



Want Sustainable Productivity? Incentivize Investments in Innovation

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ABSTRACT

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Research and development (R&D) and innovations derived from R&D have been argued to be the engine of economic growth for hundreds of years. With supporting data, the paper establishes the vital role of innovation in the value chain and sustainable growth of economies. In order to convert these strategies into the tangible outcome, we need right tools, skills, and funding. Tools are provided by research methodologies underpinned by the application of project management principles. Skills come from higher education and training in science, engineering, and technology. The sources of funding are mainly from the governments and private industries where the latter provides the major share. To generate additional funding, the author argues that governments should offer a tax break to multinational companies for additional investment in R&D above the threshold of R&D intensity. For the 'post- Brexit' United Kingdom a new R&D strategy is of particular importance when the supply of the EU research money will discontinue.

1. Introduction

HM Treasury's paper entitled 'Fixing the foundations: Creating a more prosperous nation' (Cm 9098, July 2015) is praiseworthy. It contains many good ideas and initiatives aiming to focus on 'world-beating productivity. It recognizes that the longer-term productivity of an enterprising economy like the UK depends on 'public and private investment in infrastructure, skills, and science.' The main driver of productivity is a higher production of goods and services with efficient resources. Higher production comes from increasing global demand created by innovative new products which are delivered by high investment in R&D (research & development) and skills. R&D is the starting engine of the value chain and productivity. The government commitment in the science capital is robust, but the overall investment intensity in R&D does not go far enough. This is the missing link of achieving sustainable growth in economy and productivity. My article is not a critique of the HM Treasury's paper; it aims to complement it by presenting a case of why we need more investment in R&D and how it could be done.

1.1 The Impact of Research and Development

Research and development (R&D) and innovations derived from R&D have been argued to be the engine of economic growth for hundreds of years. Karl Marx started the debate in the nineteenth century by suggesting that innovations could be associated with waves of economic growth. Innovations are the outcomes of R&D and not inventions from serendipity.

The social rate of return is generally obtained by estimating the impact on growth in one firm of R&D undertaken by other firms. The private rate

of return (also known as Schumpeterian profit) can be estimated by looking at the impact of a firm's own R&D on the firm's output. These rates of return both inform us of how important R&D is for growth and provide one of the main justifications for government subsidies to R&D. Firms' decisions to undertake R&D are based on their private return to R&D. We believe that because this is lower than the social rate of return, there is underinvestment in R&D. To achieve the optimal level of R&D investment, government policy should aim to bring private incentives in line with the social rate of return. However, a question remains, does an increase in R&D expenditure lead to increases in the knowledge stock, or does it simply result in increases in economic growths? The evidence suggests increases in both fronts.

The OECD in their recently published Innovation Strategy (OECD, 2010) highlight that innovation will science and innovation' in many developed Western economies. Economic growth theory asserts that innovation is a primary source of productivity growth. Since the recognition of the relationship between technological progress, innovation, and economic performance, investment in research and development (R&D) has grown rapidly, along with a widening of innovation activity across many sectors of the economy. The doubt is not about the positive impact of R&D on the macroeconomic growth of both national economies and industries. However, the debate is on between (a) where the best return on R&D expenditure is and (b) whether state or industry is more effective in the transformation of human and environmental well-being by R&D investment and activities.

Table 1: R&D Expenditure in G20 Countries in 2009

G20 Countries	GDP (US \$ Billion) Year 2009	R & D as % GDP Year 2009	R & D (US \$ Billion)
United States	12,949	2.90	376
Japan	4,467	3.36	150
China	3,335	1.70	57
Germany	2,833	2.82	80
United Kingdom	2,320	1.86	43
France	2,203	2.26	50
Italy	1,732	1.26	22
Canada	1,171	1.92	22
India	1,065	0.80	9
Brazil	1,011	1.17	12
Korea	945	3.56	34
Russia	869	1.25	11
Mexico	866	0.40	3
Australia	787	2.75	22
Turkey	509	0.85	4
Indonesia	354	0.08	0.3
Saudi Arabia	348	0.08	0.3
South Africa	271	0.93	2.5
Argentina	223	0.60	1.3

Total R & D Expenditure 2009 = US \$ 900 Billion (2.35% of GDP)

Source: OECD (2010)

