

# THE ECONOMICS OF RESEARCH

---

THREE SOCIOECONOMIC IMPACT ANALYSES OF  
INVESTING IN RESEARCH IN DENMARK



## MORE KNOWLEDGE IS NEEDED ON THE IMPACT OF INVESTING IN RESEARCH

---

In a world with increasing international competition for resources and solutions, research, education and innovation are prerequisites for Denmark's ability to maintain lasting economic growth in the long term. Nevertheless, although Denmark invests more than DKK 20 billion (€3 billion) on public research annually, there is very little specific knowledge on how investing in research influences relevant socioeconomic parameters such as gross domestic product (GDP). Further, the economic impact on Danish society of recruiting and retaining researchers from abroad at public research institutions in Denmark has not yet been calculated.

The Novo Nordisk Foundation therefore recently initiated an analysis of the impact of public funding of private research within the life sciences and two analyses of the impact of investing in public research.

The overall results are described in a new report (in Danish): *Forskningsøkonomi – 3 samfundsøkonomiske effektanalyser af investeringer i forskning i Danmark* [The economics of research – three socioeconomic impact analyses of investing in research in Denmark]. This brochure summarizes some of the most important conclusions from the full report, which is available on the Foundation's website.

The Foundation would like to thank all the researchers, economists and other experts who have contributed to the analyses.

Although these three new analyses shed some light on several important effects of investing in research, further research in this topic is still required. The Foundation intends to contribute to supporting this research field in the coming years.

*Novo Nordisk Foundation, April 2016*

## OVERVIEW OF THE THREE ANALYSES AND THE RESULTS

1

WHAT IS THE IMPACT OF PUBLIC FUNDING OF PRIVATE RESEARCH WITHIN THE LIFE SCIENCES?

ANSWER

Public funding of private research strongly reinforces the private sector's own funding of research. In monetary terms, for every €1 of public funding earmarked for research and development given to companies in the life sciences, the companies increase their own investment in research and development by an additional €4–11.

2

WHAT IS THE SOCIO-ECONOMIC IMPACT OF CHANGES IN INVESTMENT IN PUBLIC RESEARCH?

ANSWER

Increasing investment in public research increases GDP, public consumption, private investment and private consumption in the short term (5 years) and medium term (10 years).

3

WHAT IS THE ECONOMIC IMPACT OF ADDING RESEARCHERS FROM ABROAD TO THE PUBLIC RESEARCH SECTOR IN DENMARK?

ANSWER

Adding researchers from abroad to the public research sector has macroeconomic benefits for Denmark's economy. These researchers increase GDP, employment, public and private investment and consumption.

### BACKGROUND FOR THE ANALYSES

Socioeconomic impact analyses require both economic theory and empirical models. The Foundation has therefore collaborated with external experts. In the spring of 2015, DAMVAD Analytics investigated several economic model configurations based on a licensed version of the Annual Danish Aggregate Model (ADAM). The Danish Rational Economic Agents Model (DREAM) research group undertook simulations in the DREAM model in the autumn of 2015. The models and the results were then discussed with researchers and economists at the University of Copenhagen, Copenhagen Business School, the Think Tank DEA, the DREAM research group, DAMVAD Analytics and the Danish Agency for Science, Technology and Innovation under the Ministry of Higher Education and Science.

## WHAT IS THE IMPACT OF PUBLIC FUNDING OF PRIVATE RESEARCH WITHIN THE LIFE-SCIENCE INDUSTRY?

### BACKGROUND

We know that research within the life sciences can result in new forms of scientifically based prevention and treatment of disease, which can improve people's quality of life and longevity. However, knowledge about the economic impact of public investment in research and development is limited in Denmark.

Research within the life sciences carried out by private companies is mainly publicly funded through public-private research partnerships that may accompany parallel public investment in research activities in public research institutions. Public funding bodies such as Innovation Fund Denmark, the European Union Framework Programme for Research and Technological Development etc. may provide the public investment.

### PURPOSE AND METHODS

The analysis sought to determine whether increased public funding of the research and development carried out by private life-science companies is causally linked with, for example, the companies' own investment in research and development.

The analysis examined this question by modelling a structural selection model and applying four econometric models. The analysis was based on Statistics Denmark's data from 408 research companies active in research within the life-science industry that have registered expenditure related to research and development more than once during 2000–2013. During this period, 75 of these 408 companies received public funds for research and development activities. The data appear as a time series, which enables the public and private funding of a private company's research activities to be compared over the years.

### RESULTS

The main result shows that public funding of research and development carried out by private companies increases these private companies' own investment in research and development.

The analysis finds that a 1% increase in the public funding of private research leads to an increase in the private companies' own investment in research of between 0.16% and 0.40%.

