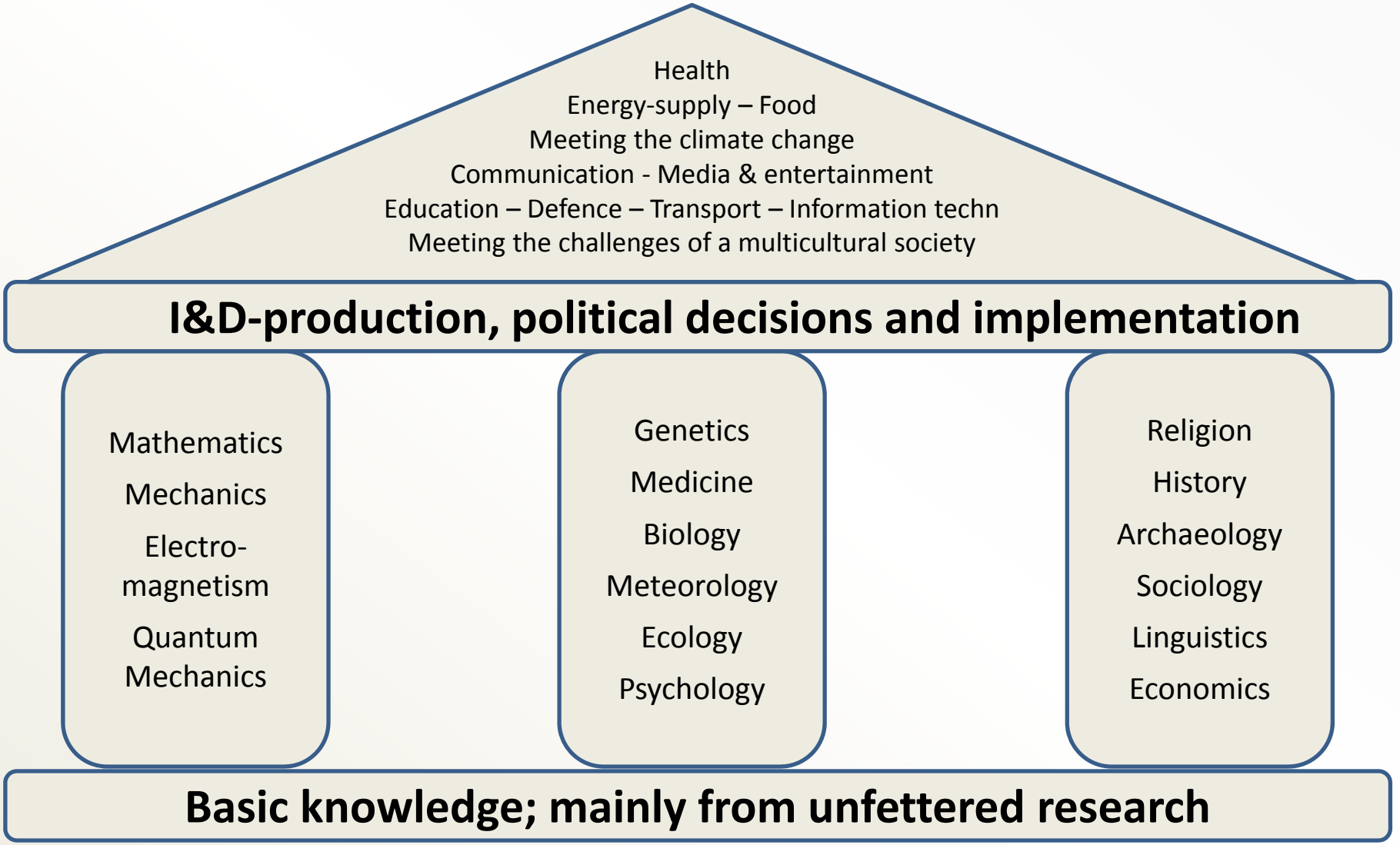
The Role of Fundamental Research

for the Economy and our Society

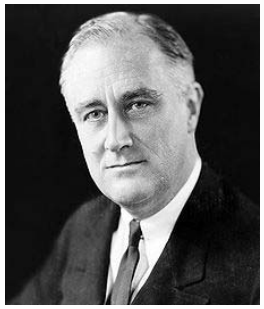
Torsten Åkesson

Society is developing in an environment of knowledge



The importance for society of a continuous increase of our basic knowledge

- **November 1944**
  - President F.D. Roosevelt writes to his science advisor Vannevar Bush



Which are the actions needed to organize and support research for scientific production and developing talents?

