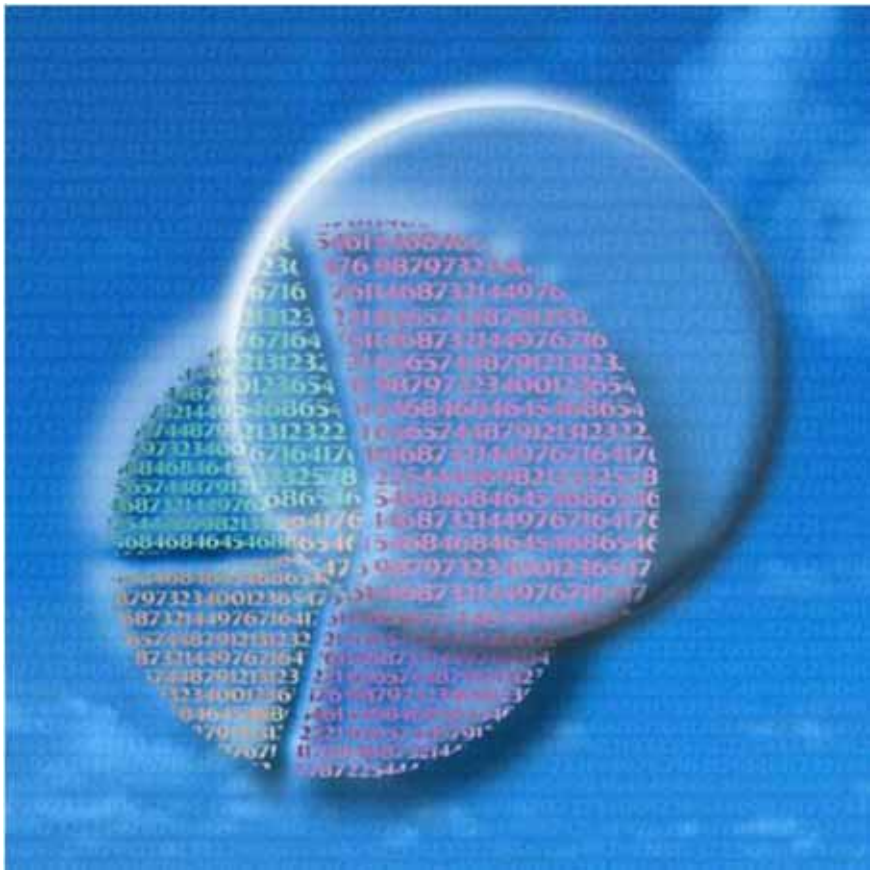


Impact assessment methodologies: caveat emptor

Workshop
Efficiency, Effectiveness and Impact of Research and Innovation
Roma, 20 February 2015

Andrea Saltelli
European Commission - Joint Research Centre (JRC)
Unit of Econometric Analysis and Statistics
http://www.andreasaltelli.eu
andrea.saltelli@svt.uib.no

Topic of the workshop

This workshop: Assessing Efficiency, Effectiveness and Impact of Research and Innovation …

Relevant JRC's econometrics and applied statistics research:

Sensitivity analysis, sensitivity auditing, university ranking and composite indicators development,…

When testing the evidence some reasonable people (and guidelines) suggest that ‘sensitivity analysis would help’.

...

JRC fostered sensitivity analysis development and uptake (20 years of papers, schools and books).

Today we call it **sensitivity auditing** and teach it within the syllabus for impact assessment run by the SEC GEN.

Sensitivity auditing :

- Conceived for mathematical modelling
- Comes from uncertainty & sensitivity analysis
- Addresses model-based evidence used for policy

Saltelli, A., Guimarães Pereira, Â., Van der Sluijs, J.P. and Funtowicz, S., 2013, What do I make of your latinorum? Sensitivity auditing of mathematical modelling, Int. J. Foresight and Innovation Policy, 9, 2/3/4, 213–234.

