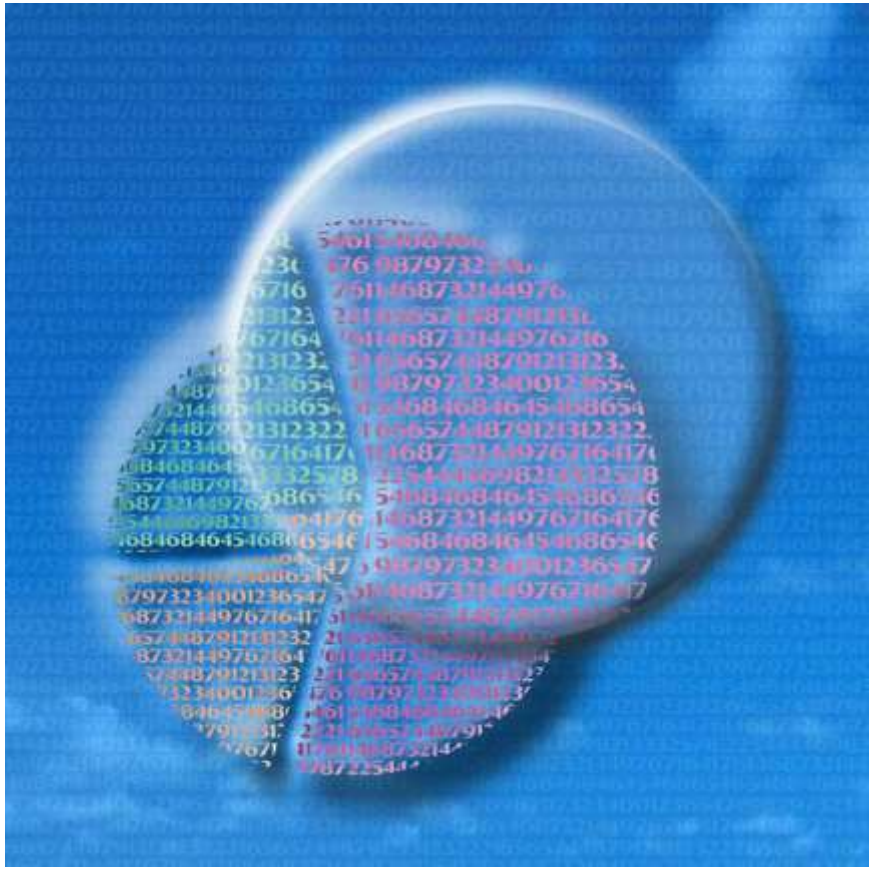

Sensitivity Auditing

Statistical and participatory tools for
Impact Assessment
28-29 April, 2016
Brussels – PLB3 – 4/59
Rue P.Lebon 3 – ROOM 3.36

Andrea Saltelli[(a)],
Ângela Guimarães Pereira[(b)]