- **July 1945**
  - Vannevar Bush submits *Science The Endless Frontier* to President H. S. Truman

The Government should accept new responsibilities for promoting the flow of new scientific knowledge and the development of scientific talent in our youth.

1945: “Science The Endless Frontier”

- **“Scientific Progress is Essential”**
  A list of core improvements in society made possible by science
- **“Science Is a Proper Concern of Government”**
  It is the role of the Government to open new frontiers and make them accessible to all citizens
- **“Government Relations to Science …”**
  Ask for increased support; general public research support did not exists pre WWII.
- **“Freedom of Inquiry Must Be Preserved”**
  As long as universities and research institutes are vigorous and healthy and their scientists are free to pursue the truth wherever it may lead, there will be a flow of new scientific knowledge.

- Action: **Set up a National Research Foundation**
  - Operationally independent from the Government
  - Support non-profit research
- **The blueprint for research support in many countries**

Universities and research laboratories laying the foundation

- **Universities and public research institutions**
  - Produce new independent knowledge
  - Educate students and bring out talents; *well educated competent people is the major asset in the knowledge based economy*

- **Other actors**
  - Make products out of the knowledge through innovations, development and the subsequent steps
  - Take political decisions and implement them

But, basic research does more than producing independent knowledge ...

Fundamental research has many facets benefiting society

- **Main raison d'être**

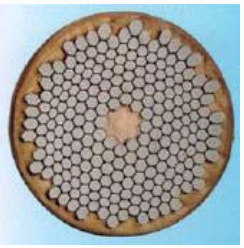
  The obtained knowledge: History demonstrates its importance; *it is evident! It is unpredictable!*

- **Technology progress forced by challenges**

  Technology progress forced by the obstacles towards the research goal: *WWW, accelerators, standardization of national databases, ...*

- **Industrialization of emerging technologies or/and stimulation of industrial performance by difficult specifications**

  Big science (which essentially is 100% fundamental research) needs large scale production. Example: *The industrialization of superconducting magnets made for accelerator-construction opened the door for very strong magnets for medical purposes (MRI)*



- **Training of graduates and engineers**

  Graduate students are trained to doctors and then leave; post-doctors are hired for a few years and then leave; newly graduate engineers are recruited and after a while leave.

- **Attractor to Science and Technology**

  We focus our ambitions on the experiences we get while growing up. Science and technology need to be seen in a way that catches the attention and fuels the curiosity. The fundamental research has a tendency to do that.

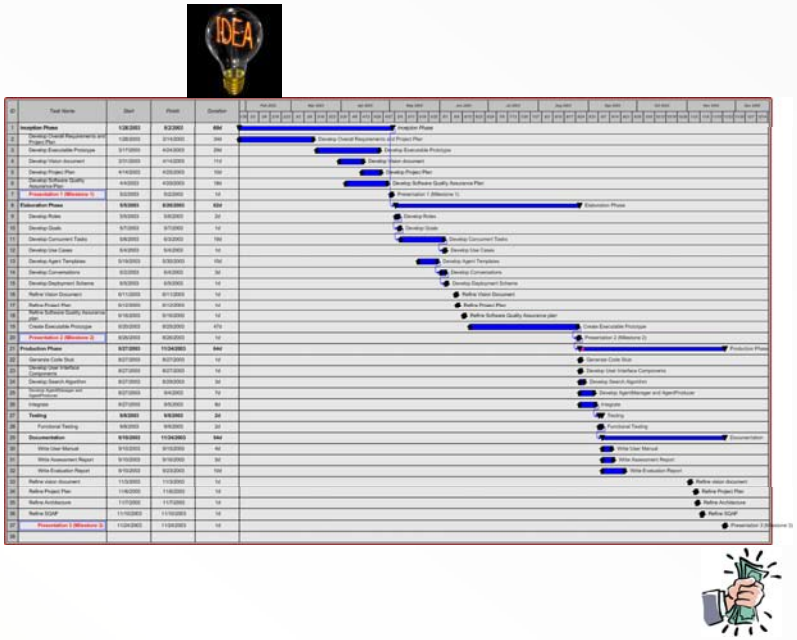
Broadening the mission: Universities and research laboratories as active partners in the economy