Saltelli, A., Funtowicz, S., When all models are wrong: More stringent quality criteria are needed for models used at the science-policy interface, Issues in Science and Technology, Winter 2014, 79-85.
http://issues.org/30-2/andrea/

Testing (composite) indicators: two approaches

Michaela Saisana, Andrea. Saltelli, and Stefano Tarantola (2005). Uncertainty and sensitivity analysis techniques as tools for the quality assessment of composite indicators. *J. R. Statist. Soc. A* **168**(2), 307–323.

Paolo Paruolo, Michaela Saisana, Andrea SaltelliRatings and rankings: Voodoo or Science?, *J. R. Statist. Soc. A*, **176** (2), 1-26

Sensitivity analysis for university ranking

Michaela Saisana, Béatrice d'Hombres, Andrea Saltelli, Rickety numbers: Volatility of university rankings and policy implications *Research Policy* (2011), **40**, 165-177

What if

This workshop: Assessing Efficiency, Effectiveness and Impact of Research and Innovation …

What if there are important tensions around some underlying narratives which militate against such an assessment?

Innovation

Innovation is at the hearth of the European Commission's strategies to tame ongoing societal crises

But the **Innovation** narrative is under increased pressure and scrutiny against the insurgence of crises …

Crises of trust, legitimacy, sustainability, inequality, fairness, trust, globalization, controversies among schools of economic thought,…

A workshop next week:
See https://ec.europa.eu/jrc/en/event/workshop/new-narratives-innovation

Innovation

A web-streaming service will be offered, with public access on the internet, to enable people, who cannot be physically present in the room, to follow the event. **The links will go live on the days of the workshop:**

26/02:
http://scic.ec.europa.eu/streaming/index.php?es=2&sessionno=3d7d9461075eb7c37fbbfcad1d7042c1
27/02:
http://scic.ec.europa.eu/streaming/index.php?es=2&sessionno=13d2b7361a27dbc9960ae158598a6a96
You are kindly invited to circulate these links among your colleagues.

Science's crisis

European Commission

Issues with trust also in the science …

Joint Research Centre

Science's crisis

Issues with trust / quality in the scientific enterprise

- "Science still commands enormous—if sometimes bemused—respect. But its privileged status is founded on the capacity to be right most of the time and to correct its mistakes when it gets things wrong. […] The false trails laid down by shoddy research are an unforgivable barrier to understanding"

The Economist, October 19, 2013, How Science goes wrong, p. 11.

Science's crisis

Issues with trust / quality in the scientific enterprise

- Laboratory experiments cannot be trusted without independent verification (Sanderson 2013), rules are proposed to spot "suspected work […in] the majority of preclinical cancer papers in top tier journals" (Begley 2013).

Begley CG 2013 Reproducibility: Six red flags for suspect work Nature 497 433–434.

Ioannidis J P A 2005 Why Most Published Research Findings Are False PLoS Medicine 2(8) 696-701.

Sanderson K 2013 Bloggers put chemical reactions through the replication mill Nature 21 January 2013.

