

MODELLING THE IMPACT OF PUBLIC R&D SPENDING PLANS

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To discuss the report further please contact:

Anubhav Mohanty: amohanty@oxfordeconomics.com

Oxford Economics

4 Millbank, London SW1P 3JA, UK

Tel: +44 203 910 8000

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CONTEXT AND RATIONALE FOR THIS NOTE

In 2017, the UK government set a target for research and development (R&D) spending—public and private combined—to reach 2.4 percent of GDP by 2026/27, up from 1.7 percent of GDP in 2016/17.¹ To help meet this target, in the 2020 Budget the government announced a large expansion of public support for R&D, increasing public R&D investment to £22 billion by 2024/25 (0.8 percent of GDP). The government hopes that increased public R&D spending will not only directly increase the amount of innovative activity, but also stimulate, or “crowd in”, private R&D expenditure.

The increase in private R&D investment which results from each additional unit of public R&D investment is known as the “leverage rate” and is a key measure used by policy makers to understand the ripple effects of public investment. In March 2020, the Department for Business, Energy & Industrial Strategy (BEIS) published a study by Oxford Economics that provided updated estimates of the R&D leverage rate in the UK and other OECD countries.²

In this research note, we combine the government’s commitments for public R&D expenditure from the 2020 Budget with our updated leverage rate estimates from our research for BEIS to assess the likely impact on private R&D. We then consider how much further private R&D investment will be required for the UK to meet the government’s target of investing 2.4 percent of GDP in R&D by 2026/27.

PUBLIC R&D ANNUAL SPENDING ASSUMPTIONS

In the 2020 Budget, the government announced plans to increase public R&D expenditure to £22 billion (0.8 percent of GDP) by 2024/25, up from £9.8 billion (0.5 percent of GDP) in 2017/18. The government has not yet provided details of how it plans to increase public R&D spending.

The UK also receives funding from the European Union (EU) through the Horizon 2020 Programme. Following Brexit, the UK may continue to be a part of the Horizon Programme or may fund its own replacement programme. It is not clear whether the UK government’s projected spend of £22 billion includes funding from Horizon 2020 (or a similar replacement programme). We were advised by NCUB that a replacement programme – Horizon Europe – is expected to support R&D expenditure of approximately €1.5 billion per year in the UK (approximately £1.3 billion per year) over the next seven years.

Given these uncertainties, we consider the implications of increased government R&D expenditure under alternative scenarios as follows:

- In our **Main Scenario**, we assume that public R&D spending increases at a constant rate to £22 billion in 2024/25 and increases in line with GDP in the subsequent years to 2029/30.

¹ UK Government Industrial Strategy (2017).

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664563/industrial-strategy-white-paper-web-ready-version.pdf

² Oxford Economics (2020), “Research and development: relationship between public and private funding”, <https://www.gov.uk/government/publications/research-and-development-relationship-between-public-and-private-funding>

- **Alternate Scenario 1:** Same assumptions as in the Main Scenario but with public R&D expenditure lower by €1.5 billion per year (or £1.3 billion per year) between 2020/21 and 2026/27, to reflect the possibility that EU Horizon 2020 funding is not replaced.
- **Alternate Scenario 2:** Public R&D spending increases to £22 billion in 2024/25 (same as in the Main Scenario) and increases in line with inflation in the subsequent years (i.e. public R&D spending is constant in real terms).
- **Alternate Scenario 3:** Public R&D spending increases to £22 billion in 2024/25 (same as in the Main Scenario) and increases in line with Oxford Economics' forecasts of UK public investment expenditure in the subsequent years.

Across all scenarios, we assume that the residual private R&D investment—private R&D investment not stimulated by public R&D investment—grows in line with inflation (i.e. it remains constant in real terms). This assumption is deliberately conservative: it implies that the growth rate for residual private R&D investment over the 2018/19 to 2020/30 period is 2.0% per year on average. In comparison, residual private R&D investment grew at an average rate of 5.6% per year in the 2010/11 to 2017/18 period.

LEVERAGE RATE IN THE UK

The “leverage rate” indicates the impact of a 1 percent increase in public R&D investment on private R&D investment. In our study for BEIS, we estimated that a 1 percent increase in public R&D increases private R&D by between 0.23 percent and 0.38 percent within the same year.

