Public Health Interventions of the 20th Century, John Halstead, Giving What We Can, 2015

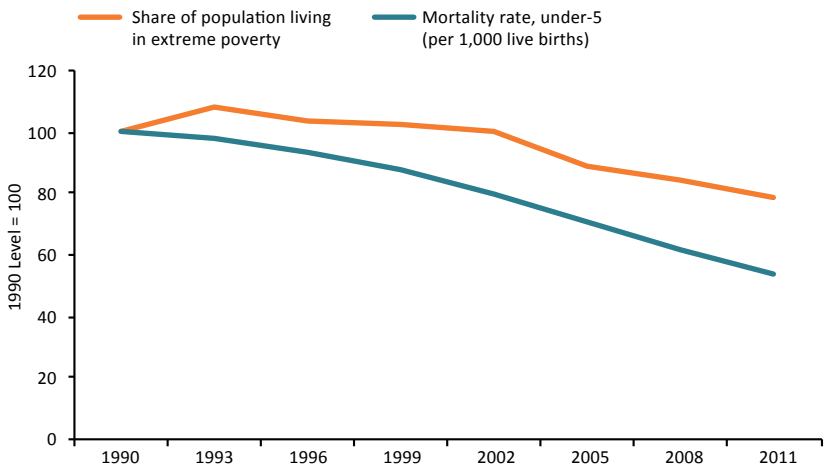
14 Children Dying Before the Age of 5 (per 1,000 live births), Our World in Data, 2012

15 World Poverty, Max Roser, Our World in Data, 2016

16 The Best Public Health Interventions of the 20th Century, John Halstead, Giving What We Can, 2015

17 See Poverty vs Mortality graph – The impacts of life-saving interventions on fertility, David Roodman, 2014

Figure 1: Extreme poverty and child mortality in developing Sub-Saharan Africa since 1990



Source: Our World in Data, World Bank

Why medical research is underfunded

- At its best, medical research can offer among the highest rates of return available anywhere. The US' investment of $26 million into developing a polio vaccine in the 1950s is estimated to have prevented 160,000 deaths and generated a net benefit of $180 billion,[18] a rate of return likely only matched by Alexander Fleming's accidental discovery of penicillin or Norman Borlaug's Green Revolution. Today, it is estimated that every $1 dollar invested in a HIV vaccine could return between $2 and $67.[19]

- If public support of health is a good thing, health research and development is particularly likely to be underfunded. As a public good with significant positive externalities, basic research has traditionally been seen by both left and right as a good use of publicly funded support. It is hard for entrepreneurs to fully capture the benefits of new innovation, leading to underinvestment by the market in new innovation – William Nordhaus famously estimated that historically innovators have only been able to capture 2.2% of the social value of their creation.[20]

- This underinvestment is only likely to be more severe to the extent that private discount rates are higher than you might believe socially justified, or given the inability of developing nations to borrow against future growth to pay for life saving technologies today. Unsurprisingly most R&D activity focuses on the needs of the much richer customer base in already advanced economies, despite the objectively far greater need in the developing world. Only around $3 billion a year is spent on R&D targeted at infectious diseases concentrated in low and middle income countries, or just 1–2% of total R&D.[21] Between 1975 and 1999 only 16 out of 1393 newly released drugs were for tropical diseases and tuberculosis.[22] Even traditional aid sceptics such as Angus Deaton have argued that as a global public good further funding basic health research would be a good use of resources, and avoids many of the problems with other types of aid.[23]

18 The Astonishing Returns of Investing in Global Health R&D, Lawrence Summers, Gavin Yamey, 2015

19 The Astonishing Returns of Investing in Global Health R&D, Lawrence Summers, Gavin Yamey, 2015

20 Schumpeterian Profits in the American Economy: Theory and Measurement, William D. Nordhaus, National Bureau of Economic Research, 2014

21 Global health 2035: a world converging within a generation, Prof. Dean T Jamison, Prof. Lawrence H Summers et al., The Lancet, 2013

22 Drug development for neglected diseases: a deficient mark and a public-health policy failure, Dr Patrice Trouiller, Dr Piero Olliaro, The Lancet, 2002

