The Changing Landscape for Funding Research and Development

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ABSTRACT

This research seeks to describe the continuing predicament of R&D funding in the U.S. and to provide support for a return to higher R&D spending as a proportion of GDP to maintain American leadership in innovation. Historically, government investment has funded most foundational scientific research leading to technological advances in communications, recording, and networks, including global positioning systems to the Internet. The U.S. has been leading in research and development. However, that investment leadership position is in question due to declining proportionate government support for R&D. The R&D function in private enterprise is ill-equipped to support long-term innovation, which will reward competitors. Past and current research evidence shows that public R&D investment leads private investment and furthers the strategic goals of innovation and economic growth. The COVID-19 pandemic led to unprecedented public research commitments to the rapid development of drugs, vaccines, and various protective and medical equipment. The long-term impact of this public investment on innovation is not clear. According to some theories, the trend of declining U.S. public investment in R&D will negatively impact U.S. economic growth.

Keywords: development, funding, investment, innovation, growth

INTRODUCTION

The United States has been preeminent in research and development (R&D), but this leadership position is increasingly in question (Bruce and de Figueiredo, 2020; Cannon et al., 2014). Historically, U.S. government investment funded most of the foundational scientific research leading to significant technological advances in communications, recording, and networks, including global positioning systems and the Internet (Cannon et al., 2014; Singer, 2014). However, evidence suggests a decrease in public R&D funding, which could become a trend of declining proportionate government support for R&D. AS reform of policy supporting government funding of R&D may be necessary to reverse this trend.

Based on theories of market systems and minimal government interference, there is a widely supported view that the private sector should lead in funding R&D, rather than the government 0using taxpayer-funded revenues for this purpose. To some extent, this view may reflect the belief that public R&D expenditures crowded out R&D investment within enterprises and private industry (Cannon et al., 2014; Wang et al., 2020). Yet, the R&D function in private enterprises is ill-equipped to support long-term that may also reward those competitors which did not participate in its creation (Wang et al., 2020).

However, the structure, role, and motivation of private R&D funding will need to be more fully developed if there is to be any expectation that the private sector can successfully supplement or entirely replace government-funded R&D. The research evidence continues to show that public R&D investment leads private investment and furthers the shared goal of innovation and economic growth (Cannon et al., 2014; Wang et al., 2020). This paper seeks to describe the predicament of R&D funding in the U.S. and provide support for a return to a higher percentage of GDP allocated to R&D to maintain American leadership in innovation. This study will support this argument by looking at the background, history, and comparative evaluation of the U.S. position as a funder of R&D in the global context.

BACKGROUND

The U.S. R&D Funding

While overall funding levels for American R&D investment have increased in absolute value as shown in Figure 1 (Appendix), the net effect when accounting for inflation and GDP growth is that R&D spending has been falling as a proportion of total spending in the American economy for a decade (Antonelli, 2019). The decreasing investment rate in R&D, as shown in Figure 2 (Appendix), was already well underway before the 2020 coronavirus pandemic event and its related economic impacts.

The federal government began decreasing its R&D commitment starting with the 2011 Budget Control Act (BCA), which created strict spending limitations that bound all federal departments and agencies (Hourihan & Parkes, 2016). Political leadership has also provided less support to public R&D programs (Wang et al., 2020). This political stance is based on the position that sustaining innovations would follow from allowing the market to make investment and allocation decisions without government interference. Essentially, there is less political and corporate faith in government-funded R&D outcomes, particularly science-based R&D, compared to the previous period (Antonelli, 2019).

According to the Organization for Economic Co-operation and Development (OECD), American gross domestic R&D expenditures in 2019, as shown in Table 1 (Appendix) and Figure 2 (Appendix), were steady at about 2.8% of GDP. The 2019 level of R&D expenditures ranged from 2.5% to 2.83% of annual GDP (OECD, 2020). The minimum reported R&D as a proportion of GDP reported between 1981 and 2019 was 2.268% in 1981. Although the greatest levels of R&D expenditures occurred over the past five years, this spending does not make up for the failure to increase the rate while other countries doubled their R&D investment rate. Overall, the quality of growth is negligible, even where it occurred.

By way of illustration, U.S. R&D spending as a proportion of GDP lags behind the R&D spending of other trading partners. For example, as indicated in Table 2 (Appendix), Israel consistently spends between 4.5% and 4.9% of GDP on public R&D investment. Korea spends between 3.9% and 4.5% of its annual GDP on R&D (OECD, 2020). China, Sweden, Austria, Germany, Denmark, and Japan spend between 3% and 3.5% of their annual GDP on R&D (OECD, 2020). The trend for each of these countries is a gradual increase in the rate of R&D expenditures as a proportion of GDP (OECD, 2020). However, the United States has struggled to maintain a ratio above 2.7% (OECD, 2020). In 1994, the U.S. was in third place in terms of R&D expenditures expressed as a percentage of GDP, behind Israel and Japan (OECD, 2020). At that time, 2.5% was considered a high rate of spending. Just ten years later, in 2004, Israel, Sweden, Finland, and Japan had moved past the 3% R&D rate barrier, and the U.S. moved down into the sixth spot (OECD, 2020). Ten years after that, as shown in Table 3 (Appendix), the rates for Israel and Sweden were above 4%, and the U.S. fell back into the tenth spot as many European nations increased their R&D commitment beyond the 3% mark (OECD 2020). The 2019 data, just five years later, as shown in Table 4 (Appendix), reveals that these positions have become relatively stable (OECD, 2020).