It is relevant to observe from Table 1 that knowledge-based high-tech economies of the G20 group (viz. USA, Japan, South Korea, Germany, UK, France, Canada and Australia) are investing between 1.86% and 3.56% of GDP in R&D. This is indicative of the experience of these countries delivering the positive impact on their economic growth by relatively higher R&D investments compared to emerging economies. This finding is also supported by a recent empirical study, which has concluded that R&D investment is positively related to economic growth for the high-tech industries. Empirical evidence has shown that the impacts of R&D expenditures in the high-tech sector have a strong positive effect on GDP per capita at the highest quartile of the distribution. However, all sectors' R&D spending relative to GDP is subject to significant negative returns only when considering the middle-income countries. A study by IMF prepared by Ulku (2004) suggests a positive relationship between per capita GDP and innovation in both 20 OECD countries and ten non-OECD countries, while the effect of R&D stock on innovation is significant only in the OECD countries with large markets.

Therefore, the apparent conclusions on the R&D investment are:

- R&D investment has a positive impact on economic growth
- The growth is more visible in developed high-tech countries

It is good to spend on R&D, but the question remains: what is the right amount and where is the best area of investment? The strategy of R&D expenditure is comparable to the famous words of Lord Lever, the founder of Unilever, who says: "Half the money I spend on advertising is wasted, and the problem is I do not know which half." To understand 'which half' is not wasted research is still ongoing and a jury is still out. Can a project management approach provide some pointers? We will explore this in later sections of this paper.

2. R&D roles of state and industry

Natural capital is an economic construct that another big issue of R&D investment is whether state or industry should play a big role and who is more effective. A traditional view is that more recent innovations and scientific developments are associated with industry rather than state (e.g. polyethylene by ICI, ballpoint pen by Reynolds Pen, Zantac by Glaxo, photocopying by Xerox, Windows operating system by Microsoft, iPhone by Apple and son on). The large companies have specialized in particular areas and aimed to provide scientific leadership by a large amount of R&D investment. Conventional wisdom insists the answer to innovations lies with private entrepreneurship.

However, this 'myth' is challenged in a recent publication by Mazzucato (2013) who argues that the entity that takes the boldest risks and achieves the biggest breakthroughs is not the private sector, it is the much-maligned state. Mazzucato notes that "75 percent of the new molecular entities approved by the FDA trace their research ... to publicly funded National Institutes of Health (NIH) labs in the US". Such discoveries are then handed cheaply to private companies that reap huge profits. The US National Science Foundation funded the algorithm that drove Google's search engine. Early funding for Apple came from the US government's Small Business Investment Company. Apple put this together, brilliantly, but it was based on seven decades of state-supported innovation. In any case, the private sector could not have created the internet or GPS. Only the US military and NASA had the resources to do so. Mazzucato also suggests that policy makers increasingly believe the myth that the state is only an obstacle to an innovation of support. Indeed, the scorn heaped on government also deprives it of the will and capacity to take entrepreneurial risks. The thesis of Mazzucato may be controversial. However, it is rational that the failure to recognize the role of the government in driving innovation may well be the greatest threat to rising prosperity. It is also important to explore whether the state or industry is bearing the largest share of R&D investment.

The 2010 R&D Scoreboard (BIS, 2010) shows that 1000 companies most active in R&D spent about £344 billion out of which top 25 companies (see Table 2) accounted for 37% of the share. Furthermore, 78% of global R&D expenditure occurs in five countries: USA, Japan, Germany, UK, and France. Global R&D intensity (R&D expenditure as a proportion of sales) stood at 3.6%. Among the 1000 leading companies in the UK, R&D intensity stood at only 1.7%. The top five R&D ranked companies in the UK (viz. GSK, AstraZeneca, BT, Unilever and Royal Dutch Shell) accounted for 35% of the total R&D investment of £25 billion by top 1000 UK companies.

It is evident from the Table 2 that the global investment in industrial R&D is led by companies in the USA, Japan and Germany followed by the enterprises in Switzerland, France, UK and South Korea. These are the knowledge based developed and high-tech economies. In countries in the emerging markets (e.g. China, India, and Brazil) and also the resource dependent economies like Saudi Arabia both the total R&D investment and more significantly the R&D intensity are well behind these of knowledge-based high-tech economies.