23 There is a solution to the aid dilemma, Angus Deaton, Financial Times, August 2 2016

The government's new aid strategy

- Overall, DfID's latest annual report estimates that it will spend £350 million on research and evidence this year, or 3.5% of its total programme spend.[24] The Government's new Aid strategy, announced last November, included a significant expansion of spending on research and development, particularly in health and life sciences:
  - A new £1 billion Ross Fund over five years run by DfID and the Department for Health including £100 million into research and development for infectious diseases, £115 million to develop new drugs, diagnostics and insecticides for diseases of emerging resistance, £315 billion fighting anti-microbial resistance, £188 million on prevention and future response to disease outbreaks such as Ebola and £200 million to tackle neglected tropical diseases.[25]
  - A new Global Challenges Research Fund of £1.5 billion over five years to be run by BEIS to "harness the expertise of the UK's world leading research base" and focussing on health, clean energy, sustainable agriculture, conflict, and inclusive growth. £810 million has been allocated out between the Research Councils, National Academies and International Partnership Programme, with a further £691 million currently unallocated and to be used on multidisciplinary research.[26]

The impact of global health research

- Most studies of the average return on investment for health research on significant diseases find a return between 10–100 DALYs per $1000:[27]
  - The Office for Health Economics found a cost per DALY of $12–$107 for public private partnership R&D into vaccines, and $12 to $17 for drugs.[28]
  - The Centre for Global Development estimated that an advanced market commitment for new treatments for malaria could deliver DALYs at $15.[29]
  - Bio Ventures for Global Health estimates that new vaccines for tuberculosis could save DALYS at $6 to $26 per DALY.[30]
  - The International Aids Vaccine Initiative estimated that an advanced market commitment to pay for a vaccine for AIDs could deliver DALYs at $21–$67.[31]
  - The Global Priorities Project estimates that the marginal return on research into major neglected tropical diseases is around $71, although some diseases such as malaria potentially had substantially higher returns.[32]
- These figures give an order of magnitude estimate that the Government's additional £1.5 billion for health research, should deliver a gross 19 to 200 million DALYs.[33] **Under a standard conversion, that is the equivalent of 650,000 to 6.7 million lives, or a central estimate of 2,400,000 lives saved.**
- Inevitably, there will be some opportunity costs to this spending, so the net value will be less, although not necessarily by very much. In general, cost effectiveness estimates for different health interventions seem to follow a power law, suggesting that the very best interventions can be order of magnitudes better than the average programme. Although we do not have

24 Annual Reports and Accounts, DFID, July 2016

25 Ross Fund: Summary, Department of Health, January 2016

26 The Allocation of Schience and Research Funding: 2016/17 to 2019/20, BIS, March 2016

27 Literature review based on: Medical Research: Part 2, Max Dalton, Giving What We Can, 2015

28 Donor Investment choices: Modelling the Value for Money of Investing in Product Development, Public Private Partnerships as Compared to Other Health Care and Non-Health Care Interventions, A. Gray, P. Fenn et al., Office of Health Economics, 2006

29 Making Markets for Vaccines: Ideas to action, Ruth Levine, Michael Kremer & Alice Albright (Co-Chairs), Centre for Global Development, 2005

30 Tuberculosis Vaccines: The Case for Investment, BIO Ventures for Global Health, 2006

31 An Advance in Market Commitment for Aids Vaccines: Accelerating the Response from Industry, International AIDS Vaccine Initiative, 2006

32 New UK aid strategy – prioritising research and crisis response, Global Priorities Project, 2015

33 Consisting of the £1 billion Ross Fund, £240 million in medical and biotechnology related funding from the allocated portion of the Global Challenges Research Fund and an assumed £230 million from the unallocated funding. Calculation based on methodology from: New UK aid strategy – prioritising research and crisis response, Global Priorities Project, 2015, and assuming a £1.2 to $ exchange rate.

comprehensive data on the cost of DALYs across DfID's portfolio, it is reasonable to assume that the marginal programmes that will be defunded are likely to be substantially less effective than health research. The World Bank judges health interventions that cost less than $100 to be highly effective,[34] while Givewell, an independent charity dedicated to identifying underfunded organisations recommends donations go toward the Against Malaria Foundation, which is cost effective at around $100 per DALY.[35]