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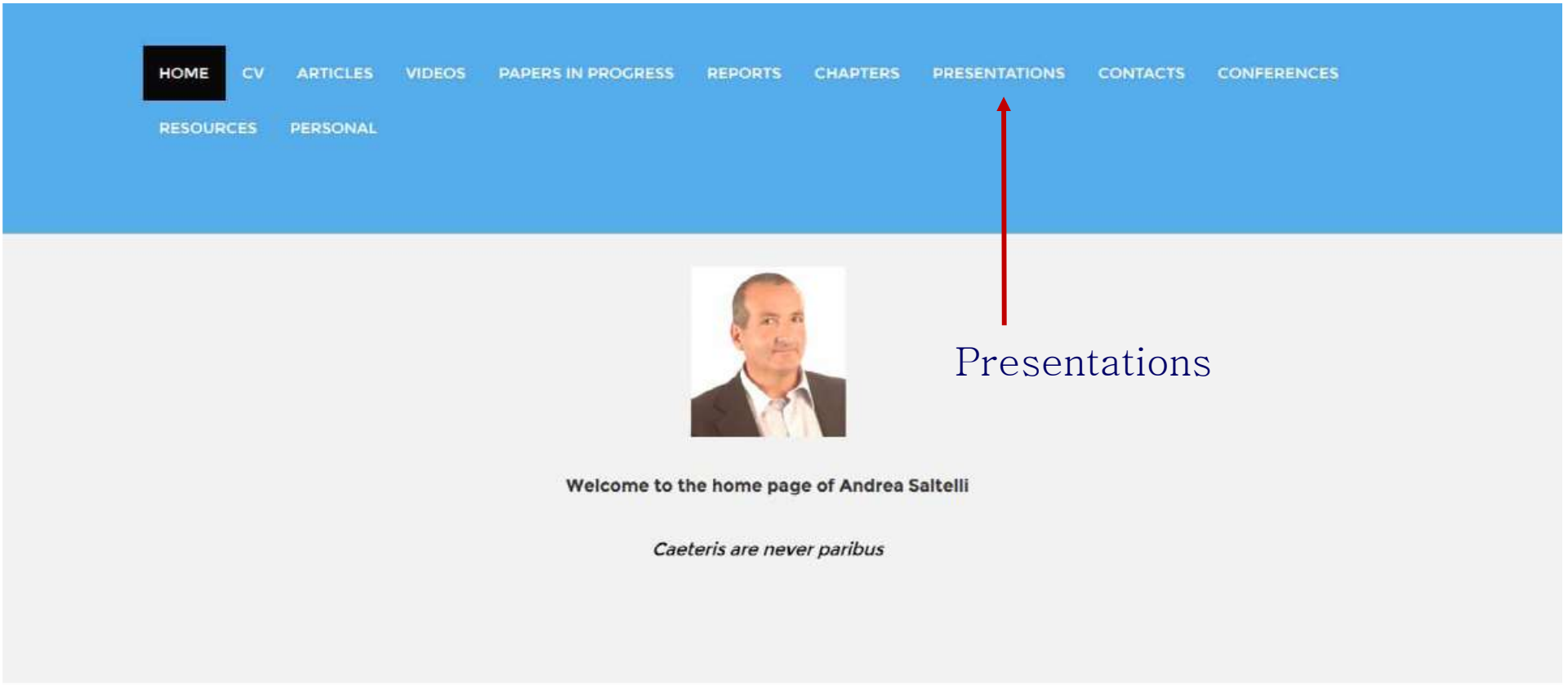
(a) European Centre for Governance in Complexity,
Universities of Bergen (NO) and Autonoma of Bacelona (ES)
(b) European Commission–Joint Research Centre

www.andreasaltelli.eu



Presentations

Where to find this presentation

andrea.saltelli@uib.no

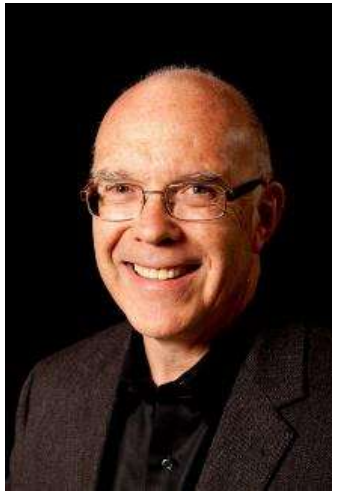
sensitivity analysis,
sensitivity auditing,
science for policy,
impact assessment, ...

Sensitivity auditing – second day

- Context for science for policy. Science's governance crisis. Trust and legitimacy.
- Models of science for policy
- Steps of a sensitivity auditing (taken from IA toolbox as a starting point) with case studies.
- Frames and socially constructed ignorance
- Quantitative story telling
- Why these approaches demand an extended peer communities
- Participatory methods – an introduction to the second JRC training module

Is there a crisis?