When we consider the R&D intensity (R&D as % of GDP) of 2010 alone, then the top three countries are Israel (4.4%), Finland (3.8%) and Sweden (3.4%) followed by Denmark (3.1%). However, the OECD engine of R&D is provided by the top five R&D investment countries (see Table 3) and these countries are carrying between them a total R&D expenditure of £478 billion in 2011 which is three times the GDP of Israel.

Table 2: Top 25 Global Companies by R&D Expenditure in 2010

Rank	Company	Sector	Country	R&D (£m)
1	Toyota Motor	Automobiles & parts	Japan	6014
2	Roche	Pharmaceuticals	Switzerland	5688
3	Microsoft	ICT services	USA	5396
4	Volkswagen	Automobiles & parts	Germany	5144
5	Pfizer	Pharmaceuticals	USA	4802
6	Novartis	Pharmaceuticals	Switzerland	4581
7	Nokia	ICT services	Finland	4440
8	Johnson & Johnson	Pharmaceuticals	USA	4326
9	Sanofi-Aventis	Pharmaceuticals	France	4060
10	Samsung	ICT services	South Korea	4007
11	Siemens	ICT services	Germany	3805
12	General Motors	Automobiles & parts	USA	3758
13	Honda Motor	Automobiles & parts	Japan	3746
14	Daimler	Automobiles & parts	Germany	3700
15	GlaxoSmith Kline	Pharmaceuticals	UK	3629
16	Merck	Pharmaceuticals	USA	3619
17	Intel	ICT services	USA	3501
18	Panasonic	Electronics	Japan	3445
19	Sony	Electronics	Japan	3308
20	Cisco	ICT services	USA	3225
21	Bosch	Automobiles & parts	Germany	3179
22	IBM	ICT services	USA	3061
23	Ford Motor	Automobiles & parts	USA	3034
24	Nissan Motor	Automobiles & parts	Japan	3030
25	Takeda	Pharmaceuticals	Japan	3014

Source: BIS (2010)

It is difficult to accept or reject the argument of more outcomes of fundamental innovation by the state as compared to the businesses (Mazzucato, 2013) because it is very difficult, if not impossible, to measure the benefits of all research patents resulting from state funded and business-funded research programs. However, if there is any correlation between the R&D investment and outcomes, then approximately 7 out of 10 outcomes are coming from businesses. This crude analysis does not prove the possible domination of either player but provides the power of investment in each camp. It is also arguable that the focus of business R&D is more on business-related new products and

processes whereas the emphasis of state-funded research is more on fundamental research providing fundamental outcomes and where the state can take the boldest risks to obtain breakthrough results. However, it is beyond argument that a larger share, around two-thirds, of R&D investment comes from the private sector and industries should be incentivised. Before we come to this incentive, let us address R&D challenges and tools to take up these challenges.

Table 3. Top 5 R&D Investment Countries (£ billion) in 2010

	Business	Government	Higher Education	Total
USA	182	32	40	254
Japan	78	9	13	100
Germany	42	9	11	62
France	24	5	6	35
UK	17	3	7	27

Source: OECD (2010)

3. Challenges of research and development

It is not doubted that innovation and in general research and development (R&D) have significantly improved the quality of life, especially during the last 50 years. The tremendous achievements in transport and communication, healthcare, information technology and environments result from R&D activities carried out in all types of laboratories and research centers. However, there are many challenges of starting and managing a research and development initiative. Although the outcome of R&D is rewarding the road map to the destination is unpredictable. In many areas, it is not clear before the event who is in the innovation race, where the starting and finishing lines are, and what the race is all about. There are many publications emphasizing different aspects of challenges for specific R&D initiative. The following section briefly addresses some of the generic challenges of R&D leading to the risks and uncertainties of success.

- Challenge of funding R&D expenditure

Arguably the biggest challenge of initiating a research and development activity, especially if it relates to basic research is to find money to start because it is very difficult to develop a business case. In the case of developing a new product from the current product portfolio, it may be relatively easy to prepare a preliminary cost-benefit analysis based on previous experience. The sources of funding are from governments, industries, individual companies, trust funds (e.g. Wellcome Trust), grant funds (e.g. Yozma fund in Israel), crowdfunding (e.g. NESTA website) (Basu, 2015). Risk-taking investors such as venture capitalists and not the least tax incentives. President Kennedy pledged the Apollo project at 'whatever it costs' but it was a unique situation without the usual economic forces in play. R&D expenditure is also affected by the health of national economies. A recent report by Battelle (2012) describes, 'Plagued by massive debts and weak overall economies, the combined government and industrial R&D organizations of the U.S. and Europe will both fail to even match their projected growth and inflation rates. While China's economy is starting to heat up with a projected inflation of 3.6% in 2013, its expected GDP growth of 8.2% and R&D growth of 11.6% will continue to move it toward a leadership role in both areas in the near future.'