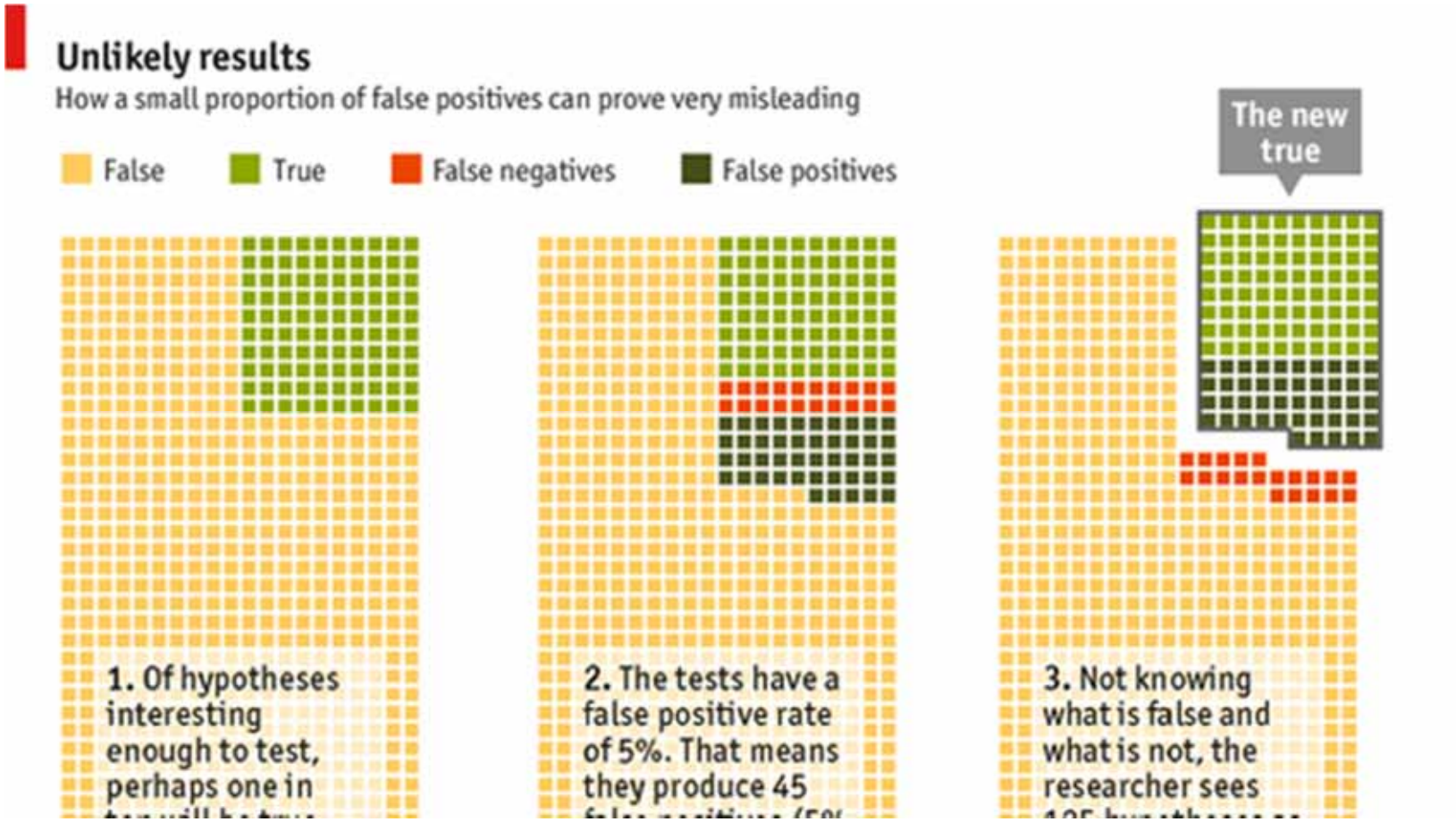
Science's crisis

Issues with trust / quality in the scientific enterprise

In a landmark study of results in cancer science Begley and Ellis were able to reproduce only 11 per cent of the original findings (2012). A death sentence for patients on experimental trials (with pharma having passed the pre-clinical phase).

Begley, C. G., and Lee M. E., 2012, Drug Development: Raise Standards for Preclinical Cancer Research, Nature, 483, 531–533.

A statistical problem ?



J. P. A. Ioannidis, Why Most Published Research Findings Are False, PLoS Medicine, August 2005, 2(8), 696-701.

A statistical problem ?

Open access, freely available online

Essay

Why Most Published Research Findings Are False

John P. A. Ioannidis

field. In this framework, a research finding is less likely to be true when the studies conducted in a field are smaller; when effect sizes are smaller; when there is a greater number and lesser preselection of tested relationships; where there is greater flexibility in designs, definitions, outcomes, and analytical modes; when there is greater financial and other interest and prejudice; and when more teams are involved in a scientific field in chase of statistical significance.

A statistical problem ?

Open access, freely available online

Essay

Why Most Published Research Findings Are False

John P. A. Ioannidis

outcomes, and analytical modes; when there is greater financial and other interest and prejudice; and when more teams are involved in a scientific field in chase of statistical significance.

Science's crisis

Issues with trust / quality in the scientific enterprise

- A Meta-Research Innovation Centre launched at Stanford (METRICS) to combat 'bad science'.

The Economist, 2013, March 15, Combating bad science Metaphysicians. Sloppy researchers beware. A new institute has you in its sights.