- Generation of new data/ publications at an unprecedented rate.
- Compelling evidence that the majority of these discoveries will not stand the test of time.
- Causes: failure to adhere to good scientific practice & the desperation to publish or perish.
- This is a multifaceted, multistakeholder problem.
- No single party is solely responsible, and no single solution will suffice.



C. Glenn Begley

John P. A. Ioannides

Begley, C. G., and Ioannidis, J. P., 2015, Reproducibility in Science. Improving the Standard for Basic and Preclinical Research, Circulation Research, 116, 116-126, doi: 10.1161/CIRCRESAHA.114.303819

Unreliable research

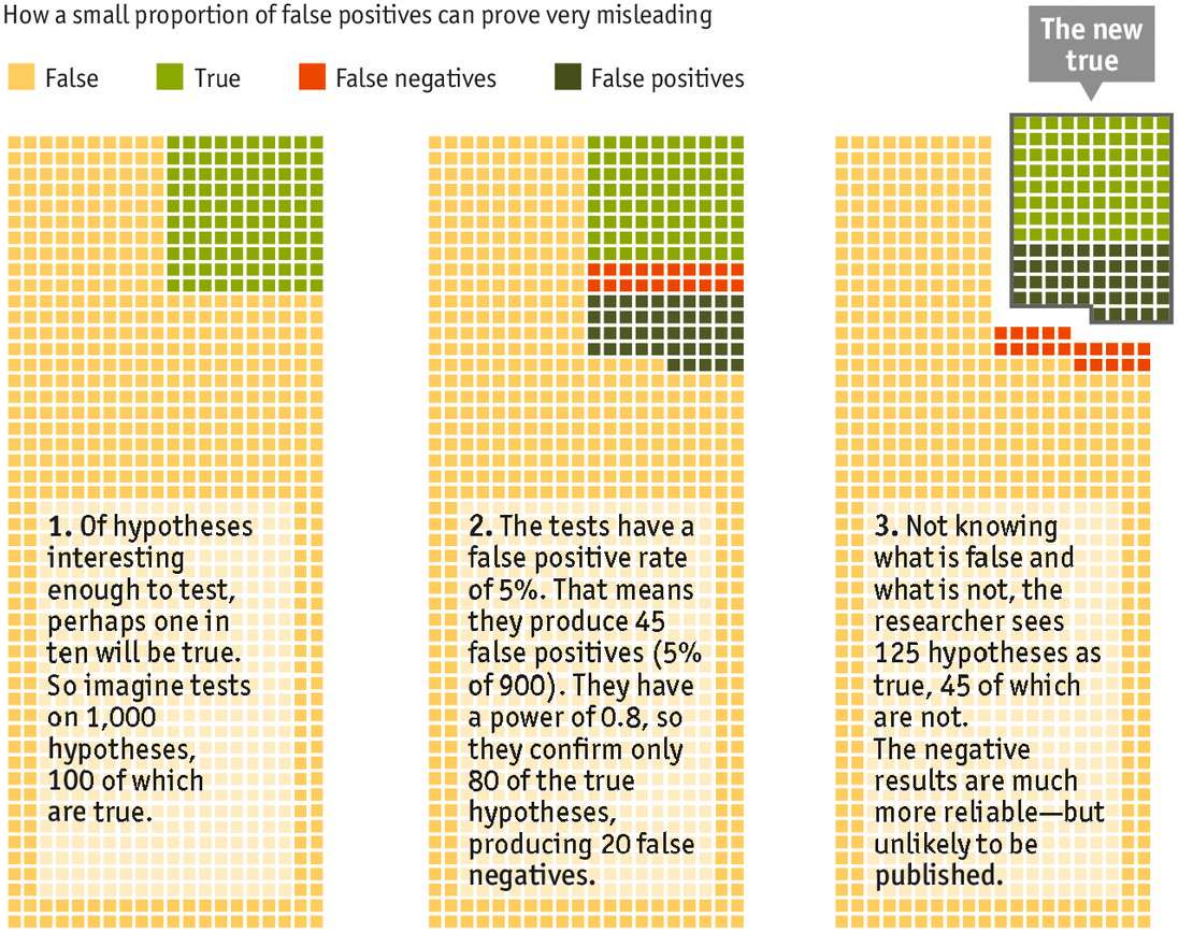
Trouble at the lab

Scientists like to think of science as self-correcting. To an alarming degree, it is not