By combining this finding with information on levels of public and private R&D support we were able to estimate the monetary impact of this leverage effect. We found that each £1 of public R&D stimulates between £0.41 and £0.74 of private R&D within the same year.

Public R&D continues to influence levels of private spending in subsequent years, with the effect decreasing over time. We found that the long-run impact of public R&D on private R&D was more than three times the short-run impact. The long-run leverage rate was estimated to be between 1.01 and 1.32, suggesting that each £1 of public R&D eventually stimulates between £1.96 and £2.34 of private R&D.

Fig. 1. Estimates of UK leverage rates

	Leverage rate		Impact of £1 of public support	
	Short run	Long run	Short run	Long run
UK leverage rate	0.23 to 0.38	1.01 to 1.32	£0.41 to £0.74	£1.96 to £2.34

Source: Oxford Economics

Leverage begins within the same year in which the public investment occurs. The impact is most substantial in that first year and fades over time. Almost all of the effects materialise within around 15 years, and the majority of private investment is crowded in by the fifth year.

The estimates of the leveraged R&D expenditure presented in this note are the median of leveraged private R&D expenditure estimates calculated using the ranges presented in Fig. 1.

KEY FINDINGS

Main Scenario: Public R&D spending increases to £22 billion in 2024/25 and increases in line with GDP in the subsequent years

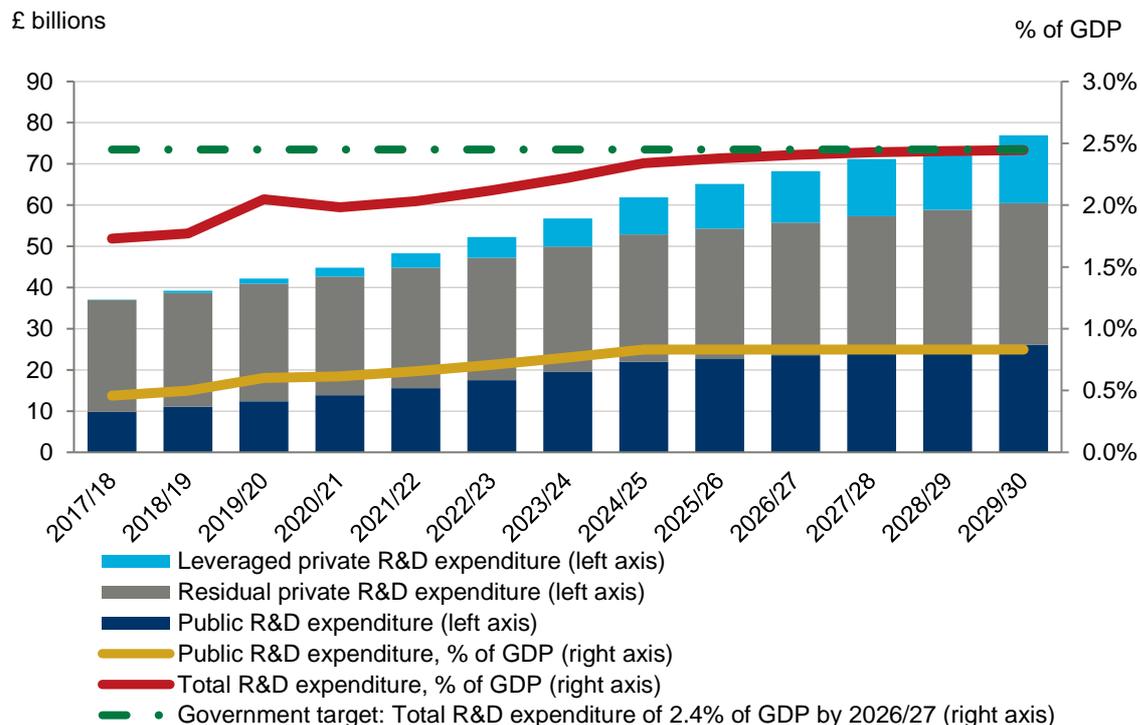
For our main scenario, we assume that public R&D expenditure increases at a constant rate until 2024/25 when it reaches the announced level of £22 billion and increases in line with GDP in the subsequent years to 2029/30, as shown in Fig. 2.

