UNIVERSITÀ DEGLI STUDI DI MILANO

Csil
CENTRE FOR INDUSTRIAL STUDIES

EIB UNIVERSITY RESEARCH SPONSORSHIP PROGRAMME

COST BENEFIT ANALYSIS IN THE RESEARCH, DEVELOPMENT AND INNOVATION SECTOR

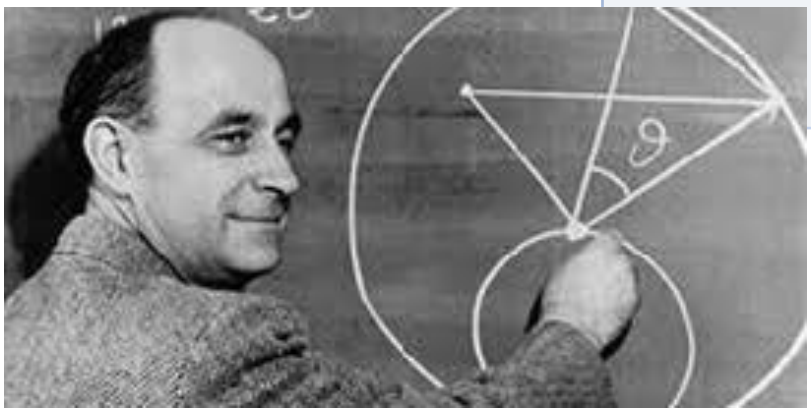
UNIVERSITY OF MILAN - DEPARTMENT OF ECONOMICS, MANAGEMENT AND QUANTITATIVE METHODS
UNIVERSITY OF MILAN - DEPARTMENT OF PHYSICS
CSIL - CENTRE FOR INDUSTRIAL STUDIES

Luxembourg, 24 January 2013

WHY FUNDING RESEARCH INFRASTRUCTURES?

And here many people will raise a question: which practical consequences came or will come from such an increase in our knowledge about the inner structure of matter?

Enrico Fermi, 1930



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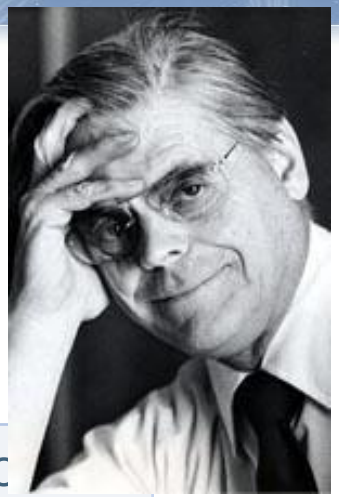


On April 17, 1969, Robert R. Wilson testified in front of Congress' Joint Committee on Atomic Energy as part of the AEC Authorizing Legislation for FY 1970.

This is his famed quote about the value of building Fermilab's first accelerator:

‘It only has to do with the respect with which we regard one and
the dignity of men, our love of culture. It has to do with those things. It has nothing to do with the military. I am sorry. [...] Otherwise, it has to do with: are we good painters, good sculptors, great poets? I mean all the things that we really venerate and honor in our country and are patriotic about. In that sense, this new knowledge has all to do with honor and country but it has nothing to do directly with defending our country except to help make it worth defending’

WHY FUNDING RESEARCH INFRASTRUCTURES?

The instruments developed by physicists for fundamental research have been – and will always be, I am sure - translated into practical applications going beyond the intentions of their creators and which, perhaps in the long run, bring benefits to all citizens.

Ugo Amaldi, Sempre più veloci, pag. 15, 2012

WHAT METHODS FOR EVALUATING RESEARCH IMPACT?

- State of the art: a mix of methods are generally suggested

- Evaluation practice at international level suggests that there is a general trend from more subjective (e.g. panel review) to more hard evidence based methods (e.g. bibliometrics)

- However, a systematic and shared methodological framework to carry out project appraisal in this field still needs to be developed

RESEARCH TEAM

- Department of Economics, Management and Quantitative Methods (DEMM) of the University of Milan
- Departments of Physics of the University of Milan
- CSIL – Centre for Industrial Studies

- The consortium, in particular, includes:
  - the team authoring four editions of the Guide to Cost Benefit Analysis of Investment Projects currently used by the European Commission, DG Regional Policy (DG REGIO), to inform the financing decision about major infrastructure projects.
  - Some of top scientists active at CERN, ranging from particle physics for fundamental physics to its application in health and other fields

