Public medical research drives private R&D investment

Quantifying the economic impact of government and charity medical research on private sector R&D in the UK

Policy briefing
February 2016
Introduction

The potential to prevent or treat illness and advance scientific knowledge is a strong driver for investment in medical (biomedical and health) research. Exploring the scale of these impacts helps in the evaluation of investment opportunities and should inform policy decisions.

In parallel, returns to the national economy are an important consideration when evaluating the worth of public (government and charity) research investment. By estimating the effects of publicly funded research on the UK economy, policy decisions can be facilitated and accountability reporting strengthened.

Realising the health and economic benefits of publicly funded (that is government funded and charity funded) research often, although not always, involves private industry. Life sciences companies build on and interact with government- and charity-funded research, conduct further research and development (R&D), and bring medicines and technologies into use in health care. Previous analyses indicate that public and private R&D investment complement one another. Public medical research spend can boost private sector R&D spend, and vice versa.

The total rate of return to UK publicly funded research (government plus charity) in the fields of cardiovascular disease and cancer have been previously estimated at 39% and 40%, respectively. These figures have been widely cited in the policy dialogue justifying government spend on medical research. They were generated by combining the estimated monetised value of health gains to the UK population (9% and 10% respectively) with an estimated benefit to the UK economy of 30%. As the investigators flagged, the 30% rate of return figure was based on data that was US-centric and that is increasingly becoming out of date.

A more accurate impact of the estimate of publicly funded medical research on private R&D investment in the UK was identified as a much needed focus of the research agenda. A new study, funded by the MRC, has met this call. The investigators used a time series of 31 years of government, charity and pharmaceutical industry R&D spend in the UK over 10 disease areas to generate a new estimate of the effect of public medical research on private sector R&D in the UK. The investigators have also revised the estimate of the economic gain (rate of return) from UK publicly funded medical research, based on this new evidence.

In this policy briefing, we explore the key findings of that study and provide an interpretation for policymakers.

'Essentially, our research question was: in the UK, does public medical research drive additional private R&D spending or replace it?'

Dr Jorge Mestre-Ferrandiz
Office of Health Economics

Modelling the relationship between public and private investment

In the earlier ‘What’s it worth?’ study, a conceptual framework was developed to estimate the economic gain from public investment in medical research. Although public investment can have a direct effect on gross domestic product (GDP), in the UK economy the majority of its economic effect is likely to be mediated via the private sector. The term ‘spillover’ is used by economists to describe an investment by one organisation, public or private, that benefits not only that organisation but other organisations in the same sector of the economy and in any other sector of the economy.

To estimate the economic benefits of publicly funded medical research, it is crucial to determine the magnitude of impact that this public spend has on private sector R&D investment (in economic terms, the elasticity).

The resulting elasticity can then be combined with the social rate of return to private sector R&D investment to estimate the economic rate of return (GDP gain) obtained from public medical research investment, or the spillovers.

'It is important not to view spillovers from public to private research as accidental, as they are often a deliberate policy objective of spending on public research.'

Jon Sussex
Chief Economist, RAND Europe, and Co-director, Cambridge Centre for Health Services Research

Importantly, econometric models are only as good as the data used to populate them. It has been previously estimated that, based on US studies, a 1% increase in public research would eventually produce anything from a 1.05% to a 2.50% increase in private R&D spend. When combined with an estimated social rate of return on private R&D investment of 50%, this elasticity indicates a real annual economic rate of return on public medical research investment of approximately 30%.

This modelling was based on US data that is becoming increasingly dated.

‘Spillover effect: The study was based on a conceptual framework whereby public medical research spending impacts upon private sector R&D investment, which in turn generates a GDP gain.

1 2
In the new study, UK data for government, charity and private sector R&D spend from 1982 to 2012 was collated for 10 disease areas and converted to 2012 prices.

**UK investment in medical research over time**

**Key findings**

- UK public spend on medical research has gradually increased over time. The British public funded £1.453 billion (in 2012 price terms) of biomedical and health research in 1982 and this rose to £3.429 billion in 2012 (a 2.4 fold increase).
- Private pharmaceutical industry R&D spend in the UK rose more rapidly, and was subject to more variation than public research spend. Private R&D spend was £925 million in 1982, and rose to £4.207 billion in 2012 (a 4.5 fold increase).
- Investment patterns differ by disease area. In some, public spend generally overshadowed private spend (eg cancer), while in others the opposite was true (eg blood disease).
- Overall, global medicine sales increased over time in all the disease areas.