The outlook and recent history are worse when the focus is on public research funding targeting universities and educational institutions (Atkinson & Foote, 2019). OECD data reveals that the U.S. is in the 28th position out of 39 OECD countries in relation to public funding of university-based R&D as a proportion of GDP (Atkinson & Foote, 2019). One-third of governments invest at about double the U.S rate of investment (Atkinson & Foote, 2019). While other nations are also reducing their commitment to university R&D, the decline in investment is falling at a slower rate (Atkinson & Foote, 2019). It has been intimated that supporting university R&D at optimal levels would require increases of at least $5 billion U.S. annually, along with tax credits that target more research besides energy-related issues (Atkinson & Foote, 2019).

The counterargument is that the real dollar value of American public R&D spending is growing. While true to some extent, this argument avoids the impact of real dollar value and inflation on comparing spending levels. A second argument is that the real dollar value of U.S. R&D spending is so much higher than other countries spending, in part due to higher GDP, it is possible to maintain stable actual dollar levels. It is necessary to look at the conceptual framework that underlies R&D’s funding as an economic and social driver to explore this issue more thoroughly.

THE CONCEPTUAL FRAMEWORK

Research in the postwar era established a basis for the belief that technology and innovation were significant drivers of economic growth and industrial expansion (Szarowská, 2017). One outcome of this research track was the Solow-Swan model in 1956, which looked at long-term growth. The model determined the most efficient approach to productivity required remaining up to date and driving technological advances in a particular area of industry or products (Szarowská, 2017). The Solow–Swan model's neoclassical economic nature was grounded in capital available ideas, capital growth, labor growth, and productivity in relation to technological progress. The model was considered an advancement to the 1946 Harrod–Domar model and its Keynesian assumptions. These decades of theory development and empirical research resulted from belief in endogenous economic growth based on technological advancement, and the R&D that precedes it was central to policy. This result is reflected in the R&D funding levels of the U.S. federal departments and agencies in the second half of the twentieth century (Szarowská, 2017).

More recently, Szarowská (2017) confirmed the continued existence of a significant correlation between public R&D expenditures and the rate of economic growth in the European Union between 1995 and 2013. This fact provided further evidence that government R&D investments are a driver of development, and in the European context, one that overshadowed the returns of private investment in R&D (Szarowská, 2017). Much of the last two decades of empirical research in this area looked explicitly at the factors which helped to mediate or support this outcome (Szarowská, 2017). One concept was the equilibrium between technological advance, economic growth, population, industry, and the market's ability to absorb such positive changes (Szarowská, 2017). In other words, the equilibrium growth rate model proposed that there was an optimal rate of technological change in terms of efficiency and effectiveness (Szarowská, 2017). The research ideas and findings that drive technological change quickly diffuse across borders (Szarowská, 2017). Over time, all the best ideas are adopted by all, and in fact, global GDP can reflect this (Szarowská, 2017).

R&D LEADERSHIP

United States

Government expenditures on R&D traditionally have focused on high-capacity institutions and enterprises. However, there has been a noticeable shift of attention in the innovation community towards smaller, high technology research and development of startups. This shift has attracted the government's attention, and a small portion of R&D funding is directed towards incubators for such technology projects. While government grants continue to have prestige, private venture capital rewards can be higher. Innovators with a popular idea that does not attract either government or venture capital funding can still turn to the public in the form of crowd-sourced funding raising platforms such as Indiegogo, GoFundMe, and Kickstarter. Whether venture capital or crowd-sourced, attracting such sources of funds requires an idea developed to the point of being just short of marketable. It is not realistic to think that either source would fund basic scientific research.

Studies on research funding in America have produced many case studies, which are highly dependent on context. One case study explored clean energy startup businesses in the United States. The study noted that firms that had not acquired research grants from the government were the least likely to capture private research funding from the venture capital community (Islam et al., 2018). This result supports the general rule that firms that receive government grants are more likely to become funded by venture capital.

R&D expenditure related to pollution abatement has been an interest for both governments and private enterprises (Grover, 2017). It is surprising, given the rising significance of sustainability, that pollution abatement research expenditures have declined since 1973 in the U.S. (Grover, 2017). Such counterintuitive findings require understanding the broader ecosystem of research and research funding, as well as substitution and displacement effects (Grover, 2017).

There is a complexity to the problem of declining R&D investment, given that recent research has documented a decline in corporate R&D since 1980 (Arora et al., 2018). Since that time, corporate researchers and development units have been decreasing willingness to publish in the scholarly literature (Arora et al., 2018). While the development of R&D that may result in lucrative patents continues to be of interest to corporate leaders, there is little interest in the private sector in sharing the results of R&D investment (Arora et al., 2018). The benefits and rewards of private investment have been declining, but it is not apparent if that is the cause or result of reduced funding commitment (Arora et al., 2018).