This percentage may seem low, but given the distribution of the total investment in privately funded research and the total public funding, the result is very much in accordance with international findings. For every €1 of public funding invested in life-science companies' research and development activities, the companies' own investment increases by €4–11. This impact was measured for up to 13 years following the receipt of public research funding.

The companies' own funding of additional research resulting from additional public investment in research was calculated based on the following:

- ▶ total public investment in research for the whole period of €230 million, so that a 1% increase would be €2.3 million; and
- ▶ total private funding for research for the whole period of €6.0 billion, so that an increase ranging from 0.16% to 0.40% amounts to €9.6 million to €24.0 million.

A change in public investment of €1 therefore results in a change in private investment of €4–11.

## CONCLUSION

Public investment in private research substantially boosts the investment in private research.



## WHAT IS THE SOCIOECONOMIC IMPACT OF CHANGES IN INVESTMENT IN PUBLIC RESEARCH?

### BACKGROUND

Public research can be dispersed throughout society through research collaboration and the dissemination of knowledge. Universities and other knowledge institutions recruit and educate researchers and graduates who acquire new knowledge and can thus offer highly educated employees to companies in Denmark. New knowledge, technologies and discoveries that emerge through public research can lead to the creation of new companies or contribute to developing established companies.

This may increase companies' investment in research, which will increase the demand for knowledge, goods, services, trade and new technologies throughout society. Overall, this increases the productivity per hour worked, production and the income of the population. More people are employed, which will increase consumption and welfare.

### PURPOSE AND METHODS

The purpose of the analysis was to map the impact on Denmark's economy and to quantify the impact of changes in the investment in public research. The analysis used the Annual Danish Aggregate Model (ADAM) of Statistics Denmark to calculate the macroeconomic impact (such as production, employment and consumption) resulting from additional investment in public research.

ADAM is a demand-driven model, and the estimates in this analysis are based on the following assumptions from the literature.<sup>1</sup>

- ▶ Changes in funding of public research influence private research funding by 0.10%.
- ▶ Private research increases a company's labour productivity by 0.09%.
- ▶ The impact on productivity only relates to the life-science sector of the economy.
- ▶ The increase in productivity is estimated conservatively, and the impact on the increase in productivity must be assumed to underestimate the long-term impact compared with the assumptions in the theoretical literature

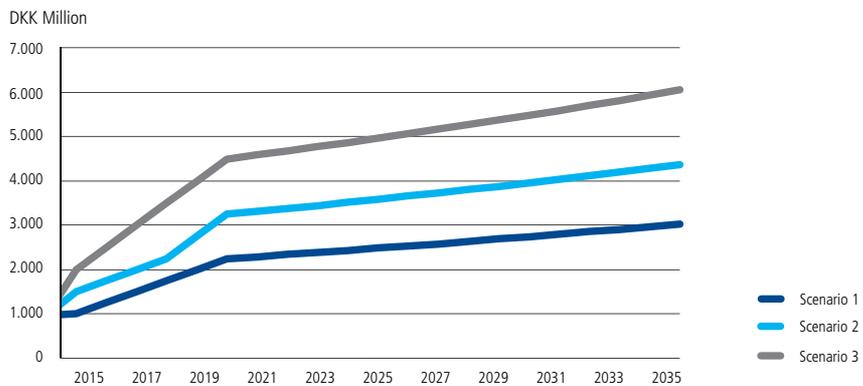
ADAM estimates the impact for three scenarios of an annual addition of extra investment in public research in 2015–2020, and thereafter the funding of public research follows the general economic trends. The model assumes gradually phasing in a permanent increase in the public funding of research from 2015 to 2020. Each scenario is compared with ADAM's baseline scenario calculation for 2014.

<sup>1</sup> The results from HERG, OHE and RAND Europe (Medical research: what's it worth? London: Office of Health Economics; 2008) show that increasing public research by 1% increases private research expenditure by about 0.10%. Denmark's Ministry of Higher Education and Science has shown that an increase of 1% in private research expenditure boosts productivity in companies by about 0.09–0.15%.

Figure 1 provides an overview for each scenario of the annual addition of funding for public research.

FIGURE 1

THREE SCENARIOS FOR ADDITIONAL FUNDING FOR PUBLIC RESEARCH, 2014–2035



## RESULTS

Table 1 provides an overall overview of selected results for the three scenarios. The results are the changes caused by the addition of investment in public research compared with the baseline calculation in ADAM. The baseline calculation includes the projected trends in Denmark's economy from 2015 without any increase in the public funding of research. Demand comprises domestic consumption and investment. Supply comprises GDP and net imports.

For example, in scenario 1 the change in GDP relative to the baseline calculation for 2020 is DKK 2 billion (€269 million). The change in GDP is positive and thus higher than the baseline calculation but the rate of increase declines over time.