- **Joint research projects**
  - (Partially) financed by non-academic actors
  - Non-disclosure agreements
- **Academic entrepreneurship**
  - Encouraged by many Universities
  - Could increase the economic growth
  - More easy to say than to do; it is a long way from a patent to a business

- **These are good developments**
  - The competence and knowledge should maximally benefit society
  - Joint activities between academia and companies is cross-fertilizing and good for society
  - Career change of researchers is a practical transfer to get frontier-knowledge into the economy

Risks with broadening the mission

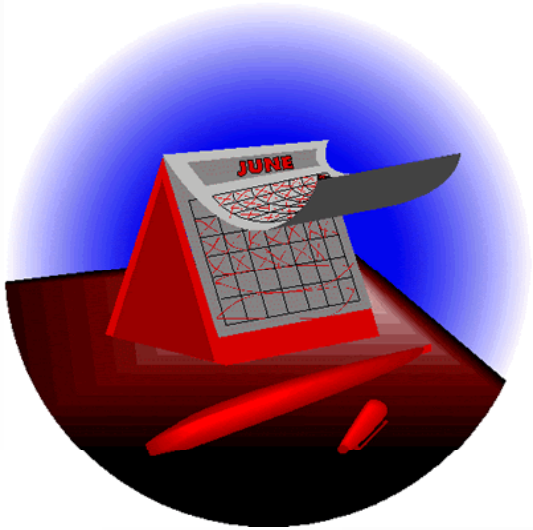
- **Required predictability of usefulness**
  - Needed for collaboration with actors outside academia, e.g. companies co-funding research projects
  - A necessity if the research should be seen as one step in a process towards a product



History: A priori requirements of formulated applicability would not have been compatible with the bulk of the ground breaking scientific discoveries that made the modern society possible

Risks with broadening the mission

- **Time-scales**
  - History shows that the time from new knowledge to application may be many decades: The future generations will need the knowledge produced by the previous generations.
  - Elsewhere the usual time-scale from investment to benefit, is much shorter
  - New actors → new time-scales in academia



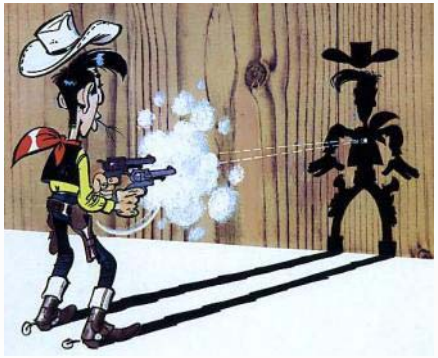
Risk: Introduction of economic incentives based on short time-scales that are incompatible with the main mission of producing independent knowledge

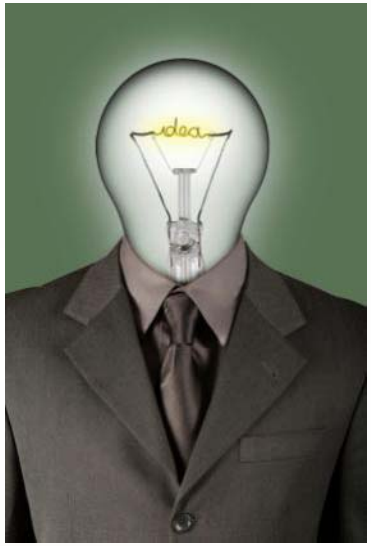
Risks due to career paths

- **The Gain – Security Duality; big gains are linked to large risks**
  - Research projects on completely new paths may result in researchers spending time and resources with no result
- **The early researcher-career starts with a sequence of short term employments**
  - Next employment depends on results from the previous
  - To try and to fail does not help the career
- **Nothing new, but the tendency is to increase the demand on continuous production**
  - The increased emphasis on blind bibliometric assessments does not invite risk-taking in research.