Public R&D expenditure grew slowly between 2009/10 and 2017/18 (average growth rate of 2.2%), implying that the leveraged portion of private R&D expenditure in 2017/18 was only around £100 million. Based on the public R&D investment assumptions above, we expect public R&D expenditure to grow much more rapidly at over 10% per year between 2017/18 and 2026/27. This could leverage private R&D expenditure worth £12 billion by 2026/27.

Combined with the residual private R&D spending that might be expected to occur independently of government spending, we find that total R&D expenditure reaches 2.4 percent of GDP by 2026/27 (Fig. 2).

Our long-term projections indicate that if public R&D spending is increased in line with GDP in the between 2024/25 and 2029/30, then total R&D spending in the UK would remain at 2.4 percent of GDP over the same time period.

Fig. 2. Public and private R&D spending projections (main scenario)



Source: Oxford Economics

Underpinning these estimates is the conservative assumption that the residual part of private R&D expenditure increases in line with inflation. Instead, if the residual private R&D expenditure increased in line with Oxford Economics' forecasts of all private investment expenditure, then the UK would achieve its target R&D spending of 2.4 percent of GDP by 2024/25 and, in subsequent years, total R&D expenditure would increase to 2.6 percent of GDP by 2029/30.

Alternate Scenario 1: EU Horizon 2020 funding lost

In this scenario, we assume that the UK loses access to funding from the EU Horizon 2020 Programme (which we assume was a part of the UK Government's target spend of £22 billion) and the UK government does not increase its R&D expenditure to compensate for the loss in EU funding.

Under this scenario, total R&D expenditure is slightly lower compared to our Main Scenario, at 2.3 percent of GDP in 2026/27 and also in 2029/30.

Alternate Scenario 2: Public R&D spending beyond 2024/25 increases in line with inflation

In this scenario, we assume that public spending beyond 2024/25 increases in line with inflation, i.e., is constant in real terms. This is a much more conservative assumption than in the Main Scenario under which we assumed public R&D expenditure grew in line with GDP.

Under this scenario, total R&D expenditure is the same as in our Main Scenario, at 2.4 percent of GDP in 2026/27 and also in 2029/30.

Alternate Scenario 3: Public R&D spending beyond 2024/25 increases in line with public investment forecasts

In this scenario, we assume that public spending beyond 2024/25 increases in line with Oxford Economics' forecasts for UK Public Investment (average growth of 4.0 percent per year over the 2024/25 to 2029/30 period). This is a more optimistic assumption than in our Main scenario, which assumed that public R&D expenditure grew in line with GDP (average growth of 3.5 percent per year over the 2024/25 to 2029/30 period).

Under this scenario, total R&D expenditure is the same as in our Main Scenario, at 2.4 percent of GDP in 2026/27 but is higher in 2029/30 at 2.5 percent of GDP.

SUMMARY

Our results are summarised in Fig. 3 below.

Fig. 3. Summary of results

Scenarios	Public R&D spending assumptions		Projections of total R&D, % of GDP	
	Medium-term (2018/19 to 2024/25)	Long-term (2025/25 to 2029/30)	2026/27	2029/30
Main Scenario	Constant growth rate to reach £22 billion by 2024/25	In line with GDP	2.4	2.4
Alternate Scenario 1	Main Scenario figures reduced by £1.3 billion per year between 2020/21 and 2026/27		2.3	2.3
Alternate Scenario 2	Same as in the Main Scenario	In line with inflation	2.4	2.4
Alternate Scenario 3	Same as in the Main Scenario	In line with OE UK Public Investment forecasts	2.4	2.5

Source: Oxford Economics

Based on the assumptions outlined, our analysis indicates that increasing investment in R&D to 2.4 percent of GDP by 2026/27 is ambitious but may be achievable given the public R&D spending

commitments made in the 2020 Budget. There are, however, some important caveats to this conclusion, which are outlined below.