TABLE 1

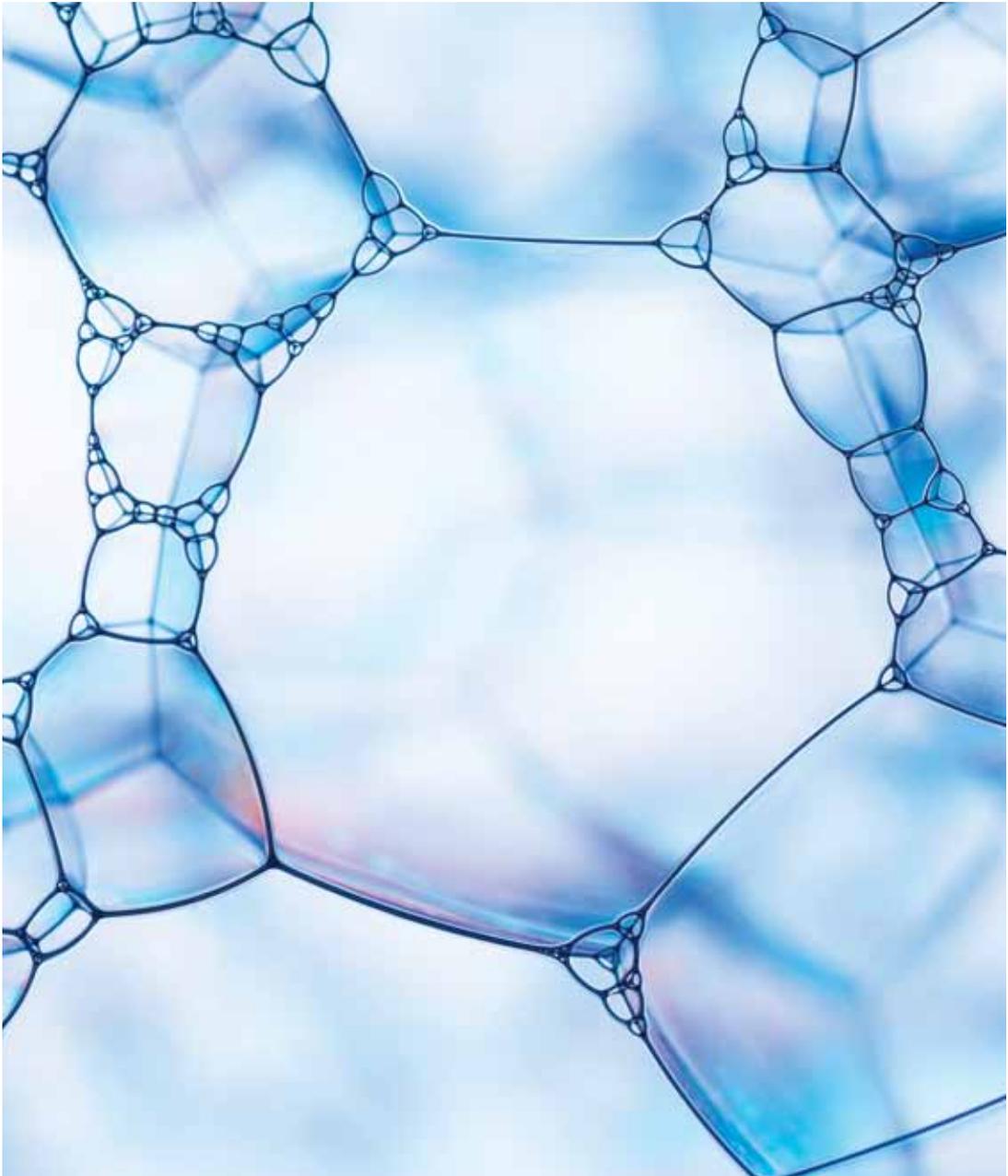
IMPACT (IN MILLIONS DKK) ON KEY ECONOMIC PARAMETERS OF THE INCREASED INVESTMENT IN RESEARCH IN THREE SPECIFIC YEARS: 2020, 2025 AND 2055 (CHANGE RELATIVE TO THE BASELINE CALCULATION OF ADAM<sup>2)</sup>)

		Demand			Supply	
		Private Consumption	Public Consumption	Private investments	GDP	Net import
Short term 2020	Scenario 1	912	2.759	386	2.040	2.024
	Scenario 2	1.384	3.978	693	3.420	2.649
	Scenario 3	1.810	5.515	930	4.721	3.746
Medium term 2025	Scenario 1	1.738	2.769	337	1.688	3.169
	Scenario 2	2.506	3.996	453	2.456	4.517
	Scenario 3	3.530	5.540	621	3.360	6.359
Long term 2055	Scenario 1	2.295	2.797	96	895	4.310
	Scenario 2	3.889	4.025	453	1.522	6.227
	Scenario 3	4.609	5.595	178	1.787	8.634

<sup>2)</sup> 1 € = 7.44 DKK

## CONCLUSION

Increasing the funding for public research has a positive socioeconomic impact, based on changes in public and private consumption, investment and GDP. This applies especially in the short and medium term. Since the analysis uses a conservative estimate for productivity increases, the long-term impact seems to be underestimated.