Next steps

- In summary, there are good reasons to believe that this shift in funding will significantly improve global welfare, and continue Britain's role as a leader in development. Over the next few months, we will consider further:
  - What are the biggest challenges faced by the world, and how can we can quantitatively assess their potential impact? What approaches have proved most successful in the past?
  - Looking more broadly than the life sciences, how can we take advantage of the UK's other comparative advantages such as in agriculture, energy or machine learning?
  - What are the best policy mechanisms for allocating funding to projects with the a tractable path to the greatest impact? How can the Global Challenges Research Fund be targeted at the best projects whilst maintaining academic independence and the spirit of the Haldane Principle?

34 Disease Control Priorities in Developing Countries (2nd ed.), 'Intervention Cost-Effectiveness: Overview of Main Messages', Ramanan Laxminarayan, Jeffrey Chow & Sonbol A. Shaid-Salles, 2006

35 The Unintuitive Power Laws of Giving, Jeff Kaufman, 2013

Aid and the National Interest

Aid and soft power

- At least in the short term, Brexit could damage Britain's global reputation, with many international observers interpreting it as part of an international turning away from globalisation and towards insular nationalism. The Government have been clear that this is not their intention, with Prime Minister Theresa May arguing in her first speech that the UK will "forge a bold new positive role for ourselves in the world"[36] and the new International Development Secretary Priti Patel arguing that "successfully leaving the EU will require a more outward-looking Britain than ever before."[37] If the UK is return to its historic role as champion of free trade and reassure the world that it remains an open, friendly economy, maintaining its current role as world leader in development is essential.

> "According to the latest Portland/Facebook Soft Power Index, the UK is second only to the US in global soft power"

- Britain currently enjoys disproportionate global influence, thanks to a historical legacy of global links, long standing position at the centre of multi-lateral organisations like the Security Council or the Commonwealth, hosting London as the leading global city and the disproportionate impact of its universities and creative industries. According to the latest Portland/Facebook Soft Power Index, the UK is second only to the US in global soft power.[38] Alongside Britain's history or private sector, Britain's leadership in development has likely boosted the country's reputation, both as a result of official government aid and as home to third sector organisations like Oxfam or Save the Children. There is limited evidence on the quantitative impact of aid on overseas popularity, although some research has found for example that targeted, sustained, effective and visible aid can substantially improve perceptions of the donor country.[39]

- Brexit also opens up new opportunities for development. The UK can now theoretically redirect aid through more effective means than the Europe Commission, allow preferential market access to developing countries, increase the share of migrants from emerging economies and unilaterally reform farm subsidies upon leaving the Common Agricultural Policy. The latter, in particular, offers the potential to enable Britain to become a pro-poor voice in global trade, which we know is one of the most effective means of accelerating development. An increase in trade volumes of 10% is estimated to raise incomes by 5%, while at the moment Africa accounts for only 3% of global trade.[40]

36 Statement from the new Prime Minister Theresa May, UK Government, 2016

37 New Ministerial Team: Department for International Development, UK Government, 2016

38 Soft Power 30, Portland Communications & Facebook, 2016

39 Doing Well by Doing Good: The Impact of Foreign Aid on Foreign Public Opinion, Benjamin E. Goldsmith, Yusaku Horiuchi and Terence Wood, 2014

40 www.gov.uk/government/publications/2010-to-2015-government-policy-economic-growth-in-developing-countries/2010-to-2015-government-policy-economic-growth-in-developing-countries

Security risks

- Beyond the economic impact, many health problems are inherently global, and impossible to confine to one country. Just as Britain was the pioneer of public health and vaccination after Edward Jenner's work in the nineteenth century today it can be the pioneer of global public health. As the recent Ebola outbreak has reminded the world, the sudden arrival of a global health pandemic remains a live risk, with 50 million killed in the 1918 influenza outbreak, 35 million lost to HIV/AIDS and an expected $60 billion a year loss without further global investment.[41] Equally, without further action it is estimated antimicrobial resistance will cost 10 million lives a year by 2050 and 100 trillion dollars in lost economic output.[42] In the long run, medical isolationism is likely to be even more dangerous than its military counterpart.