**Data sources:**

- Government spend: the Medical Research Council, Department of Health, and Higher Education Funding Council for England (previously the University Funding Council)
- Charitable spend: the Wellcome Trust and Association of Medical Research Charities
- Private spend: The Association of the British Pharmaceutical Industry
- Global pharmaceutical sales: IMS Health.

**Disease areas:**

- Blood, cancer, cardiovascular, central nervous system (CNS), gastroenterology, infection, respiratory, skin, vision, and "other" (all remaining disease areas).

---

The impact of public medical research on private R&D

An econometric vector error correction model (VECM) was used to describe the relationship between public sector expenditure, private sector expenditure and global pharmaceutical sales over the short- and long-term.

The model takes into account trends in global sales of medicines (a key source of funds for private industry R&D investment) and changes in charity and government spend.

The cumulative effects, year by year, of public research on private R&D investment were identified by the impulse response function (IRF).

**Key findings**

- Overall, the study strongly suggested that there is a complementary relationship between public medical research spend and private pharmaceutical industry R&D spend in the UK.
- In the long run, a 1% increase in government spend on medical research is associated with a 0.66% increase in private R&D spend, while a 1% increase in charity spend is associated with a 0.21% increase in private spend (best-fit model).
- Nearly half (44%) of the increase in private R&D investment would happen within one year of the increase in public research spend, but it takes decades for the full impact to be felt.
Interpreting the results for policy makers

What is the scale of impact in pounds sterling?
The estimated elasticity can be applied to data on public and private spend in medical research to provide ‘real-life’ figures. The estimated impact varies depending on the relative scale of public and private spend in a given year and the elasticity estimate applied. The modelling assumes that the elasticity is constant throughout the entire period.

Taking these variables into account, every additional £1 of public spend on medical (biomedical and health) research is associated with an eventual additional £0.99 (range £0.83 to £1.07) of private R&D spend in the UK. Although 44% of this impact on private R&D would be seen in the first year, the remainder would take years, maybe decades, to work through.

What economic rate of return does this represent?
By combining the estimated elasticity with previous estimates of the social rate of return from private R&D spend of around 50% and using 2012 expenditure data, a more precise estimation of the economic benefits to the UK economy of public medical research can be made than was previously possible.

Based on the study model, the rate of return, in terms of impact on GDP, to public medical research spend lies in the range 15% to 18% with a best estimate of 17%.

In other words, a £1 investment in UK public medical research would benefit the UK economy to an extent equivalent to receiving 15–18 pence per year in interest for ever in return for that investment. This calculation does not include the monetised value of health benefits.

What are the updated estimates of the value of cardiovascular and cancer research?
Original studies of the worth of cardiovascular and cancer research were based on the estimated monetary value of health gains combined with a rate of return in terms of GDP of 30% – the best available estimate at the time. Replacing this with the newly estimated, UK-centric rate of return in GDP terms of 15–18% allows total economic gains to be estimated more accurately than before.

The new rate of return suggests that publicly funded biomedical and health research generates a total rate of return of between 24% and 28% for the UK.

This is lower than the previous headline estimate of return on investment for cardiovascular (39%) and cancer research (40%), but it is a more reliable estimate and it still compares very favourably with rates of return achieved on investments in other areas of the UK economy.

Future research
The dataset created for the study could be used to investigate a further research question: what is the magnitude of the effect of charity biomedical and health research expenditure in the UK on government biomedical and health research expenditure and vice versa?

Additionally, further thought and investigation is needed on how ‘spillovers’ effects manifest themselves, ie what are the processes by which public research spend boosts private sector R&D investment?

This is likely to involve qualitative research into mechanisms that generate spillover effects and the barriers that hinder them. In particular, how are these effects channelled through individuals and their formal and informal interactions, including research collaborations and the labour market?

Why are spillovers different between the UK and US?

Limitations
As with any economic modelling, the study has limitations. These include:

- Insufficient data meant that it was not possible to determine the extent to which the rate of return varies according to the disease area that the public research is in.
- Disease categorisations may vary over time and between organisations, although this was mitigated wherever possible by using the Health Research Classification System.
- Some data points were interpolated in order to have complete funding streams available over time.
- Data do not exist for the disease area split of total pharmaceutical industry R&D expenditure in the UK. To overcome that, a proxy of the observed disease area split of private R&D was constructed, based on research publications.

Conclusions
The results of this study strongly suggest that government- and charity-funded biomedical and health research boosts private sector R&D investment and generates a substantial return on investment for the UK economy.