In part, there is a prevailing theory in corporate decision-making of declining interest in participating in research (Arora et al., 2018). In this new model, the firm may still enter partnerships with universities towards a specified goal, and they even will acquire new startups that have promising leads on technological innovation (Arora et al., 2018). An overall withdrawal from science-based R&D by private corporations since 1980 reflects this theory, and even the substitution of market research does not close this gap (Arora et al., 2018).

Global Investment

The global context for R&D investment includes an increased leadership role in China, European nations, and the European Union community. Also, there is an important history lesson in the form of the global diffusion of Soviet R&D and human capital after the fall of the Soviet Union.

China

China has become a research and development powerhouse, both in terms of the number of scientists engaged and the increasing investment rate and returns on R&D at all levels of government (Boeing et al., 2016). Technology and innovation are part of state plans to support economic growth and expansion (Boeing et al., 2016). However, the productivity and performance of R&D in China varied dramatically depending on the sector and industry, as well as the form of ownership (Boeing et al., 2016). In China, private R&D investment by firms has the highest returns, compared to that of the R&D investment returns for firms with minority or majority state ownership (Boeing et al., 2016). This result is the same when measured in either dollars or patents (Boeing et al., 2016).

An area of research interest concerning Chinese funding of R&D has been the allocation of government funding and the extent to which they have effectively achieved the goals to further private R&D investment (Boeing, 2016). A notable feature of the national Chinese R&D funding system is that it includes previous grant winners, and minority state ownership has helped secure such status (Boeing, 2016). There are many variations at the provincial level in China, as urban provinces with higher revenues also have more significant resources and more increased investment in R&D (Boeing, 2016). The crowding-out problem of enterprises withdrawing from investment as Chinese governments provide R&D subsidies continues to be debated in the scholarly literature. There is some consensus that it is less likely to be an issue for high technology, repeat recipients of R&D grants, and those firms with state minority ownership

(Boeing, 2016). An analysis of the effect of government R&D and non-R&D subsidies supports the practice for technology firms, revealing that both are likely to impact later IPO performance positively, despite the mediating factor of state ownership (Chen et al., 2018).

Addressing the inefficiency of R&D is a concern for all countries, but it is a significant concern in China, given the high levels of public funding provided for R&D (Yang et al., 2020). It is alleged that the granting of funds for R&D is improperly allocated, and the potential of R&D is incorrectly assessed (Yang et al., 2020). Over time, however, the elasticity of the output of R&D investment is stabilizing, and the human capital factor of persons qualified and trained in R&D-related fields is rising (Yang et al., 2020).

Europe

Western European countries are always ranked among the top ten countries in terms of R&D spending at the highest levels. Grants and research funding can occur at the European Union (EU) level for cross-border studies of interest to all member nations or federal subsidies at the country level (Dvouletý et al., 2020).

Czarnitzki and Delanote (2017) provided further evidence from Belgium, which confirms the complementary effects of private and public R&D, and reflects the increasing interest of private enterprises in ongoing research. However, they did not discover any significant evidence of a relationship to the market performance of products that resulted from this R&D based on public or private subsidy sources (Czarnitzki and Delanote, 2017). An evaluation of research funding in the EU found multiple indicators of positive impacts of public subsidies, including the degree of participation, dissemination and knowledge transfer, and university collaboration with the private sector (Szücs, 2018).

Post-Soviet R&D

In the late 20th century, Soviet expenditure data was not available. However, advancements and intelligence could be estimated. Soviet R&D was a matter intricately connected to foreign policy and defense against enemies. A seminal work by Les Aspin (1976) in Foreign Policy explained the issue of a missile gap, a concept describing how Soviet outspending of American defense R&D related to the escalating United States' growing insecurity. As the Soviet domain collapsed in the early 1990s, so did much of the infrastructure and networks which had previously supplied it with human capital and resourcing. The U.S. did not stand still and provided a grant program to as many as 28,000 Soviet scientists (Ganguli, 2017). Empirical research shows that these grants to assist in resettling scientists in the U.S. had the net effect of doubling publications in mathematics and other subjects where Soviet research had been strong (Borjas & Doran, 2012; Ganguli, 2017).

THE R&D MARKET FAILURE

R&D market failure refers to government interference in the R&D market, which may lead to loss, represented by the crowding out private investment. It may also refer to the business perspective of research and the high market failure of R&D investment (Choi & Lee, 2017). A market failure may also occur if R&D investment fails to achieve an optimal result for markets or what is socially optimal. For example, if corporate R&D were to drive innovation, it would likely be proprietary, and therefore it would not provide the degree of dissemination required to support economic expansion. By contrast, there is the argument that at the individual level, the high level of market failures for early research supports the need to use public funds cautiously and with accountability. It is essential to monitor public funds' use and accountability and ensure value in the outcomes for R&D spending.

THE IMPLICATIONS OF REDUCED R&D INVESTMENT

R&D is a direct driver of economic growth and employment. However, jobs in the R&D sector and their economic benefits may move to overseas locations in Europe and Asia where R&D funding remains high (Cannon et al., 2014). A reduction in U.S. R&D investment may result in more severe outcomes in the long-term such as fewer growth drivers, lower employment, and decreased capital accumulation. If the U.S. loses R&D investment leadership, the U.S. could also lose economic, competitive advantage in a global economy focused on continuous improvement and technological advancement.