Industrial strategy and the life sciences

Britain's life sciences industry

- In total, Britain currently has 5,633 health life sciences companies in biopharmaceuticals, medical technology, digital health and genomics, generating £60.7 billion in turnover and employing 220,000 people. Around two thirds of this employment is outside London and the South-East. In the last year, revenue across the sector grew by 2% while employment grew by 2.9%. The UK receives the second highest level of foreign direct investments after the US, and exports are forecast to increase from £30bn to £40bn by 2020.[43]
- It is fair to say however, that while a success, many believe that the commercial strength of the industry lags behind Britain's wider academic and non-commercial record. Pharmaceutical manufacturing has been struggling in recent years, with GVA down 26% between 2009 and 2013 and employment down 23% from 2010 and 2014. Over the same periods, Switzerland has seen its GVA increase 36% and employment go up 21%.[44] The UK has 2 out of the 10 largest pharmaceutical companies in GSK and AstraZeneca, but just 1 company out of the top 20 in medtech. We are the sixth largest exporter in pharmaceuticals and ninth largest in medtech.[45] Britain still cannot match the financing environment in America, while the NHS is seen by many in the industry as slow to adopt new treatments and innovations.

The new industrial strategy

- The new Government has chosen Industrial Strategy as one of its key priorities. While in the past industrial policy often focused narrowly on the protection of the country's manufacturing base, the new strategy is much broader than this. While it has received renewed attention under the administration, this in many ways is a continuation and amplification of the approach first undertaken by the Coalition Government. Innovation and trade

41 The Neglected Dimension of Global Security: A framework to counter infections disease crises, Commission on a Global Health Risk Framework for the Future, 2016

42 Tackling Drug-Resistant Infections Globally: Final Report and Recommendations, Jim O'Neill (Chair), The Review on Antimicrobial Resistance, 2016

43 Strength and Opportunity 2015: The landscape of the medical technology and biopharmaceutical sectors in the UK, Office for Life Sciences, 2016, Life Science Competitiveness Indicators, Office for Life Sciences, 2016

44 Life Science Competitiveness Indicators, Office for Life Sciences, 2016

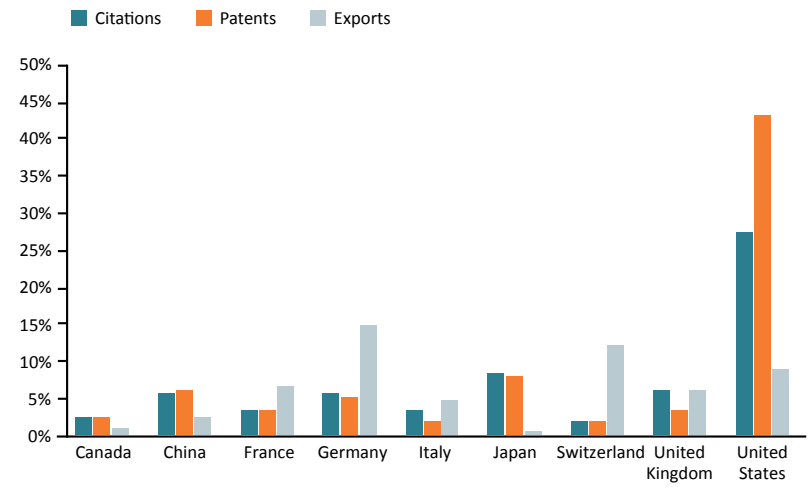
45 The UK's Contribution to Health Globally, Nadeem Hasan, Sarah Curran, et al., All-Party Parliamentary Group on Global Health, 2015

are at the heart of the strategy, with the government focused on identifying and supporting industries and clusters where Britain could potentially have a comparative advantage in the future. This included the identification of eight promising technologies, including synthetic biology, regenerative medicine and agri-science.[46] As part of that strategy in 2011 the Government launched a specific Life Sciences strategy based around three key principles: building a life sciences ecosystem, attracting the best talent, and overcoming barriers and creating incentives for innovation.