– *Challenge of managing scientific freedom*

There is a deep-rooted cultural challenge amongst R&D scientists and managers that a scientist's 'spirit of innovation' should be given freedom to exercise and the idea of applying formal control (e.g. cost control and project planning) is viewed as an impediment to free thinking. On the other hand, R&D departments do not have unlimited funds or cycle times. This cultural challenge may also result in separating research and development into two distinct departments. There is also a view that research is for scientists and development is for engineers. This demarcation, unless it is genuinely based on knowledge and experience, is not helpful. Fortunately, R&D managers are also realistic in recognizing the need of R&D successes in a competitive market. It is generally accepted that certain amount of time should be allowed for scientific inquiries.

To address this challenge to enhance the success of R&D initiatives one approach is to apply project management tools and processes and at the same time to ensure the spirit of innovation and the need for sufficient time for the research to yield results.

– *Challenge of managing risks*

Research and development are by definition exploring new opportunities often in uncharted territories and thus carrying many risks. The main and obvious risks are related to uncertainties – uncertain cost, uncertain time scale and uncertain outcomes. There are also some less obvious risks. One such risk is 'appropriability risk' to reflect the ease with which competitors may imitate a newly developed product. However, this risk regarding the management of intellectual property is relatively well protected through patents, trademark and copyright protection. The product portfolios where intellectual property protection is more open to risks (such as fast moving consumer goods) innovations tend to focus more on cumulative technologies and line extensions.

There also a risk of integrating the research, development and delivery culture. The essence of risk management is the way the R&D organization treats risks in time, cost and quality as a team from the viewpoints of a scientist, a designer, an engineer, an accountant and a product manager. R&D risk cannot be disassociated from the overall risks faced by the business. There is an inextricable link between the threats, opportunities, and risks that a business, or even a national economy, faces in the marketplace and those encountered by the R&D team.

– *Challenge of attracting talent*

The challenges of attracting appropriate skills and talents in R&D organizations is twofold. First, R&D tasks require specialists in particular areas, and it is not surprising that research laboratories deploy more PhDs than in other departments. Companies also need to identify creative talents in their hiring policy to have the best chance of generating new product ideas. It is also important to engage high potential project leaders to manage the multi-stages of an R&D program cycle. It is relatively easy to recruit qualified scientists and specialists, but it is difficult to attract creative talents and high fliers to the R&D environment. The second risk is 'competence destruction.' When technological uncertainty is high, the companies attempting to develop highly radical or untried innovations (e.g. 'dot.com bubble') need to attract expert staff, but unpredictable outcomes may involve redundancy.

– *Challenge of Globalization*

Globalization is an overarching 'mega-trend', which will increasingly shape the world during the next decades. Globalization in simple terms has rewarded the rich people in both advanced and emerging economies and also the poor people in emerging economies. However, the job losses

experienced by poor people in rich countries have been exploited by politicians in Europe and USA to their advantage. Globalization offers both opportunities and challenges for research and development to create sustainable growths and more jobs. After more than a decade of widespread global R&D expansion, multinational companies expected their international research and product development functions to deliver results. However, recent studies (Basu and Wright, 2016) have identified challenges of global R&D programs including problems interfering against the driving motivations, insecure intellectual property regimes, unbalanced brain circulation flows and the relocation of FDI (foreign direct investment) in R&D from Europe and USA to other regions (notably Asia). Companies like General Electric responded to these challenges of globalization by what is also known as 'reverse innovation' where the local design of products is made in emerging markets for emerging markets.

Globalization also creates the opportunity for reverse innovation. Reverse innovation refers broadly to the process whereby goods developed as inexpensive models to meet the needs of developing nations, such as battery-operated medical instruments in countries with limited infrastructure are then repackaged as low-cost innovative goods for Western buyers. A proven cycle of reverse innovation is:

1. Voice of customers in the emerging market;
2. Develop technology, product and business model in the emerging market;
3. Meet needs of the emerging market
4. Adapt product and business model for developed market

– *The Challenge of Functional Tensions*

One of the greatest challenges involved in delivering a typical R&D project on time and within the allocated funding is the inherent tension between two contrasting elements. On the one hand, there exists the softer, creative R&D culture; on the other, the far more driven ethos behind project management. The Project Manager has the mandate which covers mediation between representatives of different cultures, the nature of which is driven by very opposing forces. A businessman is motivated by financial benefit, while a researcher is inspired by personal curiosity and creativity.