Keeping Pace with Change

There is an ecosystem of potential financial and economic reasons why the reduction of R&D investment will negatively impact multiple levels, including government revenues from taxation. It is argued that one problem of government R&D funding is that it has been unresponsive to economic indicators (Tassey, 2020). U.S. domestic economic policy has focused on the status quo. It is not seeking out new disruptors such as those driven by technology and digital platforms. Declining GDP and performance have preoccupied decision-makers who have consequently demonstrated less interest in innovation and advancement (Tassey, 2020). However, the Solow-Swan model's main point is that significant expansion and growth require positive technological change. A further consideration for governments concerned with revenues from individual taxation amid declining GDP growth is that workers in high-tech and cutting-edge sectors and industries make about twice that of the average worker (Tassey, 2020).

Impact of the Covid-19 Pandemic

There are several impacts on R&D funding concerning the COVID-19 pandemic of 2020. As a consequence of the fast spread of the deadly virus, economic activity came to a standstill. While productivity is at an all-time low, unemployment is at an all-time high in the U.S. and elsewhere. This impact has coincided with an unprecedented need for innovation in developing a vaccine, protective equipment to prevent infection spread, and ventilators for use in hospitals. While nations have been harnessing their R&D capital and infrastructure with the spread of the coronavirus, there are many unknowns concerning the short-term research requirements or the long-term impact that this event may have on R&D spending. R&D related to COVID-19 is considered critical, and both a vaccine and drugs to lessen symptoms are the desirable outcomes (Cattani, 2020). By March 24, 2020, more than 500 clinical trials related to COVID-19 had been registered (Cattani, 2020). Such clinical trials' locations reflected the intensity with which countries were impacted by the coronavirus, with China, South Korea, and Europe leading research (Cattani, 2020). Not only has there been the commitment of public funds to research efforts, but it also is widely believed that a vaccine might be developed as early as 2021, despite the tradition of ten years or more in clinical research trials (Le et al., 2020).

Policymakers and research funders are warned that reactive funding that cannot be sustained over the long-term is unlikely to add real value as an investment (Prudêncio & Costa, 2020). Despite $100 million in SARS research funding in 2004, or the €400 million contributed by European organizations to fight Ebola, there is still no vaccine, no cure, and no licensed drugs to help for either disease (Prudêncio & Costa, 2020). This failure to develop meaningful medical treatments for SARS is instructive in light of the availability of research and evidence that a possible SARS pandemic could originate from reservoirs of infectious bats (Abi Younes et al., 2020). The research result did not provide the strong signaling that governments would have needed to create the political will to invest in prevention at higher levels (Abi Younes et al., 2020).

In terms of funding levels, early reports by the OECD in relation to self-reported commitments of governments to COVID-19 research reveals that in terms of the actual dollars, the U.S. is the top funder of such R&D, as shown in Table 5 (Appendix). While many countries reported that further R&D commitments, as shown in Table 6 (Appendix), were still to be determined, the overall funding level of nearly 3.9 billion dollars committed by the U.S. is more than twenty times the reported investment of any single country (OECD, 2020b).

While the European Union commitment of nearly $500 million as shown in Figure 3 (Appendix), combined with more than $300 million from other countries in Europe, is sizeable, it represents the contribution of a coalition of nations, and it is less than a quarter of the American R&D commitment to COVID-19 research.

Recommendations and Conclusions

The evidence continues to show that U.S. leadership position in R&D investment is critical to avoid negative effects on productivity, growth, and innovation, which are critical to the nation's employment and economic activity. The post-Soviet example is a warning about the loss of R&D infrastructure and human capital, which can occur when these research and development systems are not supported, which brings us to the next recommendation.

While the U.S. has a robust R&D infrastructure, the rising levels of R&D funding in other nations may provide more appealing environments for researchers and research. It is the sustained research context, rather than that of the short-term, which determines the direction in which the human capital of R&D, including scientists, analysts, and specialized research assistants, will migrate.

The COVID-19 global pandemic has compelled governments to make short-term increases in R&D spending specific to this health crisis. However, history tends to repeat itself. Similar short-term spending has not proven to be compelling investments. U.S. sustained investment in R&D must return to a higher proportion of GDP as a means of maintaining U.S. leadership in innovation critical to continued growth and global competitive advantage.