The Key Questions

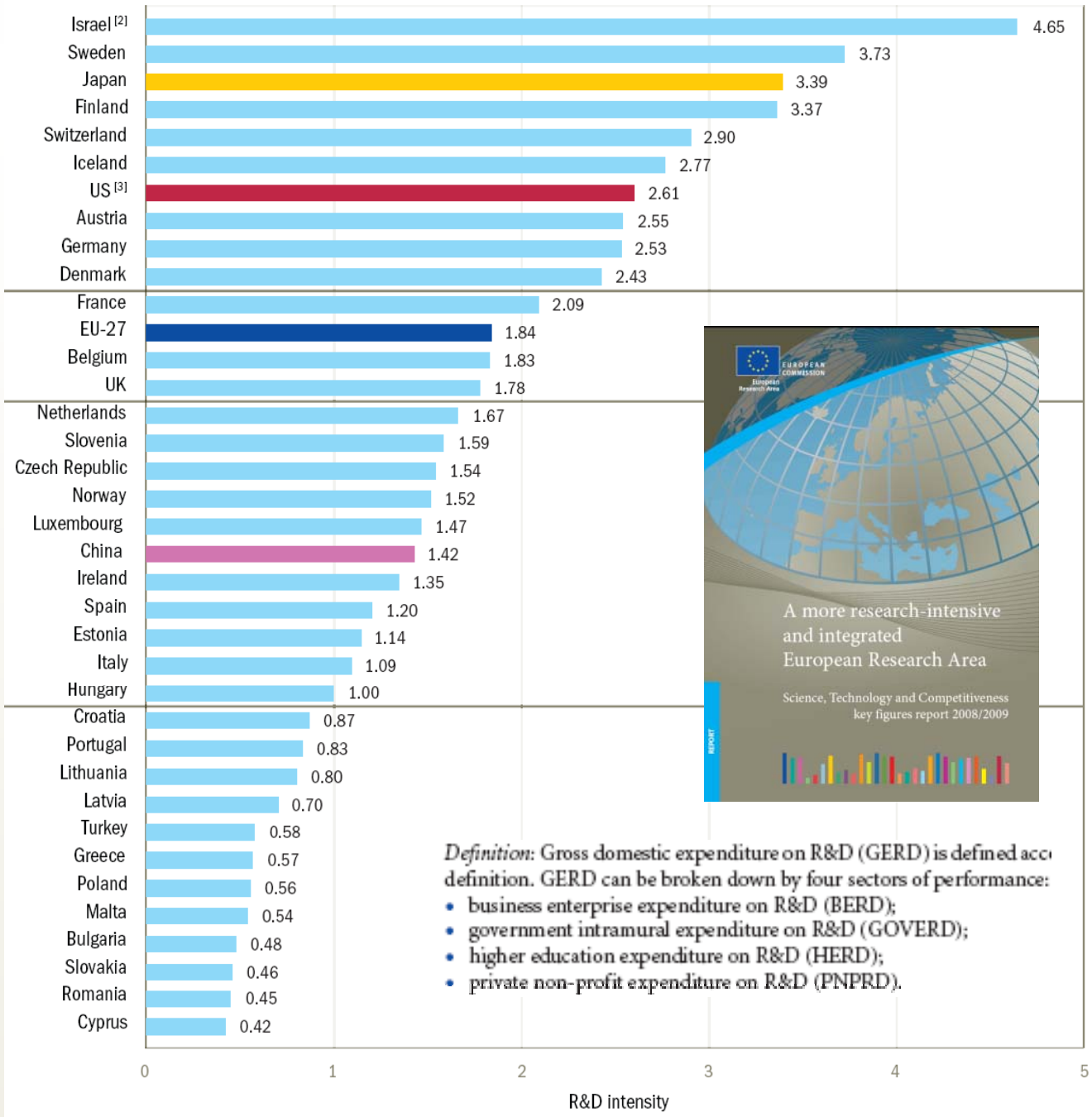
- Submitted before the introduction was prepared; *a shot from the hip*
  - Fundamental research is not easily adaptable to an innovation system with a fairly short time constant; *how should society support fundamental research while at the same time optimizing its innovation system?*
  - Big opportunities in research require risk taking when choosing research projects; *how can risk-taking in research be promoted?*
  - How can the Knowledge and Technology Transfer from fundamental research go even further?
- Are these the right questions?
- Are there any suggestions for better/complementary questions?