Oct 19th 2013 | From the print edition

Unlikely results

How a small proportion of false positives can prove very misleading



Source: *The Economist*

The Economist

"A career structure which lays great stress on publishing copious papers exacerbates all these problems."

The Economist

“There is no cost to getting things wrong. The cost is not getting them published.” Brian Nosek, quoted by The Economist.

The Economist

A landmark effort to reproduce the findings of 100 recent papers in psychology failed in more than half the cases – and the effects were smaller than claimed in the original studies (Brian Nosek's work).

Brian Nosek
Professor,
Department of
Psychology
University of Virginia

Baker, M., 2015, Over half of psychology studies fail reproducibility test. Largest replication study to date casts doubt on many published positive results, Nature, 27 August 2015.

OSC, Open Science Collaboration, 2015, Estimating the reproducibility of psychological science, SCIENCE, 349(6251) aac4716. DOI: 10.1126/science.aac4716

Yong, E., Nobel laureate challenges psychologists to clean up their act, Nature, News, 03 October 2012.

... and a couter study saying that Nosek's team got it wrong.

Gilbert, D. T., King, G., Pettigrew, S. & Wilson, T. D. Science 351, 1037 (2016).

Solutions from within:

- Four international conferences on science integrity; Pledges; Replication initiatives…
- San Francisco declaration, (2012)
- Ioannides (2014): a checklist of remedies

John P. A. Ioannides

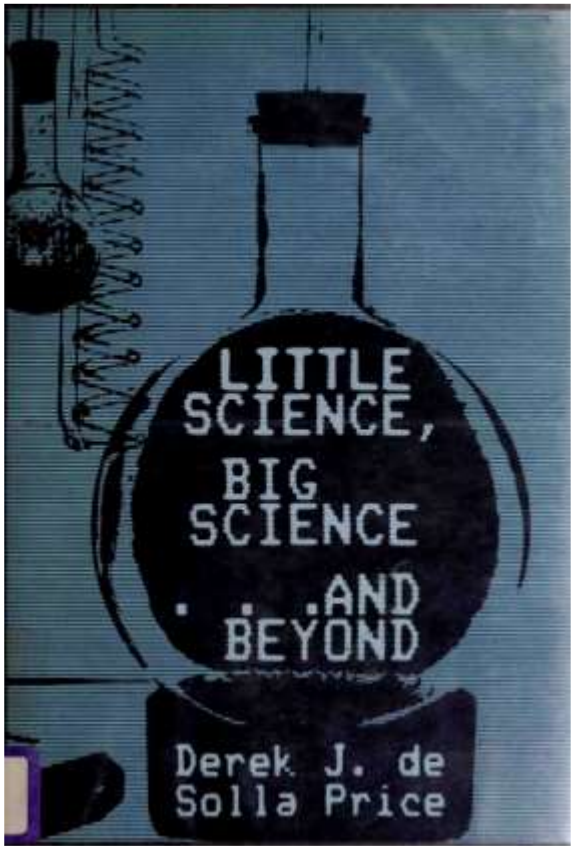
"[…] adoption of large-scale collaborative research; replication culture; registration; sharing; reproducibility practices; better statistical methods; […] and improvement in study design standards, peer review, […] training of the scientific workforce"

Declaration: http://am.ascb.org/dora/ , drafted by publishers, with separate recommendations for institutions, publishers, organizations that supply metrics and researchers.
Lancet, Editorial, 2015, Rewarding true inquiry and diligence in research, 385, p. 2121.
Wilsdon, J., 2015, We need a measured approach to metrics, Nature, 523, 129.
Ioannidis, J. P. (2014). How to Make More Published Research True. PLoS medicine, 11(10), e1001747.