- "85% of research funding 'wasted' …"

Ioannidis, J. P. (2014). How to Make More Published Research True. PLoS medicine, 11(10), e1001747.

Science's crisis

"Currently, many published research findings are false or exaggerated, and an estimated 85% of research resources are wasted."

Ioannidis, J. P. (2014). How to Make More Published Research True. PLoS medicine, 11(10), e1001747.

Science's crisis

"Shoddy science" is not confined to natural sciences: social sciences are also affected; "I see a train wreck looming" warns Daniel Kahneman; Joseph Stiglitz condemns perverse incentives in the modelling of financial products at the hearth of the present crisis.

Daniel Kahneman

Joseph Stiglitz

Yong, E., Nobel laureate challenges psychologists to clean up their act, Nature, News, 03 October 2012.
Stiglitz, J. (2010) Freefall, Free Markets and the Sinking of the Global Economy, Penguin, London.

Science's crisis

Issues with trust / quality in the scientific enterprise

- Science/knowledge degenerates when it becomes a commodity for Lyotard (1979) and Mirowski (2011).

Jean-François Lyotard

Lyotard, J.-F. 1979. La Condition postmoderne. Rapport sur le savoir, Paris : Minuit, Chapter 10.

Mirowski, P. 2011. Science-Mart: Privatizing American Science, Harvard University Press.

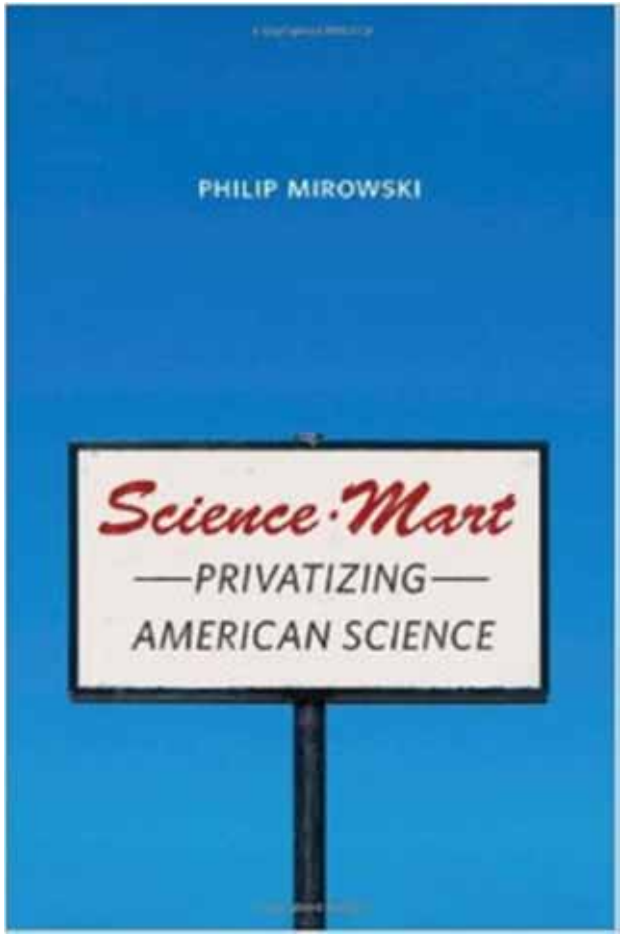
Philip Mirowski

Issues with trust / quality in the scientific enterprise

- Mirowski's take on science's lost innocence:

After the eighties neoliberal ideologies succeeded in decreasing state intervention in the funding of science, which became increasingly privatized...

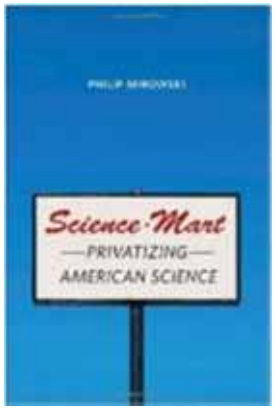
…Knowledge as a monetized commodity replaces knowledge as public good...