STEERING COMMITTEE

- Prof. Massimo Florio, Professor of Public Economics and ad personam Jean Monnet Chair of EU Industrial Policy, author of the DG REGIO CBA Guide

- Prof. Stefano Forte, Professor of Theoretical Physics, senior researcher at the INFN and member of the Steering Committee of the LHeC at CERN

- Silvia Vignetti, Director of Evaluation Studies, CSIL, and member of the research teams authoring the last two editions of the DG REGIO CBA Guide

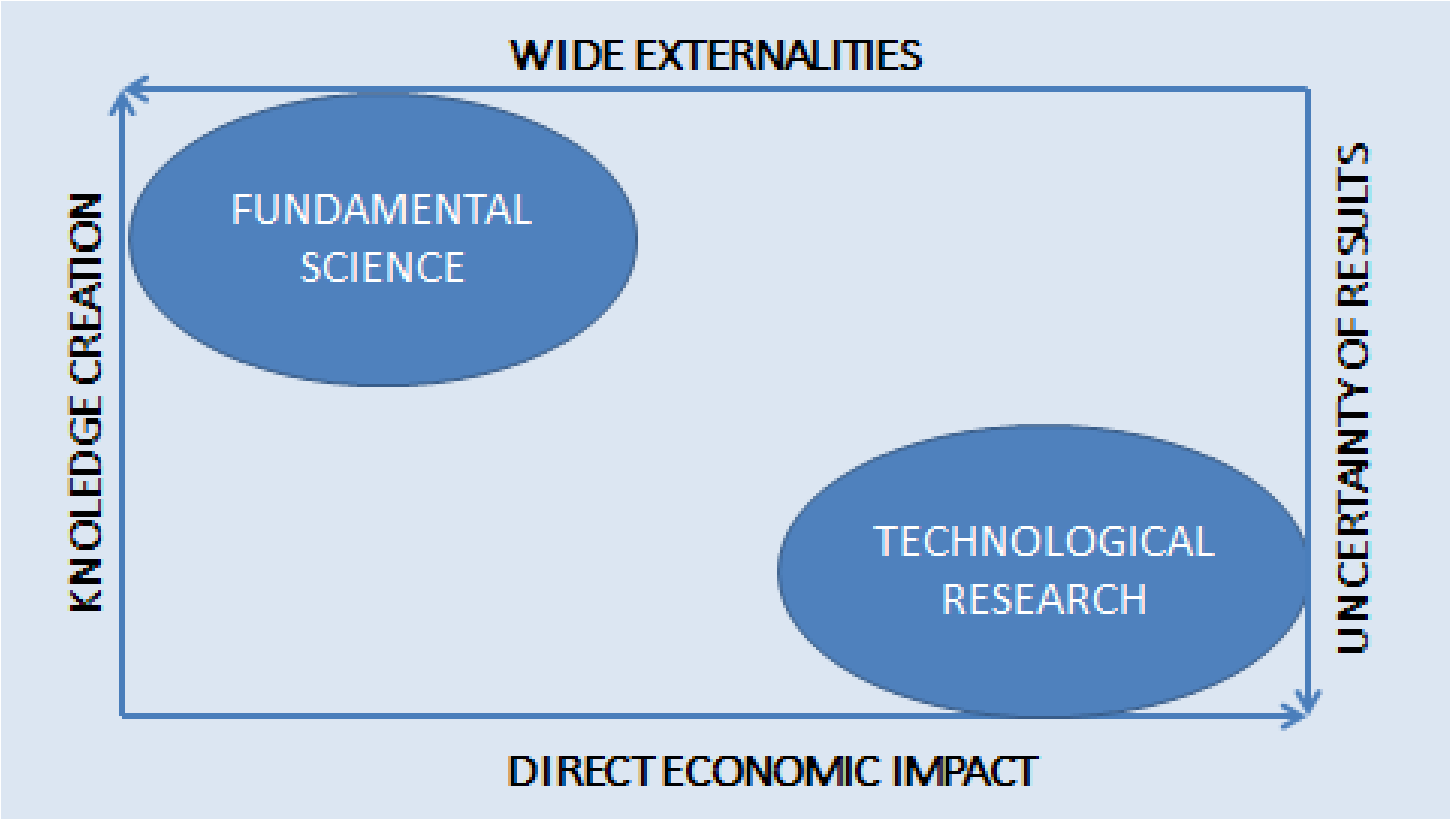
OBJECTIVE OF THE STUDY

- Take stock of the literature on the **economic impact of scientific research** (fundamental and applied)

- Developing a **CBA model for decision making** able to assess the potential future net social benefits generated by a research infrastructure and the uncertainty and risks associated to them.