Different readings of the crisis :

- Poor training, statistical design, hubris of data mining, perverse incentives, counterproductive metrics (e.g. Ioannidis; San Francisco Declaration,…)
- Science victim of its own success, exponential growth, senility by exponential growth & hyper-specialization (De Solla Price;)
- Science as another victim of the neoliberal ideology (e.g. Mirowski)
- Science as a social enterprise whose quality control apparatus suffers under the mutated conditions of technoscience (Ravetz, Lyotard)

There were rare anticipations of this crisis. In 1963 Derek J. de Solla Price prophesized that Science would reach saturation (and in the worst case senility) under its own weight, victim of its own success and exponential growth (pp 1-32).



Derek J. de Solla Price

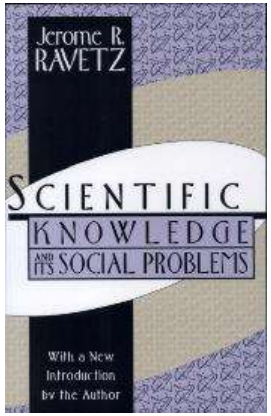
de Solla Price, D.J., 1963, Little science big science, Columbia University Press.

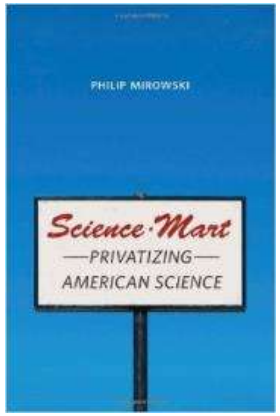
Science/knowledge degenerates when it becomes a commodity for Ravetz (1971), Lyotard (1979) and Mirowski (2011).

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

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.