CAVEATS AND LIMITATIONS

The analysis presented in this note is intended to demonstrate what *could* happen under a series of seemingly plausible assumptions, but is not intended as a formal forecast of what *will* happen. Many other factors will impinge on the UK's ability to meet the 2.4% target, but it was not possible to analyse and account for these within the very limited time available for this exercise.

In particular, our calculations assume that the leverage impact of public R&D in future years is similar to that identified for past years. This is a simplifying assumption in the absence of other information, but there may be important reasons why this is not the case. For example:

- The overall economic outlook is extremely uncertain at present, which may mean that some businesses are much more cautious or less able to invest funds in R&D in response to increased government R&D funding. For similar reasons, our assumption that the non-leveraged element of private R&D increases in line with inflation may prove optimistic if businesses become significantly more cautious.
- The expected rate of increase of government spending is extremely rapid. It is unclear whether the wider economy has the "absorptive capacity" to capitalise on public research when funding is increasing so quickly.
- A related challenge may arise if the private sector is unable to respond to increased government funding due to capacity constraints, for example a lack of research staff or infrastructure.

APPENDIX: DETAILED RESULTS

Main Scenario: Public R&D spending increases to £22 billion in 2024/25 and increases in line with GDP in the subsequent years

Fig. 4. Public and private R&D spending projections (Main Scenario)

Year	Public R&D expenditure, £ billion	Leveraged private R&D expenditure, £ billion	Residual Private R&D expenditure, £ billion	Total R&D expenditure, £ billion	Increase in private R&D (leveraged and residual) expenditure since 2017/18, £ billion	Public R&D expenditure, % of GDP	Total R&D expenditure, % of GDP
2017/18	9.8	0.1	27.2	37.1	-	0.5%	1.7%
2018/19	11.0	0.5	27.7	39.2	1.0	0.5%	1.8%
2019/20	12.4	1.2	28.6	42.2	2.5	0.6%	2.0%
2020/21	13.9	2.2	28.7	44.8	3.7	0.6%	2.0%
2021/22	15.6	3.5	29.2	48.3	5.5	0.7%	2.0%
2022/23	17.5	5.0	29.8	52.3	7.5	0.7%	2.1%
2023/24	19.6	6.9	30.3	56.8	9.9	0.8%	2.2%
2024/25	22.0	9.0	30.9	61.9	12.6	0.8%	2.3%
2025/26	22.8	10.8	31.5	65.1	15.1	0.8%	2.4%
2026/27	23.6	12.5	32.2	68.2	17.4	0.8%	2.4%
2027/28	24.4	13.9	32.9	71.2	19.5	0.8%	2.4%
2028/29	25.2	15.2	33.6	74.1	21.6	0.8%	2.4%
2029/30	26.1	16.4	34.3	76.9	23.5	0.8%	2.4%

Source: Oxford Economics

Alternate Scenario 1: EU Horizon 2020 funding lost
Fig. 5. Public and private R&D spending projections (Alternate Scenario 1)

Year	Public R&D expenditure, £ billion	Leveraged private R&D expenditure, £ billion	Residual Private R&D expenditure, £ billion	Total R&D expenditure, £ billion	Increase in private R&D (leveraged and residual) expenditure since 2017/18, £ billion	Public R&D expenditure, % of GDP	Total R&D expenditure, % of GDP
2017/18	9.8	0.1	27.2	37.1	-	0.5%	1.7%
2018/19	11.0	0.5	27.7	39.2	1.0	0.5%	1.8%
2019/20	12.4	1.2	28.6	42.2	2.5	0.6%	2.0%
2020/21	12.6	1.8	28.7	43.1	3.2	0.6%	1.9%
2021/22	14.3	2.7	29.2	46.2	4.7	0.6%	1.9%
2022/23	16.2	4.0	29.8	49.9	6.5	0.7%	2.0%
2023/24	18.3	5.6	30.3	54.3	8.7	0.7%	2.1%
2024/25	20.7	7.6	30.9	59.2	11.3	0.8%	2.2%
2025/26	21.5	9.4	31.5	62.4	13.7	0.8%	2.3%
2026/27	22.3	10.9	32.2	65.4	15.9	0.8%	2.3%
2027/28	23.0	12.3	32.9	68.2	17.9	0.8%	2.3%
2028/29	23.9	13.5	33.6	70.9	19.8	0.8%	2.3%
2029/30	24.7	14.6	34.3	73.7	21.7	0.8%	2.3%