- The CBA model will expand on the standard **framework adopted by the EC** adapting the model to the specificities of research infrastructures (RI).

COMPLEMENTARY ASPECTS OF BENEFITS AND UNCERTANTIES



SPECIFIC METHODOLOGICAL CHALLENGES

identification, quantification and provision of a conventional welfare metrics for products and benefits of such infrastructures:

- **Nature of expected net benefits**: inherently uncertain, seldom purely monetary and even hard to qualify (the 'success' of a research experiment does not necessary lead to a new discovery);
- **Long time span of benefits to occur**: investments take place long before returns materialise at a very uncertain point of time;
- **Uncertainty and risk**: affect investment costs, timeline and benefit (they may never materialise or being offset by new discoveries)
- **Spillovers and externalities**: causal links and attributions not straightforward (e.g. . from LEP/LHC to the Web)

RESEARCH LINES

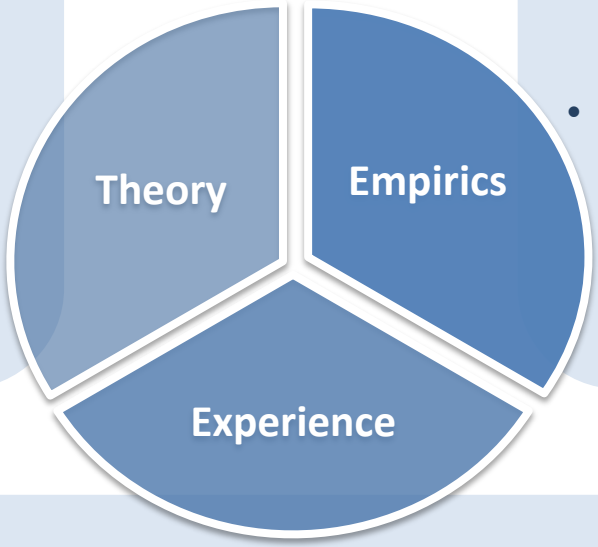
- **Research Line 1 – Development of the theoretical model:** What is the theoretical conceptual model assessing the economic benefits of research, development and innovation infrastructures (micro and macro)?

- **Research Line 2 – Reviewing the state-of-art in RDI infrastructure project appraisal:** What is the practical experience developed at EU and international level in the appraisal of research, development and innovation infrastructure?

- **Research Line 3 –Testing and fine tuning the CBA model:** What is the suggested model to assess RDI infrastructure projects and support the decision-making process?

EXPECTED DELIVERABLES

- Literature review of theory and empirics of impacts of RDI investment
- Methods to quantify and value the benefits of scientific know-how creation and diffusion through bibiometrics



- Review of RDI infrastructure project appraisals techniques worldwide with case histories
- A pilot CBA model for particle accelerators and their applications

- Two pilot case studies for fundamental and applied research (possibly LHC and hadrotheraphy infrastructure)
- A comprehensive CBA model for RDI

POSSIBLE CASE STUDIES: FUNDAMENTAL PHYSICS

- **SPS**: the 2nd largest machine in the CERN complex. It switched on in 1976, and in 1983 and led to the discovery for which the Nobel prize was awarded in 1984 to Carlo Rubbia and Simon van der Meer. It still accelerates beams which are fed into the LHC.

- **LEP** was an electron-positron collider, and it was operational from 1989 to the end of 2000, and it has led to our current precision understanding of the structure of the fundamental theory of electroweak interactions, the so-called standard model.

- The **LHC** is the highest-energy machine currently operating in the world. First beams became available in 2008, and it has led to the likely discover of the Higgs boson, which provides the frontier of our current understanding of the theory of fundamental interactions.

POSSIBLE CASE STUDIES: APPLIED PHYSICS

- Applications of particle accelerators to health physics, specifically to **hadrotherapy**, the natural outgrowth of the accelerators developed for fundamental research

- Several hadrotherapy facilities have recently started operation in Europe. Examples of are the following:

  - CNAO (Centro Nazionale di Adroterapia Oncologica - the Nathional Hadrotherapy Center for Cancer Treatment) in Pavia, Italy;
  - HIT (Heidelberge Ionenstrahl-Therapiezentrum, the Heidelberg Ion-Beam Therapy Center) in Heidelberg, Germany.