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Appendix

Figure 1: US Public R&D Expenditures
(Based on data from OECD, 2020)

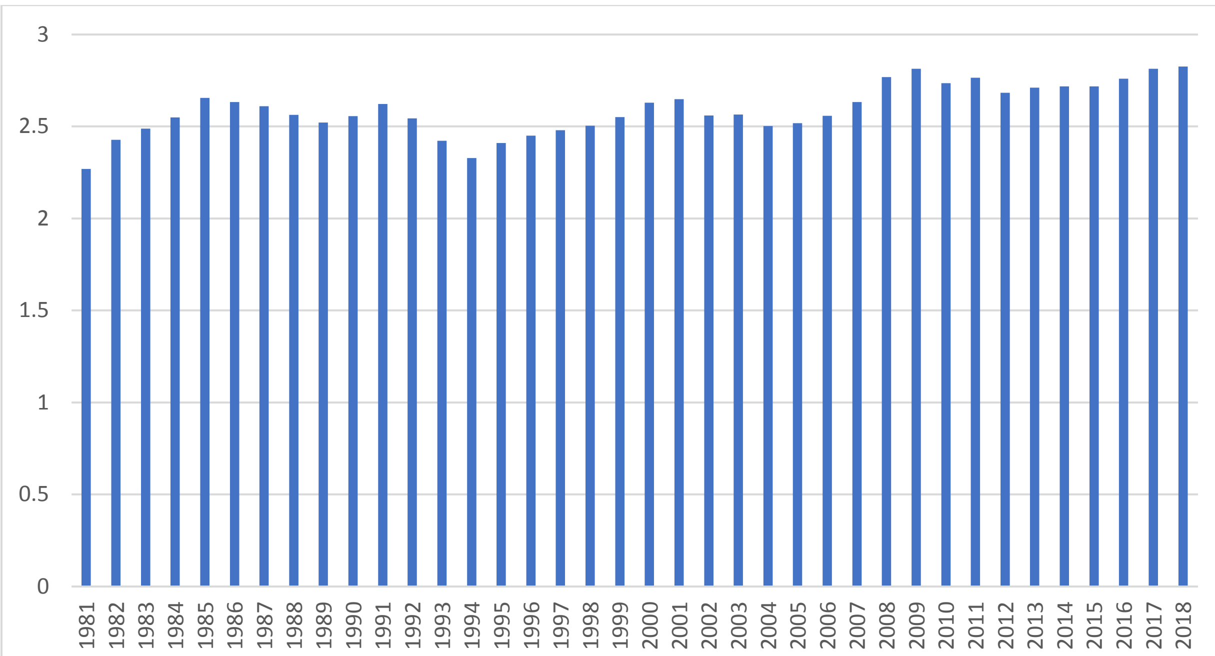

Table 1: Research and Development Spending as % of GDP
(Based on data from OECD, 2020)

YEAR	US R&D AS % OF GDP	% CHANGE
1981	2.268	
1982	2.427	7.0%
1983	2.488	2.5%
1984	2.548	2.4%
1985	2.655	4.2%
1986	2.633	-0.8%
1987	2.609	-0.9%
1988	2.563	-1.8%

YEAR	US R&D AS % OF GDP	% CHANGE
1989	2.521	-1.6%
1990	2.556	1.4%
1991	2.621	2.5%
1992	2.543	-3.0%
1993	2.422	-4.8%
1994	2.328	-3.9%
1995	2.409	3.5%
1996	2.45	1.7%
1997	2.48	1.2%
1998	2.504	1.0%
1999	2.55	1.8%
2000	2.629	3.1%
2001	2.648	0.7%
2002	2.559	-3.4%
2003	2.565	0.2%
2004	2.502	-2.5%
2005	2.517	0.6%
2006	2.558	1.6%
2007	2.632	2.9%
2008	2.768	5.2%
2009	2.813	1.6%
2010	2.735	-2.8%
2011	2.765	1.1%
2012	2.682	-3.0%
2013	2.71	1.0%
2014	2.718	0.3%
2015	2.717	0.0%
2016	2.76	1.6%
2017	2.813	1.9%
2018	2.826	0.5%

Figure 2: % change in R&D funding as % of GDP, United States
(Based on data from OECD, 2020)

