

Science Impact: Rethinking the Impact of Basic Research on Society and the Economy

An international conference on science impact, Vienna, May 10 and 11, 2007

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by [Roland Schneider](#)



The [Austrian Research Fund](#) and the [European Science Foundation](#) (ESF) organized an international conference on "Science Impact" held May 10-11, 2007 in Vienna. The conference was attended by 270 participants who, with outstanding scholars in Science, Technology and Innovation Studies from both sides of the Atlantic and senior officials from major research organizations, engaged in lively discussions concerning the changing conceptual models of how research evolves into innovation, and the methods for evaluating the impact of basic research on science and society.

Although little doubt exists, among scientists and politicians alike, about the positive impact of basic research on the economy, the exact link between those two is often hard to prove. Overall, science funding has increased considerably over recent years: for example, Austria increased from a meager research quota of 1.4% in 1993 to over 2.5% of the GDP in 2007 – and the trend is still upward. Yet the funding of basic research is being challenged more than ever. This challenge arises from various sides, from narrow budget constraints, to growing skepticism in public opinion about the prospects of science, to the general perception that funding of applied research is much more output efficient. "The discussion about the relevance of basic research is pandemic and anything but trivial," as Christoph Kratky, president of the Austrian Science Fund, summed up this development. It is in this context that the conference is "very timely, because there is more and more need to justify further spending for basic research," said Wolfgang Polt, head of the Institute of Regional and Technology Policy at Joanneum Research.

Basic research and its relation to economic growth

Karl Aiginger, director of the [Austrian Institute of Economic Research](#) (WIFO), presented an economist's analysis of the situation in his keynote address. By comparing the amount spent for R&D in various regions of the world, he stressed the specific role of science and research in the European model of an economically efficient yet socially and environmentally responsible society. For Austria, in order to move up the value chain to high-end manufacturing and services in the European context, and particularly to respond to the competition from other Central and Eastern European countries, basic research plays a crucial role for the country's long-term economic growth, company revenues, and additional employment.



Wolfgang Polt

But as Wolfgang Polt eloquently showed on the second day of the conference, any attempt to directly correlate R&D with GDP growth is rather risky. Ben Martin, director of Science and Technology Policy Research is also rather skeptical in that regard, because “every attempt to estimate the economic and social value of basic research is problematic.” He provided some examples for his view: In the past it was believed that the connection between basic R&D and socioeconomic benefit was linear, i.e., the resource “research” was put into the system at one end and was processed through several stages to its final “product,” just as you produce light from a lightbulb by burning coal in a power plant. But recent research has shown that this is not the whole picture. Instead, there are links from every stage of the process to every other stage, and every activity has direct influence at every stage. Beyond that, the picture is even less precise when you look at the level of individual innovation processes instead of the whole economy. Here, as Martin explained, it appears that not only are the various stages linked to each other, but all stages are also linked to other innovation processes, other basic research activities, and other applied research activities – not only in one economy but more and more on a global scale. Basic research in country A might lead to technical development in country B and product innovation in country C and perhaps to benefits in all three countries. Fears that some countries will reduce their investments in basic research are nevertheless overblown because, as Ben Martin said: “You have to have an absorptive capacity,” meaning that you have to do some basic research in order to have the knowledge required to make use of other results. And this knowledge is very often the tacit knowledge of researchers who conduct basic research.

How much bang for the buck?



Helga Nowotny

But not only is it a problem to evaluate the impact of basic research. It is also quite difficult to decide what this term really means: Where does basic research end and where does applied research of any kind start? One of the speakers compared this to day and night saying: “I know the difference between day and night, but I don't know exactly where day starts and night ends.” This is surely also true for the definition of basic

research. But there is another term for this stage of knowledge creation: *frontier research*. Helga Nowotny, vice president of the European Research Council, introduced this term to the conference. Frontier research goes beyond the distinction between basic and applied research. It is defined as “the leading research in developing new technology, being risky, multidisciplinary as well as multinational,” as summed up by Stefan Kuhlmann, professor in Foundations of Science, Technology and Society at the University of Twente, Enschede, The Netherlands.

And in this frontier research, according to Helga Nowotny, lies “unprecedented potential” for the economy and the society. Nevertheless, it is difficult to evaluate the potential of frontier research in detail. What is more, with evaluation comes the belief that the system can be influenced and optimized. Stefan Kuhlmann noted: “Since frontier research, based on a *methodological systematic*, is in the first place a creative enterprise often fed by serendipity, its impacts on society and economy are elusive and hardly subject to control. Pushing for effective impact would undermine the very working of science.” This was also asserted by Haim Harari, former president of the Weizmann Institute of Science in Israel, and chairman of the Executive Committee for the ISTA, who said: “First class basic research invariably leads to practical results; any attempt to guide such research according to current needs is guaranteed to miss the point and prevent the discovery of totally new opportunities, phenomena and technologies.”

So is there no need for governments to influence R&D? Not at all, there is some need because, according to Stefan Kuhlmann: “Without requests from society/government and economy to science, and without their investments in frontier research, there is no organized, sustainable science – hence there is good reason to expect and control for useful and effective science impact.”