One fundamental difficulty is the management of knowledge and human resources. R&D managers supervise highly creative knowledge-based resources. By contrast, researchers have more loyalty to their science than the rigor of project management processes. There are also creative tensions and goal conflicts between local effectiveness and global program objectives, as well as between R&D hierarchy and project management processes. The third area of friction exists between creativity and discipline.

Interestingly, some authors argued that these challenges and tensions were not negative per se. Their recommendations included one effective approach to managing these tensions - the application of integrated project and program management in R&D. There is a demand for a Project Manager who could act as a mediator between R&D staff and the external non-academic world in order to address any functional tensions. Here we are trying to manage human emotions, the drive for results and intellectual pride. One approach is to increase the knowledge and understanding of project management processes amongst R&D managers. It is also important that Project Managers are exposed to the complexity and additional risks endured by R&D managers. When the R&D leadership brings together R&D Managers and Project Managers

using a shared office and facilities there is a better chance of building up a harmonious accord.

3.1 The Importance of Project Management in Research and Development

Having discussed why research and development are so important for the sustainable growth for both businesses and national economies and also the challenges we can explore the importance of Project Management in R&D. A simple argument is that R & D work is, by definition, hard to predict but the formal disciplines of project management can provide a means of helping to plan, organize and control multi-disciplinary projects without stifling innovation. This argument appears to be too simplistic, but it merits further development.

The study by Cowley (2005) analyses company survey results (based on 60 successful and unsuccessful projects of Canadian firms) to develop eight major factors to help distinguish between successful and unsuccessful R&D projects. These factors relate very closely to project management principles. Cowley also suggests a decision model where the R&D process is broken down into five stages entailing four decision points. The five project stages are: 1) Initial Screening, 2) Commercial Evaluation, 3) Development, 4) Manufacturing/Marketing Launch, and 5) Initial Commercialization. The four decision points are between the stages. These stages are comparable to the 'stage-gate process, first published by Cooper (2001). The concept of these stages is based on the principles of 'manageable chunks' and progressive risk control embedded in the discipline and rigor of project management.

A white paper by the US Department of Energy explores the merits and limitations of traditionally "projectizing" R&D and draws attention to the need for a more appropriate and tailored application of project management techniques

Turner and Cochrane (1993) described in their 'goals and methods' matrix four types of projects based on whether the goals and methods of a project are well defined or not. For example, projects with well-defined goals and well-defined methods are Type 1 projects, typified by engineering projects. Those with well-defined goals but not well-defined methods are Type 2 projects, typified by product development projects. Type 3 projects are typically information systems projects where methods are well defined, but the goals are ill-defined. Type 4 projects have both poorly defined goals and methods, and typically research and organizational change projects are in this category. According to the model by Turner and Cochrane (1993) both Type 2 and Type 4 could relate to innovation and new product development initiatives where methods are not well defined. In other words, these initiatives, in general, lack the rigor of project management methodology. Turner and Cochrane (1993) also argues that the success rate of a project will increase when both the goals and methods are well defined. Thus arguably we have established well-defined goals and methods as two key success factors of a project, including an initiative on innovation and product development which should be treated as a project. There is more published evidence (Basu, 2014) supporting the application of project management tools and techniques to enhance the successful delivery of R&D initiatives.

3.2 Research and Development Strategy

A company's survival depends on its efforts to create new customer value in the form of a new business, new product, new technology or a new process. The creation of new values are outcomes of R&D, and their successful deliveries are carried out by projects. We need an R&D strategy. The competitive challenges in today's R&D environment and

global marketplace are forcing organizations to be more responsive, agile and efficient than ever before. Arguably these challenges are more dominant in the development of drugs in the biopharmaceutical industry. It is estimated that 7 out of 10 drugs brought to market never generate enough revenue to recover the average cost of development. The average drug development cost had increased from \$500 million in 1996 to nearly \$1 billion in 2002. The Discovery pipeline needs to be considerably larger to keep the development pipeline filled. In order to meet these challenges, we need to revamp the development process and select an R&D project portfolio that would deliver the optimum value. The revamping of the development process is helped by the rigor of project management tools and processes. To select the project of optimum value we need a carefully developed portfolio strategy.