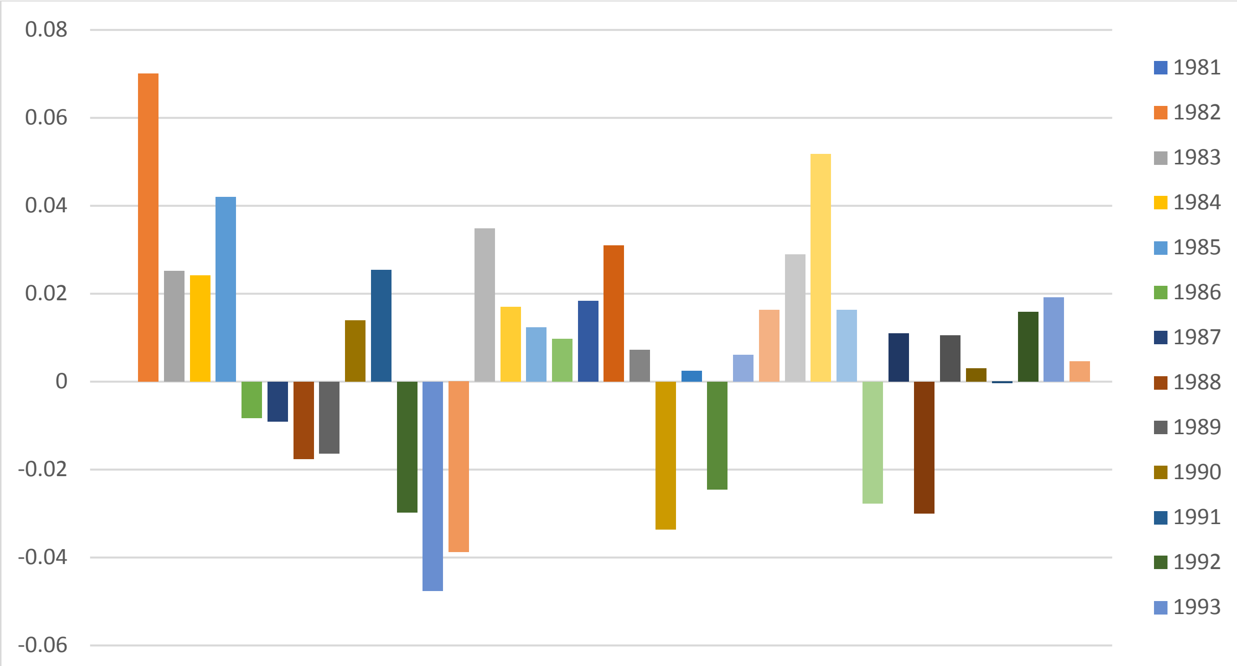

Table 2: Israel's leadership in R&D as a % of GDP
(Based on data from OECD, 2020)

YEAR	ISRAEL
1999	3.33
2000	3.933
2001	4.185
2002	4.131
2003	3.893
2004	3.873
2005	4.048
2006	4.141
2007	4.422
2008	4.342
2009	4.133
2010	3.935
2011	4.015
2012	4.161
2013	4.096
2014	4.174
2015	4.265
2016	4.512
2017	4.816
2018	4.941

Table 3: The comparative position of R&D spending as % of GDP
(Based on data from OECD, 2020)

	2014	2015	2016	2017	2018
Israel	4.174	4.265	4.512	4.816	4.941
Korea	4.078	3.978	3.987	4.292	4.528
Japan	3.4	3.282	3.158	3.208	3.275
Finland	3.148	2.872	2.724	2.732	2.755
Sweden	3.102	3.219	3.247	3.363	3.321
Austria	3.084	3.05	3.119	3.049	3.14
Chinese Taipei	3.007	3.051	3.154	3.283	3.462
Denmark	2.914	3.055	3.093	3.05	3.033
Germany	2.878	2.93	2.941	3.068	3.13
United States	2.718	2.717	2.76	2.813	2.826
China (People's Republic of)	2.022	2.057	2.1	2.116	2.141
European Union (28 countries)	1.942	1.953	1.94	1.98	2.025

Table 4: R&D as a % of GDP 2014 – 2018
(Based on data from OECD, 2020)

COUNTRY	2014	2015	2016	2017	2018
Argentina	0.592	0.619	0.53	0.557	
Australia		1.877		1.787	
Austria	3.084	3.05	3.119	3.049	3.14
Belgium	2.37	2.428	2.523	2.661	2.678
Canada	1.714	1.693	1.729	1.669	1.563
Chile	0.375	0.381	0.369	0.356	0.35
China (People's Republic of)	2.022	2.057	2.1	2.116	2.141
Chinese Taipei	3.007	3.051	3.154	3.283	3.462
Colombia	0.303	0.323	0.296	0.262	0.286
Denmark	2.914	3.055	3.093	3.05	3.033
Estonia	1.421	1.457	1.246	1.28	1.404
European Union (28 countries)	1.942	1.953	1.94	1.98	2.025
Finland	3.148	2.872	2.724	2.732	2.755
France	2.276	2.267	2.222	2.203	2.193

Germany	2.878	2.93	2.941	3.068	3.13
Greece	0.833	0.961	0.994	1.131	1.18
Hungary	1.349	1.347	1.19	1.332	1.533
Ireland	1.523	1.183	1.169	1.237	0.997
Israel	4.174	4.265	4.512	4.816	4.941
Italy	1.338	1.339	1.366	1.37	1.426
Japan	3.4	3.282	3.158	3.208	3.275
Korea	4.078	3.978	3.987	4.292	4.528
Latvia	0.688	0.623	0.44	0.515	0.641
Lithuania	1.031	1.044	0.842	0.896	0.942
Luxembourg	1.264	1.302	1.298	1.269	1.211
Mexico	0.435	0.43	0.388	0.328	0.313
New Zealand		1.232		1.347	
Norway	1.715	1.935	2.045	2.099	2.061
OECD – Total	2.319	2.31	2.302	2.342	2.379
Poland	0.94	1.003	0.964	1.034	1.21
Portugal	1.29	1.243	1.281	1.319	1.355
Romania	0.382	0.488	0.48	0.503	0.501
Russia	1.072	1.101	1.102	1.11	0.983
Slovak Republic	0.878	1.163	0.791	0.886	0.838
Slovenia	2.365	2.196	2.011	1.866	1.951
South Africa	0.771	0.798	0.819		
Spain	1.242	1.222	1.19	1.21	1.243
Sweden	3.102	3.219	3.247	3.363	3.321
Switzerland		3.372		3.293	
Turkey	0.861	0.882	0.945	0.96	1.035
United Kingdom	1.643	1.65	1.66	1.68	1.729
United States	2.718	2.717	2.76	2.813	2.826