Back-up slides

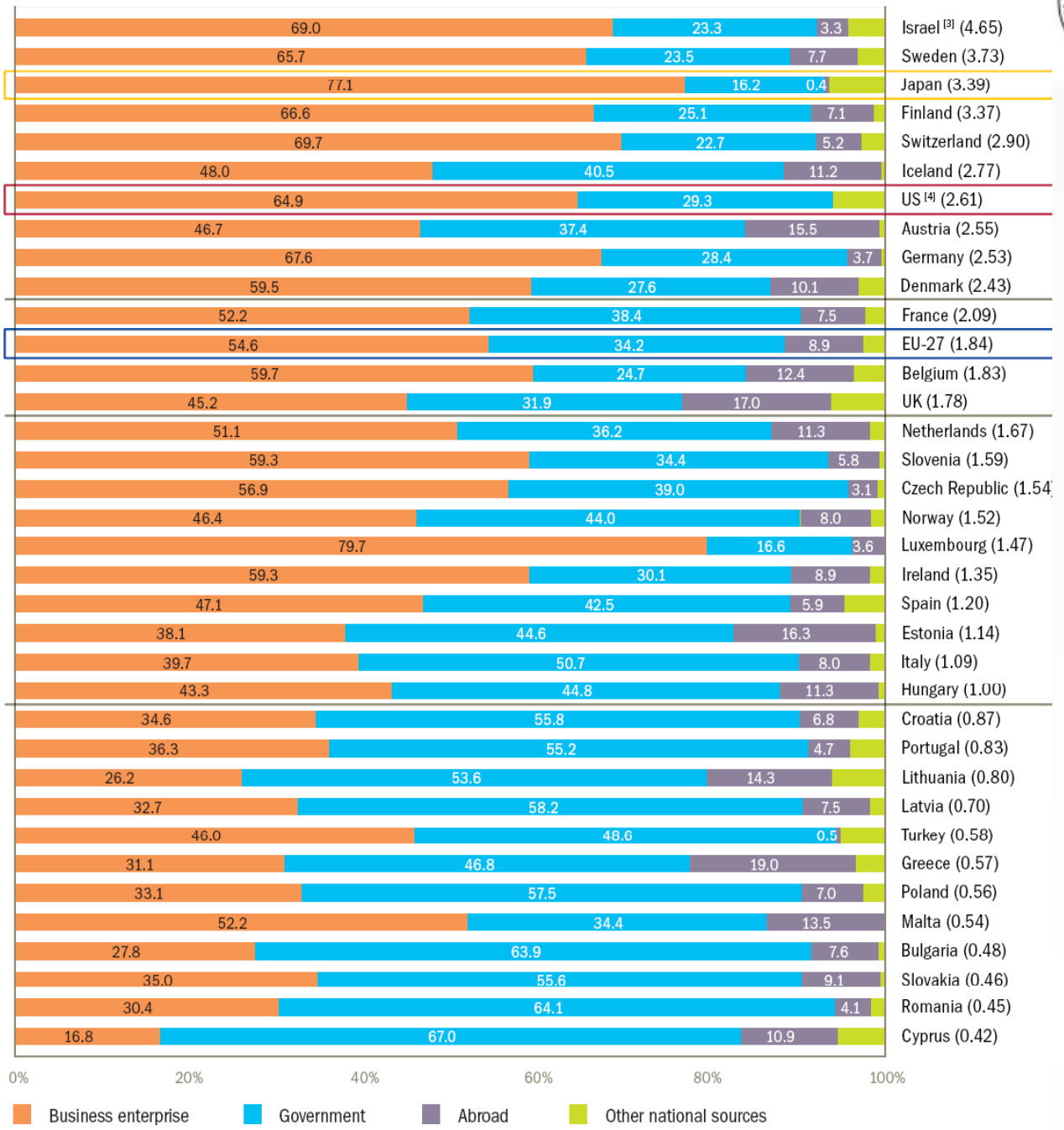
FIGURE I.1.3 R&D intensity (GERD as % of GDP), 2006 [1]



Definition: Gross domestic expenditure on R&D (GERD) is defined acc
definition. GERD can be broken down by four sectors of performance:

- business enterprise expenditure on R&D (BERD);
- government intramural expenditure on R&D (GOVERD);
- higher education expenditure on R&D (HERD);
- private non-profit expenditure on R&D (PNPRD).