Source: Oxford Economics

Alternate Scenario 2: Public R&D spending beyond 2024/25 increases in line with inflation
Fig. 6. Public and private R&D spending projections (Alternate Scenario 2)

Year	Public R&D expenditure, £ billion	Leveraged private R&D expenditure, £ billion	Residual Private R&D expenditure, £ billion	Total R&D expenditure, £ billion	Increase in private R&D (leveraged and residual) expenditure since 2017/18, £ billion	Public R&D expenditure, % of GDP	Total R&D expenditure, % of GDP
2017/18	9.8	0.1	27.2	37.1	-	0.5%	1.7%
2018/19	11.0	0.5	27.7	39.2	1.0	0.5%	1.8%
2019/20	12.4	1.2	28.6	42.2	2.5	0.6%	2.0%
2020/21	13.9	2.2	28.7	44.8	3.7	0.6%	2.0%
2021/22	15.6	3.5	29.2	48.3	5.5	0.7%	2.0%
2022/23	17.5	5.0	29.8	52.3	7.5	0.7%	2.1%
2023/24	19.6	6.9	30.3	56.8	9.9	0.8%	2.2%
2024/25	22.0	9.0	30.9	61.9	12.6	0.8%	2.3%
2025/26	22.5	10.7	31.5	64.7	15.0	0.8%	2.4%
2026/27	22.9	12.2	32.2	67.3	17.2	0.8%	2.4%
2027/28	23.4	13.4	32.9	69.7	19.1	0.8%	2.4%
2028/29	23.9	14.4	33.6	72.0	20.8	0.8%	2.4%
2029/30	24.4	15.3	34.3	74.1	22.4	0.8%	2.4%

Source: Oxford Economics

Alternate Scenario 3: Public R&D spending beyond 2024/25 increases in line with public investment forecasts
Fig. 7. Public and private R&D spending projections (Alternate Scenario 3)

Year	Public R&D expenditure, £ billion	Leveraged private R&D expenditure, £ billion	Residual Private R&D expenditure, £ billion	Total R&D expenditure, £ billion	Increase in private R&D (leveraged and residual) expenditure since 2017/18, £ billion	Public R&D expenditure, % of GDP	Total R&D expenditure, % of GDP
2017/18	9.8	0.1	27.2	37.1	-	0.5%	1.7%
2018/19	11.0	0.5	27.7	39.2	1.0	0.5%	1.8%
2019/20	12.4	1.2	28.6	42.2	2.5	0.6%	2.0%
2020/21	13.9	2.2	28.7	44.8	3.7	0.6%	2.0%
2021/22	15.6	3.5	29.2	48.3	5.5	0.7%	2.0%
2022/23	17.5	5.0	29.8	52.3	7.5	0.7%	2.1%
2023/24	19.6	6.9	30.3	56.8	9.9	0.8%	2.2%
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2027/28	24.7	14.1	32.9	71.7	19.7	0.8%	2.4%
2028/29	25.7	15.5	33.6	74.8	21.9	0.8%	2.5%
2029/30	26.8	16.9	34.3	78.0	23.9	0.9%	2.5%

Source: Oxford Economics



OXFORD
ECONOMICS

Global headquarters

Oxford Economics Ltd
Abbey House
121 St Aldates
Oxford, OX1 1HB
UK

Tel: +44 (0)1865 268900

London

4 Millbank
London, SW1P 3JA
UK

Tel: +44 (0)203 910 8000

Frankfurt

Marienstr. 15
60329 Frankfurt am Main
Germany

Tel: +49 69 96 758 658

New York

5 Hanover Square, 8th Floor
New York, NY 10004
USA

Tel: +1 (646) 786 1879

Singapore

6 Battery Road
#38-05
Singapore 049909

Tel: +65 6850 0110

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Email:

mailbox@oxfordeconomics.com

Website:

www.oxfordeconomics.com

Further contact details:

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