Table 5: Top funders of COVID-19 R&D
(Based on data from OECD, 2020b)

COUNTRY		**TOTAL EXPECTED FUNDING LEVEL (IN U.S. millions)**
United States	$	3,895.4
European Union	$	490.56
Korea	$	176.00

COUNTRY		TOTAL EXPECTED FUNDING LEVEL (IN U.S. millions)
Japan	$	121.30
United Kingdom	$	107.10
Canada	$	55.86
Netherlands	$	48.50
France	$	42.60
Luxembourg	$	36.00
Spain	$	34.85
Germany	$	33.00
Austria	$	27.20
Australia	$	26.55
Brazil	$	20.45
Russian Federation	$	20.00
Denmark	$	14.20
Israel	$	13.00

Figure 3: Comparing U.S. and European funding allocations to COVID-19 R&D
((Based on data from OECD, 2020b)

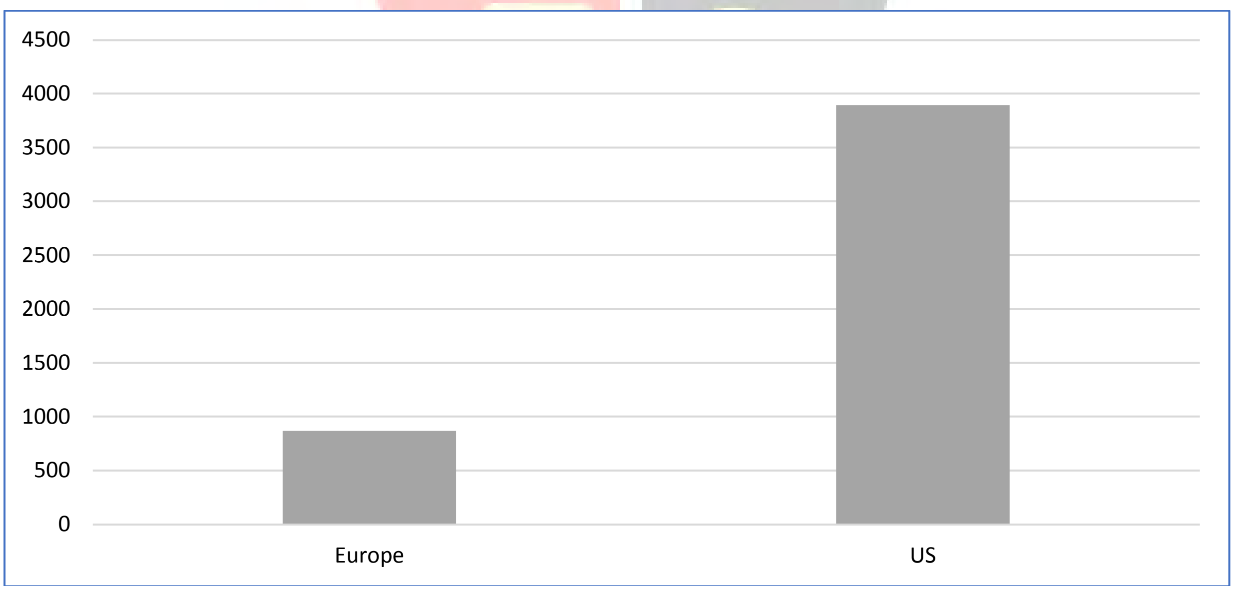

Table 6: COVID-19 related R&D inputs reported to the OECD
(Based on data from OECD, 2020)

COUNTRY /REGION	COUNTRY/REGION ACRONYM	PROGRAM NAME	EXPECTED FUNDING LEVEL (IN US)
United States	US	BARDA Broad Agency Announcement (BAA	2000.00
United States	US	Notice of Special Interest (NOSI) regarding the Availability of Emergency Competitive Revisions for Research on Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and Coronavirus Disease 2019 (COVID-19)	836.00
United States	US	Notice of Special Interest on the 2019 novel Coronavirus	550.00
European Union	EU	European Commission call for Innovators for COVID-19 EIC Accelerator	177.00
Korea		vaccine commercialization technology development project	176.00
European Union		Horizon 2020	145.00
United States	US	Notice of Special Interest on the 2019 novel Coronavirus	103.40
European Union	EU	Development of therapeutics and diagnostics combatting coronavirus infections	101.80
Japan	COVID-19 supplement to existing call	Cyclic Innovation for Clinical Empowerment (CiCLE)	95.00
United States	US	RAPID	75.00
United States		Peer Reviewed Medical Research Program Clinical Trial Award	75.00
United States		Peer Reviewed Medical Research Program Investigator-Initiated Research Award	75.00
United States		Peer Reviewed Medical Research Program Technology: Therapeutic Development Award	75.00
European Union	EU	Advancing knowledge for the clinical and public health response to the [COVID-19] epidemic	65.00
United States		National Institute of Biomedical Imaging and Bioengineering (NIBIB)	60.00
United Kingdom			58.00
Netherlands		Additional appropriations for emergency corona research	46.50
Canada	CAN	Canadian 2019 Novel Coronavirus (COVID-19) Rapid Research	36.40