This spillover effect implies a real annual rate of return (in terms of economic impact) of UK publically funded biomedical and health research of between 15% and 18%.

Combined with previous estimates of the monetary value of health gains from cardiovascular and cancer research, the total rate of return including those health gains is around 24% to 28%.

Overall, this suggests that the rate of return from government- and charity-funded research in the UK is greatly in excess of the 3.5% required by the UK government for public investments generally, and compares very favourably with other investments in the UK.

‘At 24% to 28%, the estimated total rate of return for government and charity biomedical and health research greatly exceeds the UK government’s 3.5% general requirement for public investments’

Professor Jonathan Grant
Director of the Policy Institute at King’s
Glossary

**Elasticity** – a measure of how responsive an economic variable is to a change in another (in the instance of this study, a measure of how responsive private sector R&D spend is to changes in public research spend).

**Gross domestic product (GDP)** – a measure of national income. GDP is the monetary value of all the finished goods and services produced within a country’s borders in a specific time period (usually a year).

**Rate of return** – the annual benefit received from an initial investment, expressed as a percentage of the initial investment. A rate of return of X% to an initial investment of £100 means that the net benefit yielded by that initial investment is equivalent to receiving £X back every year thereafter.

**Spillover** – the benefit from an investment by one organisation, public or private, that is received by others in the rest of the economy.

References

About the MRC
The Medical Research Council is at the forefront of scientific discovery to improve human health. Founded in 1913 to tackle tuberculosis, the MRC now invests taxpayers’ money in some of the best medical research in the world across every area of health. Thirty-one MRC-funded researchers have won Nobel prizes in a wide range of disciplines, and MRC scientists have been behind such diverse discoveries as vitamins, the structure of DNA and the link between smoking and cancer, as well as achievements such as pioneering the use of randomised controlled trials, the invention of MRI scanning, and the development of a group of antibodies used in the making of some of the most successful drugs ever developed. Today, MRC-funded scientists tackle some of the greatest health problems facing humanity in the 21st century, from the rising tide of chronic diseases associated with ageing to the threats posed by rapidly mutating micro-organisms. www.mrc.ac.uk

About the Policy Institute at King’s
The Policy Institute at King’s College London acts as a hub, linking insightful research with rapid, relevant policy analysis to stimulate debate, inform and shape policy agendas. Building on King’s central London location at the heart of the global policy conversation, our vision is to enable the translation of academic research into policy and practice by facilitating engagement between academic, business and policy communities around current and future policy needs, both in the UK and globally. We combine the academic excellence of King’s with the connectedness of a think tank and the professionalism of a consultancy. http://www.kcl.ac.uk/sspp/policy-institute

About RAND Europe
RAND Europe is a not-for-profit organisation whose mission is to help improve policy and decision making through research and analysis. Our clients include European institutions, governments, charities, foundations, universities and private sector firms with a need for impartial research. We operate as a research-focused business, using a professional services model within the context of a public good mission. We combine deep subject knowledge across diverse policy areas including health, science and innovation; defence, security and infrastructure; and home affairs and social policy. Combined with proven methodological expertise in evaluation, impact measurement and choice modelling, we are able to offer quality-assured research and analysis, unbiased insights and actionable solutions that make a difference to people’s lives. http://www.randeurope.org

About the Office of Health Economics
The Office of Health Economics conducts research and provides consultancy services on health economics and related policy issues that affect health care and the life sciences industries. OHE was founded in 1962 to (1) commission and undertake research on the economics of health and health care; (2) collect and analyse health and health care data for the UK and other countries; (3) disseminate the results of its work and stimulate discussion of them and their policy implications. Its independent Editorial Board and Policy Board have helped maintain OHE’s international reputation for the quality and independence of its research. https://www.ohe.org/

About the University of York
The University of York was founded in 1963 with 230 students. It now has around 16,000 students and more than 30 academic departments and research centres. A member of the Russell Group, it features regularly in the ranks of the UK’s foremost universities. In the 2014 Research Excellence Framework, York ranked tenth out of 155 UK universities for the impact of its research. York was named Times Higher Education University of the Year in 2010 and the University has won five Queen’s Anniversary Prizes. The University of York places equal emphasis on research and teaching. Students in every department – both undergraduate and postgraduate - are taught and advised by leaders in their field. http://www.york.ac.uk

This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. To view a copy of this license, visit http://creativecommons.org/licenses/by-nc-nd/4.0/