Jerome R. Ravetz

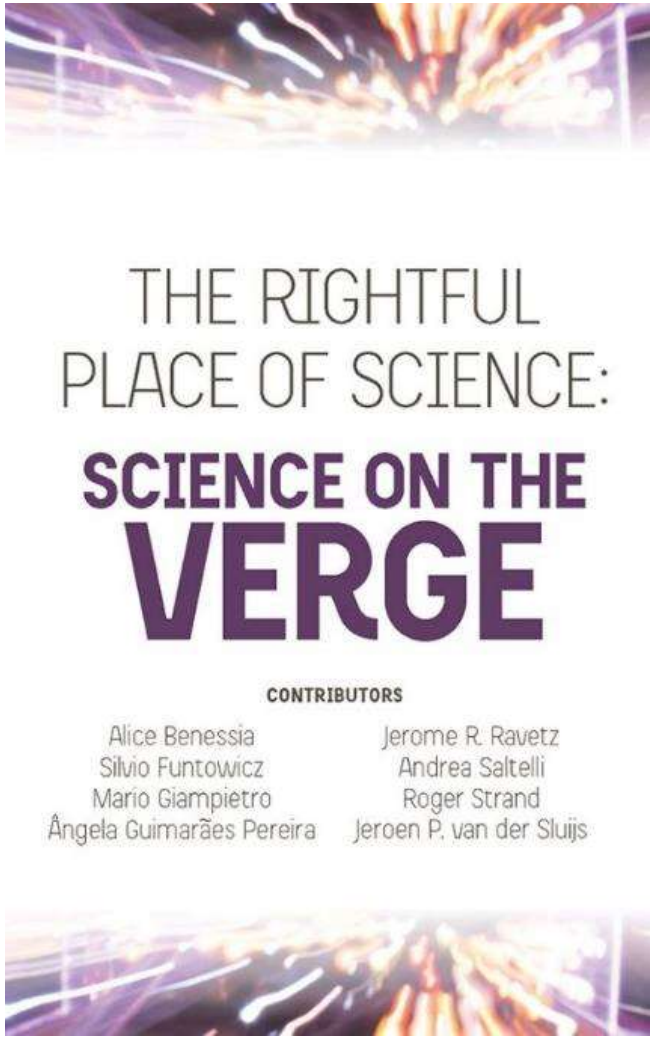
Jean-François Lyotard

Philip Mirow

Published by the Consortium for Science, Policy and Outcomes at Arizona State University, March 2016, on Amazon.

http://www.amazon.com/Rightful-Place-Science-Verge/dp/0692596380/ref=sr_1_1?s=books&ie=UTF8&qid=1456255907&sr=1-1&keywords=saltelli

http://www.andreasaltelli.eu/science-on-the-verge



Discussion points

- Is there a crisis then? Build a counter argument
- Should this concern me? Build an argument for and one against

Does the crisis impact science for policy & science's advice?

"Belinda Phipps, who took over at the Science Council last year, accused the sector of complacency and said the public trusted scientists only because they did not understand their work."

Whipple, T., The Times, February 22, 2016

THE TIMES

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Welcome to your preview of The Times

Scientists 'should take ethics oath like doctors'

Tom Whipple Science Editor
Published at 12:01AM, February 22 2016

Scientists need their own version of the Hippocratic oath and a regulation system similar to doctors to avoid a big scandal, the head of their standards body has said.

Studies suggest that a significant proportion of scientific papers are not repeatable
Monty Rakusen/Corbis

Post a comment

"What struck me, coming into this sector is just how unregulated it is compared to the medical profession," Ms Phipps said. "Think what damage a scientist could do if he or she behaved badly or fraudulently. The potential damage is enormous, yet there is almost no regulation."

Whipple, T., The Times, February 22, 2016

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Monty Rakusen/Corbis

Post a comment

Ignoring the connection between science's crisis and science advice?

The OECD report on Science Advice 2015; not a single mention of science's crisis.

OECDpublishing

Please cite this paper as:

OECD (2015), "Scientific Advice for Policy Making: The Role and Responsibility of Expert Bodies and Individual Scientists", *OECD Science, Technology and Industry Policy Papers*, No. 21, OECD Publishing, Paris.
http://dx.doi.org/10.1787/5js33l1jcpwb-en

OECD Science, Technology and Industry Policy Papers No. 21

Scientific Advice for Policy Making

THE ROLE AND RESPONSIBILITY OF EXPERT BODIES AND INDIVIDUAL SCIENTISTS

OECD

http://www.oecd-ilibrary.org/docserver/download/5js33l1jcpwb.pdf?expires=1442656356&id=id&accname=guest&checksum=AF1467AD25FF8BE6516083077CCEE31A

Those aspect of science most used in policy (mathematical and statistical modelling) are also those more problematic

WORLD VIEW *A personal take on events*

MICHAEL TEMCHINE

Reproducibility will not cure what ails science

A bill to make data for environmental regulation more transparent reveals the fuzzy boundary between science and ideology, argues **Daniel Sarewitz.**

Sarewitz, D., 2015, Reproducibility will not cure what ails science, Nature, 525, p. 159.

Saltelli, A., Funtowicz, S., 2014, 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/

If quantification is so problematic why the urge to quantify at all cost?

The myth of scientific quantification via risk or cost benefit analyses, including of the impact of new technologies, has been at the hearth of the critique of the ecological moment (e.g. Schumacher, 1973; Winner, 1986; Funtowicz and Ravetz, 1994)

E. F. Schumacher, 1973, Small Is Beautiful. Economics as if People Mattered, Penguin Perennial,

Winner, L., 1986. The Whale and the Reactor: a Search for Limits in an Age of High Technology. The University of Chicago Press, 1989 edition.