The Portfolio strategy represents a company's choice as to which set of projects balances the potential delivery of R&D results over time. Ultimately the portfolio strategy determines which R&D projects should be funded and at what levels. Some organizations see the portfolio as a top-down statement of aspirations, allocating resources to broad categories. For others, the portfolio is merely a bottom-up accumulation of available projects. The best practices of R&D strategy propose a variety of approaches for selecting the R&D portfolio, such as financial, strategic, scoring and 'bubble diagram' (e.g. Pearl, Oyster, Bread & Butter and White Elephant).

The 'bubble diagram' or the risk reward matrix is often compared with the 'growth-market share' matrix of Boston Consulting Group (www.bcg.com) where the product portfolio is grouped as Star, Wild Cat (Question Mark), Cash Cow and Dog. In this comparison Pearl is like Star, Oyster is like Wild Cat, Bread and Butter are like Cash Cow, and White Elephant is similar to Dog. Pearls address revolutionary commercial applications, and they deal with proven technical advances. Oysters represent early stage projects designed to produce a new strategic advantage. They have blockbuster potential, but breakthroughs are needed to unlock this potential. Bread and Butter projects indicate high probabilities of success and good commercial value. These projects usually focus on evolutionary improvements to current products and processes in existing development areas. Projects with high risks and low rewards are White Elephants. They consume resources, displace more promising projects, and are unlikely to enjoy technical success or produce substantial commercial value. A recommended approach to using the 'bubble diagram' is shown in the following three steps:

- Assign each R&D project to an appropriate quadrant of the 'bubble diagram' based upon quantitative evaluation of the project opportunity and risk
- Capitalize on Pearls, eliminate or reposition White Elephants, and balance the resources devoted to Bread-and-Butter and Oyster projects to achieve alignment with overall strategy
- Use the understanding of the 'bubble diagram' quadrants to regularly review the project portfolio to shape the way for managing individual projects.

4. Way forward

The boundaries of research are continually changing, and my analysis indicates some key areas of research strategy including:

- Genetic engineering where the direct manipulation of an organism's [genome](#) is conducted by inserting a new DNA into the host genome or by synthesizing the DNA and then inserting this construct into the host organism.

- Medical research for aging population to find better treatments for age-related ailments such as dementia and Alzheimer's and various forms of arthritis
- New digital and mobile technology including miniaturization and cloud computing
- Alternatives to fossil fuel energy including solar, tidal and wind power
- New generation of environment-friendly motor cars including electric and hybrids

In order to convert these strategies into the tangible outcome, we need right tools, skills, and funding. Tools are provided by research methodologies underpinned by the application of project management principles. Skills come from higher education and training in science, engineering, and technology. We also know that the sources of funding are mainly from the governments and private industries where the latter provides the major share. So here is a question to the Finance Minister, do you incentivize businesses to invest more in innovation and R&D. The answer is obviously yes. It can be argued the 'Patent Box' incentive by the previous UK government encouraged large companies to apply to lower their corporation tax. UK Government (HMRC, 2007) has also provided a complex process for claiming R&D tax credits for employee costs, staff provider costs, materials cost, clinical trial costs, software costs etc. But we need more to incentivize investment at the front end of R&D, and the process should be simpler. This how you may consider doing it. In addition, reducing the corporation tax (which is being legitimately manipulated by some multi-national companies) offer a tax break for additional investment in R&D above the threshold of R&D intensity. Depending on the type of industry the threshold should vary (e.g. Pharmaceuticals 12%, Automotive 4%, FMCG 2%). The details of the incentive scheme can be worked out with further analysis, but the principle is sound. Investment in innovation and R&D stays in the country to create sustainable productivity, growth in employment, a firm knowledge base and a resultant growth in the national economy ensuring intellectual properties at the start of the value chain.

Around £730 million a year of EU money is spent on research and development in the UK. Following the EU Referendum on 18 June 2016, the strategy of R&D funding is now more critical for the 'post-Brexit' United Kingdom when the supply of EU R&D grants will discontinue. Therefore, incentivizing investment in innovation is more critical in 'post Brexit' United Kingdom

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