Ian Halliday

What is needed is a balance between the freedom of research, especially basic research, and responsible goal-oriented funding. This leads to the need to develop well-tailored funding mechanisms for the various areas of basic research. As described by Ian Halliday, president of the European Science Foundation:

“There are many scales of money and time in various fields. Some areas require huge teams with infrastructure in order to be competitive, others are working on a smaller scale.” But he agreed that both are “under increasing pressure to add to the economy.”

And although it is commonly agreed that basic research has a positive impact on society as well as on the economy, it is much more difficult to explain or evaluate what effect one scientific result might have. In this context, Mr. Harari told the story about Joseph Thompson who won the Nobel Prize for Physics in 1906 for his discovery of the electron. At the following dinner party he proposed a toast to the electron: “To the electron – may it never be of any use to anybody.”

This shows very well the whole underlying problem, not only of basic research but also for the funding of basic research. Today the majority of the world economy directly or indirectly depends on Thompson’s discovery, but in his time not even the scientist himself was aware of this “unprecedented potential” of his discovery. Haim Harari in this context compared basic research and raising children: “In both cases, you invest without knowing what will come out, in both cases the fruits may or may not come, and if they do, it can happen early or late. Someone once said that children are a small fraction of the population but 100%

of our future. I say: Basic research is a small fraction of all R&D but it is 100% of our economic future."

Why do we (re)search?

So although it seems rather clear that basic research *is* important for economic and social development, there is still another important aspect in this discussion. It deals with the question why scientists do research in the first place. This is an important point, which sometimes seems to be overlooked nowadays. "The main justification for basic research is that it is a fundamentally humanistic enterprise. Human beings are creative agents, and one way that we exercise our creativity is by asking questions about the nature of nature, the nature of society, and of course the nature and purposes of creativity itself. The act of discovering things has a value quite independent of whether a given discovery can be put to use for benefiting society," said Sheila Jasanoff, a conference speaker and professor of science and technology studies at Harvard University, when speaking with *bridges*. For example, there is not much "use" in the short term for such activities as solving complex mathematical conjectures, unraveling the stages of evolution, or trying to understand matter at a very fundamental level, but all these activities are still leading to "a more reflective, knowledgeable, sophisticated, and historically self-aware condition of being human." So even in sciences where there is no obvious economic or social value, there is still this grand and admirable thirst of human nature for exploring the unknown, not only for mundane benefit, but more for the pure motivation of better understanding our world. And, according to Mrs. Jasanoff, this motivation is also very well reflected in FWF-funding, especially for the Wittgenstein-Awards.



Sheila Jasanoff

Furthermore, as confirmed by the other speakers, there is often economic and social potential in areas where this was not initially obvious. In this realm the humanities, often decried for producing nothing "useful" compared to the natural sciences, play a vital role. "Over and over in the history of science we see that revolutionary breakthroughs have happened because humanistic and scientific inquiry fed one another. Most broadly stated, the imagination that underlies scientific creativity cannot be divorced from cultural imagination as a whole; the two nourish one another," Jasanoff stressed. What is more, humanities can often play a direct role in the economy. Just imagine the economic activities (from book revenues to the tourism in London and Rome) connected to the best selling novel, *The Da Vinci Code*. And without the results of archaeology and art history this book could not have been written. Nevertheless this research was certainly not done for the revenues, nor because it would eventually form the basis for a thrilling story – but rather for purely "thirst to discover the unknown."

So is all well in the world of science funding? Funding is increasing, public awareness of science is increasing (at least for the parts with obvious value or an interesting narrative), and politicians unanimously agree on the necessity of basic research. Still there are some warning voices. Erik Arnold, managing director of Technopolis, warned that ""emphasis on STI is quite fashionable amongst politicians nowadays,

partly because of the European Union's concern with spending more on R&D. New concerns like climate change mean that this will not remain the case. We need to have a good story about science impact, because it will be a lot harder arguing for research funding in future."

Sheila Jasanoff adds that it is up to the scientists to make sure that the value of science remains high in the political consciousness, but "we are going through a period when much of the Western world is coming to grips with decreasing natural resources and the awareness that knowledge is a natural (or at least *human*) resource that cannot be neglected. This particular moment will end, and the language in which we talk about STI will undoubtedly change. But public investment in knowledge-making is not likely to disappear anytime soon. And so long as scientific research remains an important line item in public budgets, not to mention a dimension of interstate competitiveness, debate on it is also likely to remain alive."

To summarize, this conference made a couple of points very clearly. First, basic science is important. It is important for the development of our society and economy, but it is also important for satisfying the pure drive to better understand our world. Second, there is no simple answer to the connection between funding of basic research and its impact. There is evidence of course, for an abundance of links through various "exploitation channels," and any successful funding model has to cope with this complex system. Therefore scientists have to stand up against overly simplistic answers to that question. Nevertheless, as Wolfgang Polt brilliantly concluded, there is of course an ultimate answer for "those who are not satisfied with overly complex answers of limited political clarity."

And the ultimate answer is, of course, 42.

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