## WHAT IS THE ECONOMIC IMPACT OF ADDING RESEARCHERS FROM ABROAD TO THE PUBLIC RESEARCH SECTOR IN DENMARK?

### BACKGROUND

Many researchers from abroad already work at public research institutions in Denmark. More researchers are expected to be recruited to Denmark if the funding of public research at such public institutions as universities and hospitals is increased.

### PURPOSE AND METHODS

The purpose of the analysis was to study the long-term macroeconomic impact of recruiting researchers from abroad to work at public research institutions in Denmark.

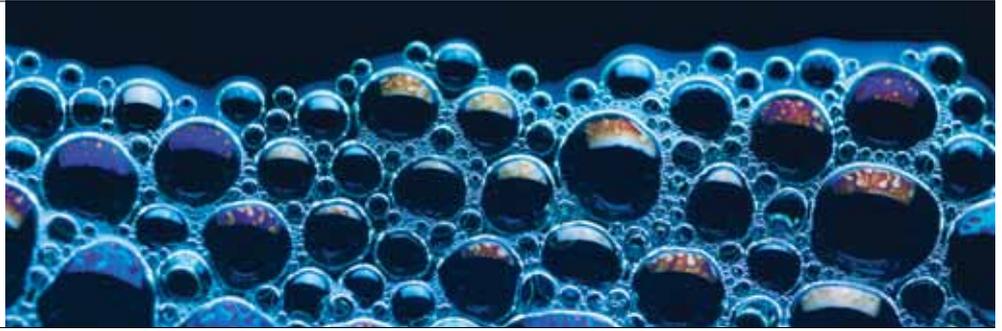
The macroeconomic model DREAM<sup>3</sup> estimates long-term projections of the economic trends in Denmark. The model calculates the projected impact of economic policy initiatives. This analysis used DREAM to analyse the projected impact from 2015 of recruiting 200 highly qualified researchers from abroad to work and remain in Denmark on such parameters as GDP, employment, changes in the public fiscal balance and public and private investment and consumption.

The analysis made the following assumptions about the researchers recruited to Denmark.

- ▶ All researchers come from abroad, and each brings a spouse.
- ▶ All researchers are employed in the public sector.
- ▶ All researchers are employed full time.
- ▶ The researchers earn an average of €107,500 annually.
- ▶ All researchers are 30–50 years old.
- ▶ All spouses have a labour market participation rate, an unemployment rate and productivity based on their geographical origin, gender, age and background.

The DREAM model does not include an actual research sector that, for example, considers spillover effects between public and private research or between research and educational level. The analysis only measured the immediate socioeconomic impact of recruiting researchers from abroad. Because this analysis is based on conservative assumptions, the actual impact may be higher.

<sup>3</sup> DREAM is an overlapping generation model for the Danish economy.



## RESULTS

Relative to the baseline calculation in DREAM, the results show that recruiting 200 researchers and their partners annually from 2015 would improve Denmark's public fiscal balance annually by DKK 2.94 or € 400 million (in 2014 prices). In addition, the long-term effects (in 2050) would be as follows:

- ▶ The population will grow by 16,000 individuals.
- ▶ Employment will grow by 0.35%.
- ▶ Denmark's GDP will increase by 0.70%.
- ▶ Private investment will grow by 0.32% and public investment by 1.76%.
- ▶ Private consumption will increase by 0.52%.
- ▶ Public consumption will increase by 2.24%.

## CONCLUSION

Recruiting highly qualified researchers from abroad to work in Denmark's public research sector provides positive socioeconomic benefits.

NOVO NORDISK FOUNDATION

Tuborg Havnevej 19  
DK-2900 Hellerup  
Denmark  
Telephone: +45 3527 6600

nnfond@novo.dk  
[www.novonordiskfoundation.com](http://www.novonordiskfoundation.com)

---

The Novo Nordisk Foundation is an independent Danish foundation with corporate interests. The Foundation has two main objectives:

- 1: to provide a stable basis for the commercial and research activities conducted by the companies in the Novo Group; and
- 2: to support scientific, humanitarian and social purposes.

The vision of the Foundation is to contribute significantly to research and development that improves the health and welfare of people. Since 2010, the Foundation has paid out nearly €1 billion primarily for research within biomedicine and biotechnology at public research institutions in Denmark and the other Nordic countries.

Read more at [www.novonordiskfoundation.com](http://www.novonordiskfoundation.com).