COUNTRY /REGION	COUNTRY/REGION ACRONYM	PROGRAM NAME	EXPECTED FUNDING LEVEL (IN US)
United States	US	Notice of Special Interest (NOSI): Repurposing Existing Therapeutics to Address the 2019 Novel Coronavirus Disease (COVID-19)	36.00
Luxembourg		“new aid linked to the development and production of products in the fight against Covid-19”	36.00
Spain			30.00
Austria	AUT	Emergency Call for research into COVID-19 in response to the Sars-CoV-2 outbreak	25.00
United Kingdom	UK	COVID-19 Genomics UK Consortium	23.50
United Kingdom	UK	COVID-19 Rapid Response Call	23.00
Russian Federation			20.00
Japan		Drug Discovery Support Program: Development of Covid-19 vaccine	19.00
Germany		Funding announcement for research on COVID-19 in the wake of the SARS-CoV-2 outbreak	18.00
France	FRA	Flash Call COVID-19	16.00
Germany		Call for Multidisciplinary Research into Epidemics and Pandemics in Response to the Outbreak of SARS-CoV-2	15.00
France		Call for projects for innovative solutions to fight COVID-19	13.00
Israel			13.00
Australia		UQ – University of Queensland research – COVID-19 vaccine project	11.00
Canada		Pandemic Response Challenge Program	10.70
Brazil			10.00
Brazil			10.00
United States		Centers for Disease Control COVID-19 Broad Agency Announcement	10.00
Finland		Special call for applications for research into COVID-19	9.20
France	FRA	COVID-19: 20 projects’	8.60
Thailand			8.00

COUNTRY /REGION	**COUNTRY/REGION ACRONYM**	**PROGRAM NAME**	**EXPECTED FUNDING LEVEL (IN US)**
Denmark	DNK	[no specific program]	7.10
Denmark		Extraordinary Grand Solutions call: COVID-19	7.10
Colombia		Call MinCienciatón	6.40
Portugal		Emergency Fund Covid-19	6.00
Australia	AUS	Fast-tracking research into treatments for COVID-19	5.10
Argentina		COVID-19 – Convocatoria Extraordinaria	5.00
Canada		COVID-19 Challenge: Made in Canada filtration material for the manufacture of N95 respirators and surgical masks	5.00
France		Règlement de l'appel à projets flash COVID-19 SUD de l'ANRS	5.00
Sweden		Finding new ways in the time of a crisis	5.00
Spain			4.85
Japan	JPN	AMED support for research on the novel coronavirus disease (COVID-19)	4.70
Belgium (French part)		CUR (Credit Urgent de Recherche) and PER (Projets exceptionnels de Recherche)	3.30
Portugal		AI 4 COVID-19: Data Science and Artificial Intelligence in the Public Administration to strengthen the fight against COVID-19 and future pandemics – 2020	3.30
Australia	AUS	Fast-tracking research into treatments for COVID-19	3.20
Belgium		Special call for COVID-19 research projects	3.00
Australia		Covid-19 National Health Plan	2.90
United Kingdom		The Joint Initiative on Research in Pandemic Preparedness and Response (JIREP),	2.60
Norway		COVID-19 Emergency Call for Proposals: Collaborative and Knowledge-building Projects for the Fight Against Coronavirus Disease (COVID-19)	2.50
Poland		EXPRESS CALL TO FUND RESEARCH ON COVID-19	2.40
Austria		no specific program	2.20
Netherlands			2.00
Canada		COVID-19 challenge – Low-cost sensor system for COVID-19 patient monitoring	1.90

COUNTRY /REGION	COUNTRY/REGION ACRONYM	PROGRAM NAME	EXPECTED FUNDING LEVEL (IN US)
Canada		COVID-19 Challenge — Point of Care and Home Diagnostic Kit for COVID-19	1.86
Australia		Covid-19 National Health Plan	1.70
Norway		COVID-19 Emergency Call for Proposals: Collaborative and Knowledge-building Projects for the Fight Against Coronavirus Disease (COVID-19)	1.70
Portugal		RESEARCH 4 COVID-19	1.64
South Africa			1.60
Peru			1.50
Japan	JPN	Research Program on Emerging and Re-emerging Infectious Diseases in FY2019	1.40
Australia	AUS	Fast-tracking research into treatments for COVID-19	1.30
Estonia		RITA	1.20
New Zealand		2020 COVID-19 and Emerging Infectious Diseases Grant	1.14
European Union		Fighting COVID-19 Open Call 2020	1.10
Australia		Medical Research Future Fund (MRFF)	0.95
South Africa			0.665
European Union		EIT Health COVID-19 “Rapid Response” in 2020 for on-going and new projects	0.66
Japan		J-RAID	0.60
Japan		Supplement to on-going projects of Strategic Basic I Porgrams (CREST, PRESTO)	0.60
New Zealand		2020 COVID-19 New Zealand Rapid Response Research	0.57
Brazil			0.45
Australia		Fast-tracked funding for the COVID-19 pandemic to support critical research areas	0.40