Issues with trust / quality in the scientific enterprise

- Mirowski's take on science's lost innocence:

…In house science labs of major corporation were closed and research outsourced to universities which …



… became more and more looking as corporations…

… then research ended up outsourced again to contract-based private organizations……➔

An ethical problem?

Issues with trust / quality in the scientific enterprise

- The centrality of ethics for quality (1971).

Jerome R. Ravetz

"Two separate factors are necessary for the achievement of worthwhile scientific results: a community of scholars with shared knowledge of the standards of quality appropriate for their work and a shared commitment to enforce those standards by the informal sanctions the community possesses; and individuals whose personal integrity sets standards at least high as those required by their community.

Ravetz, J., 1971, Scientific Knowledge and its Social Problems, Oxford University Press, p.22.

An ethical problem?

Issues with trust / quality in the scientific enterprise

- The centrality of ethics for quality (1971).

Jerome R. Ravetz

"with the industrialization of science, certain changes have occurred which weaken the operation of the traditional mechanism of quality control and direction at the highest level. […] The problem of quality control in science is thus at the centre of the social problems of the industrialized science of the present period. If it fails to resolve this problem […] then the immediate consequences for morale and recruitment will be serious; and those for the survival of science itself, grave."

Ravetz, J., 1971, Scientific Knowledge and its Social Problems, Oxford University Press, p.22.

Science's crisis

"To make more published research true, … the adoption of large-scale collaborative research; replication culture; registration; sharing; reproducibility practices; better statistical methods;"

Ioannidis, J. P. (2014). How to Make More Published Research True. PLoS medicine, 11(10), e1001747.

Science's crisis

"…Standardization of definitions and analyses; more appropriate (usually more stringent) statistical thresholds; and improvement in study design standards, peer review, reporting and dissemination of research, and training of the scientific workforce."

Ioannidis, J. P. (2014). How to Make More Published Research True. PLoS medicine, 11(10), e1001747.

Science's crisis

"…Selection of interventions to improve research practices requires rigorous examination and experimental testing whenever feasible."

Ioannidis, J. P. (2014). How to Make More Published Research True. PLoS medicine, 11(10), e1001747.

Science's crisis

"…Harness the motives of various stakeholders … Modify … reward system for science, affecting the exchange rates for currencies (e.g., publications and grants) and purchased academic goods (e.g., promotion and other academic or administrative power) and introducing currencies that are better aligned with translatable and reproducible research."

Ioannidis, J. P. (2014). How to Make More Published Research True. PLoS medicine, 11(10), e1001747.

An ethical problem?

"No formal system of imposed penalties and rewards will guarantee the maintenance of quality, for
the tasks of scientific inquiry are generally too subtle to be so crudely assessed" (p. 407).

Jerome R. Ravetz

Ravetz, J., 1971, Scientific Knowledge and its Social Problems, Oxford University Press, p.22.

Other solutions?

Could the movement known as ‘Citizens’ Science’ respond to official science’s predicaments (McQuillan, 2014) and ‘pick up the gauntlet’ thrown by official science’s contested hegemony?

McQuillan, D., 2014, The Countercultural Potential of Citizen Science, Media and Communication Journal, Vol. 17, No. 6 (2014) - 'counterculture', http://journal.media-culture.org.au/index.php/mcjournal/article/view/919

Other solutions?

"Is the internet to science what the Gutenberg press was to the church?"

Silvio Funtowicz, Centre for the Study of the Sciences and the Humanities, University of Bergen (NO)

Peer Review and Quality Control, S. Funtowicz & J. Ravetz, International Encyclopedia of the Social & Behavioral Sciences, 2nd edition, 2015.

Other solutions?

"[…] the new social media have given strength to the extended peer community in science in a way reminiscent of the contribution of printing to the Reformation."

Peer Review and Quality Control, S. Funtowicz & J. Ravetz, International Encyclopedia of the Social & Behavioral Sciences, 2nd edition, 2015.

Other solutions?

"Collegial peer review is being rapidly transformed to review by an 'extended peer community,' raising important issues to the governance of science."

Peer Review and Quality Control, S. Funtowicz & J. Ravetz, International Encyclopedia of the Social & Behavioral Sciences, 2nd edition, 2015.

DIY INNOVATION...