- The next decade or so will open up significant opportunities for Britain to build on its strengths in life sciences. A new wave of technologies, including machine learning, wearables, genome sequencing and gene editing, offers the potential for fundamental advances in medical treatments and delivery. Leaving the EU offers the potential for Britain to strike a better balance between safety and innovation. The European Union's over adherence to the precautionary principle has arguably slowed European research, with the Clinical Trials Directive alone estimated to significantly reduce non-commercial clinical trials activity and double the administrative burden.[47] The US has ten types of commercially planted GM crops on more than 70 million hectares, while Britain has none.[48]

- Given wider trends in the world market, there should be ample room for UK life sciences to grow over the next decades. At present, looking in detail at the pharmaceuticals industry, the UK is responsible for around 6% of citations, 3.7% of patents and 6.3% of exports, a ratio of exports to citation share of 1.05 times. While the UK is unlikely in the medium term to be able to match the 6.3 ratio enjoyed by Switzerland – which appears to be an outlier – it seems much more plausible that it could aspire to match the performance of a France or Germany, which achieve a ratio of exports to citations of 1.9 and 2.6 respectively. Simply seeking to maintain current world market share would imply significant growth, with global health spending expected to increase 4.3% a year between 2015 and 2019.[49]

Figure 2: Pharmaceutical industry world share



Source: OECD, Scimagojr.com, author calculations

46 Eight Great Technologies, Rt Hon David Willetts, BIS, 2013

47 Policy Statement: EU Clinical Trials Directive, Cancer Research UK, 2010

48 What GM Crops are Being Grown and Where?, The Royal Society, 2015

49 2016 Global life sciences outlook Moving forward with cautious optimism, Deloitte, 2016

The impact of public R&D spending

- Public investment in research and development aimed at the developing world can play a synergistic role in this strategy. In order to calculate the net return from public R&D, we need to know both the spillover effect – how much will public sector research and development stimulate additional private investment – and how what the social rate of return on that investment is likely to be. A medium sized literature already exists that tries to answer these questions, with the best data suggesting that **publicly funded R&D in the UK has a social rate of return of around 20%**.[50] In general, most evidence suggests that public funding of research and development is a complement, rather than a substitute for private research and development, suggesting that this number could be an underestimate of the final return as public research will additionally crowd in extra private spending. A recent paper for BIS by Economic Insight, for example, found that every additional £1 of public research generates £1.36 in private investment.[51]

> "In short, the evidence so far suggests that, even ignoring its potential global impact, publicly funded development R&D is highly likely to have a strong rate of return for the British economy"

- There is less evidence around the specific impact of public research spending on private spending broken down by industry, and none yet specifically looking at the spillover effect of public development research spending. However, new research this year by Rand Europe, Office of Health Economics, University of York and the Policy Institute at King's, found specifically that public investment in health research and development was a strongly complementary with private investment, with a 1% increase in public spending associated with 0.8% increase in private sector spend. (A 1% increase in charitable spending was associated with a 0.21% increase in private spending.) **Combined with previous estimates of social rates of return and economic values of health gains, this suggests a pure economic rate of return to public research of 15–18%** or including health gains 24 to 28%.[52] This is an order of magnitude higher than the 3.5% rate of return required by the Green Book for public sector investments.

Next steps

- In short, the evidence so far suggests that, even ignoring its potential global impact, publicly funded development R&D is highly likely to have a strong rate of return for the British economy. During the course of our coming research, we intend to look in more detail at:
  - What has the quantitative impact of past public funding been, and what does this tell us about likely future returns. To what extent does development R&D funding stimulate the private sector in the same way we know takes place with broader public R&D?
  - How should this new research agenda feed into the framework of the government's broader new industrial strategy, and its focus on supporting

50 Rates of return to investment in science and innovation, Frontier Economics, July 2014

51 What is the relationship between public and private investment in science, research and innovation, Economic Insight, 2015

52 Quantifying the economic impact of government and charity funding of medical research on private research and development funding in the United Kingdom, Jon Sussex, Yan Feng et al., BMC Medicine, 2015

the industries of the future? How can we best take advantage of any potential synergies whilst ensuring we don't undercut the primary goal of global impact?

- How should the new aid strategy fit into Britain's new foreign policy in the wake of Brexit? How can we take advantage of Britain's world leadership in development and renewed focus on free trade to both develop new trade deals and support a wider pro-poor trade agenda?

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