FIGURE I.1.10 R&D expenditure by main sources of funds (%), 2006 [1] ranked in terms of R&D intensity, 2006 [2] (in brackets)



Research expenditures in government institutions and in higher education establishments as fraction of the GDP

[%]	(GOVERD+HERD)/GDP
Iceland	1,12
Israel	1,08
Austria	0,95
Sweden	0,88
Finland	0,85
France	0,80
USA	0,76
Germany	0,72
Denmark	0,67
Norway	0,67
Switzerland	0,66
EU-27	0,63
Netherlands	0,60
Czech Republic	0,60
UK	0,57
Italy	0,55
Japan	0,55
Slovenia	0,55
Spain	0,51
Estonia	0,51
Croatia	0,49
Portugal	0,46
Belgium	0,45
Hungary	0,45
Lithuania	0,43
Latvia	0,41
Ireland	0,41
Poland	0,32
Bulgaria	0,31
Romania	0,29
Turkey	0,28
Cyprus	0,28
Greece	0,27
Slovakia	0,26
Luxembourg	0,24
Malta	0,19

FIGURE I.1.14 Share of public sector expenditure on R&D (GOVERD + HERD) financed by business enterprise

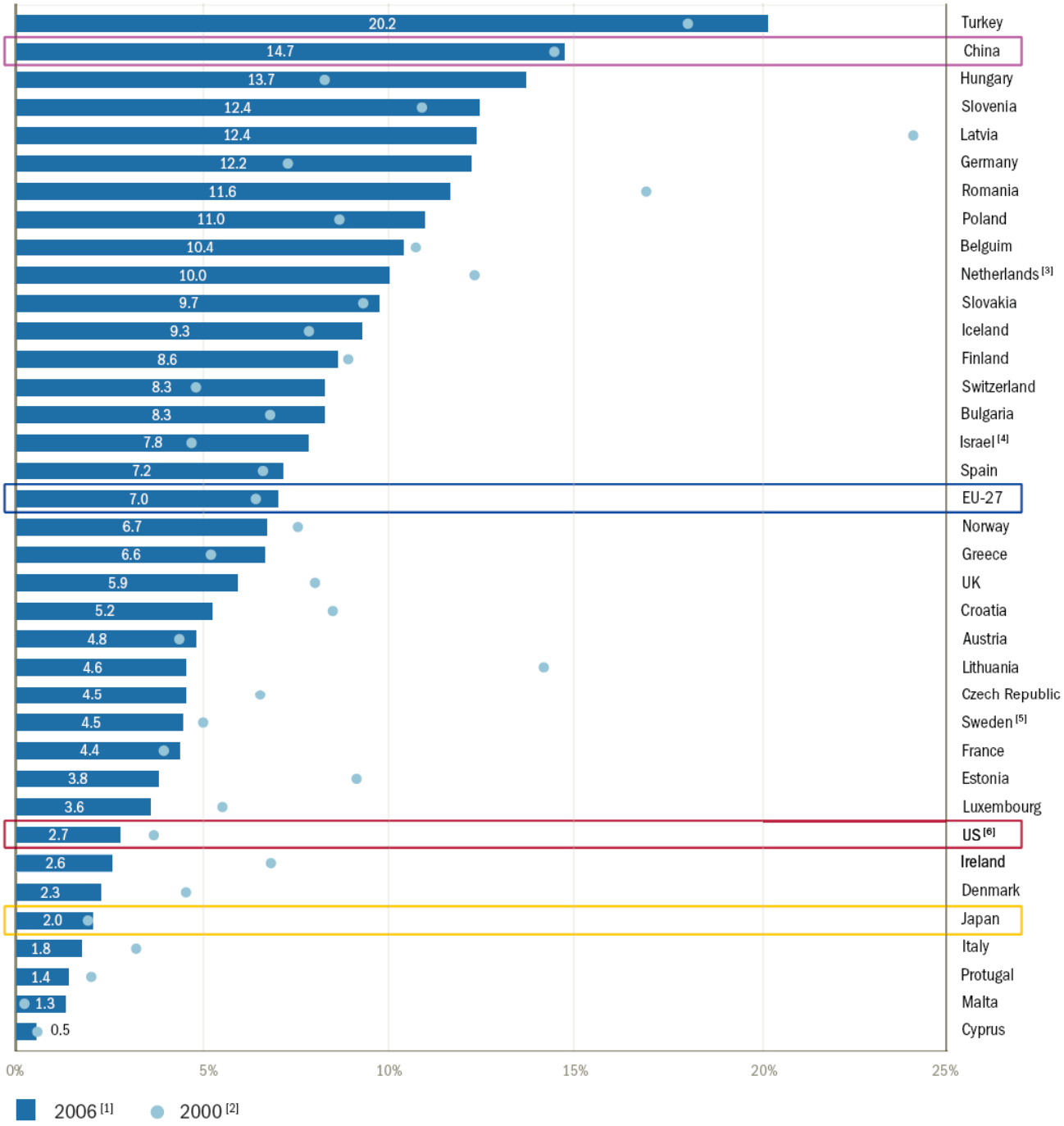


FIGURE I.2.2 Scientists and engineers as % of labour force, 2006

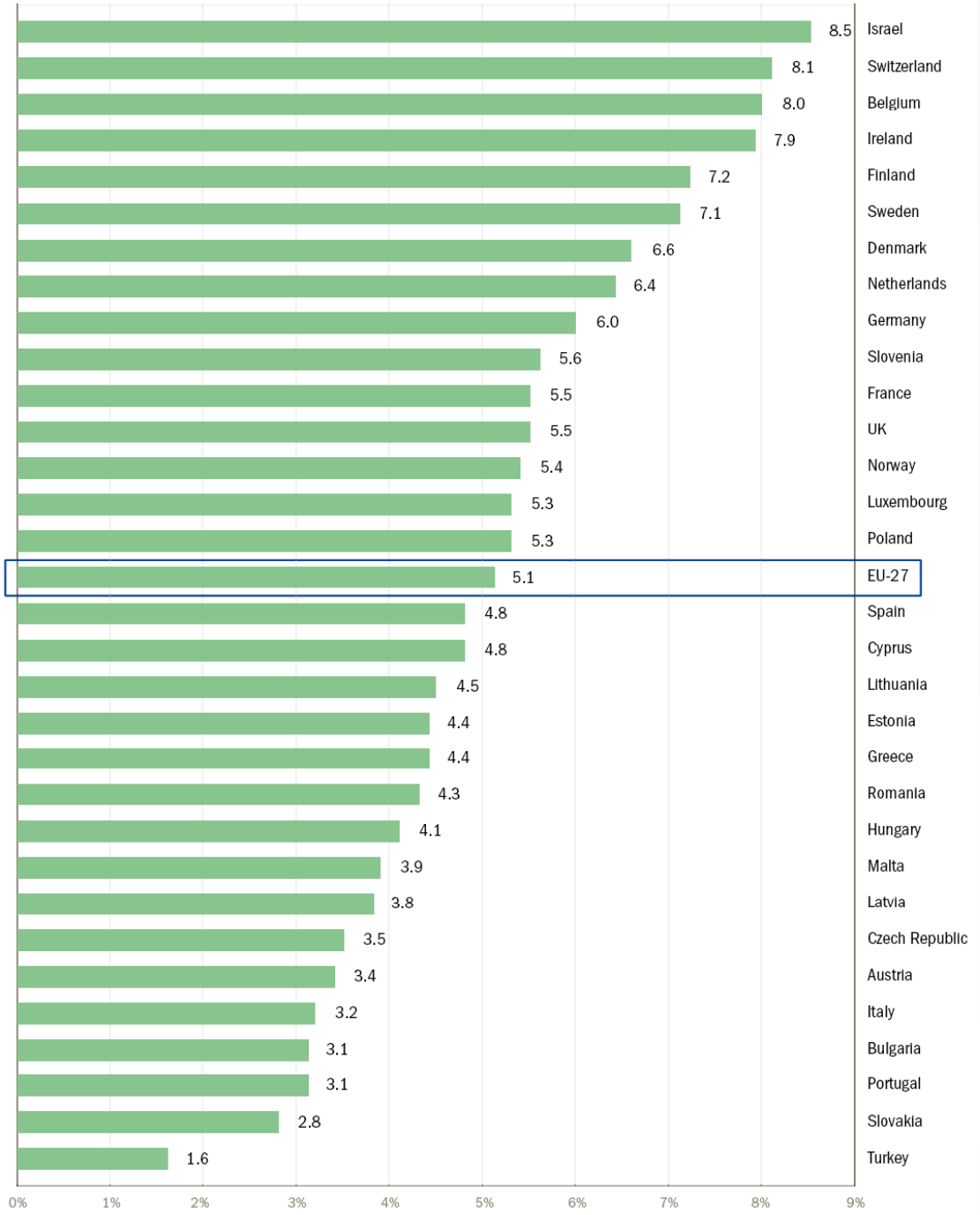


FIGURE I.2.10 Doctoral graduates per thousand population aged 25-34, 2000 and 2005 [1]