Funtowicz, S.O. and Ravetz, J.R. (1994). The worth of a songbird: Ecological economics as a post-normal science. Ecological Economics 10(3), 197-207.

[…] quality is much more difficult to 'handle' than quantity, just as the exercise of judgment is a higher function than the ability to count and calculate. Quantitative differences can be more easily grasped and certainly more easily defined than qualitative differences: their concreteness is beguiling and gives them the appearance of scientific precision, even when this precision has been purchased by the suppression of vital differences of quality.

Ernst Friedrich "Fritz" Schumacher

E. F. Schumacher, 1973, Small Is Beautiful. Economics as if People Mattered, Penguin Perennial,

Techniques (such as cost benefit analysis, CBA) are never neutral; according to Winner (1986) ecologists should not fall into the trap of CBA and risk analyses

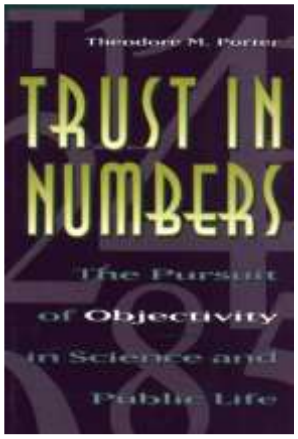
(Chapter ON NOT HITTING THE TAR-BABY)

Langdon Winner

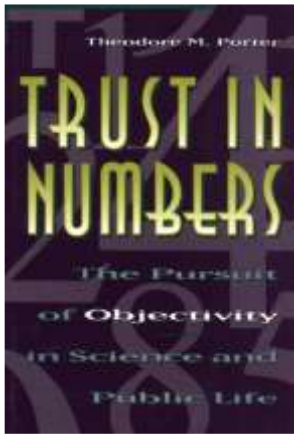
Winner, L., 1986. The Whale and the Reactor: a Search for Limits in an Age of High Technology. The University of Chicago Press, 1989 edition.

p. 8: “The appeal of numbers is especially compelling to bureaucratic officials who lack the mandate of a popular election, or divine right. Arbitrariness and bias are the most usual grounds upon which such officials are criticized. A decision made by the numbers (or by explicit rules of some other sort) has at least the appearance of being fair and impersonal.”

Theodor M. Porter



Theodore M. Porter, Trust in Numbers, The Pursuit of Objectivity in Science and Public Life, Princeton 1995



p. 8: “Scientific objectivity thus provides an answer to a moral demand for impartiality and fairness. Quantification is a way of making decisions without seeming to decide. Objectivity lends authority to officials who have very little of their own.”

Trust, authority and styles of quantification: two different stories

ECOLE NATIONALE
DES PONTS ET CHAUSSEES

US Army Corps of Engineers®

Porter's story: Quantification needs judgment which in turn needs trust …without trust quantification becomes mechanical, a system, and 'systems can be played'.

Discussion points

- Do I see a relationship between trust and quantification?
- Are we (my team, my organization) more like the ‘corps des ingénieurs des ponts et chaussées’ or the US Army corps of Engineers?
- Are we (as above) into evidence based policy or policy based evidence? Build cases for one and the other.

Demarcation: facts separate from values

On demarcation:

"the incoming commission must find better ways of separating evidence-gathering processes from the 'political imperative'", A. Glover, former Chief Science Adviser of President Barroso (Wildson, 2014).

Wilsdon, J. 2014. Evidence-based Union? A new alliance for science advice in Europe. In The Guardian. Available at: http://www.theguardian.com/science/political-science/2014/jun/23/evidence-based-union-a-new-alliance-for-science-advice-in-europe.

Anne Glover

Evidence based policy – in the prevailing positivistic narrative – is predicated on a separation of facts from values, of scientists from their customers, on demarcation of roles.

‘Demarcation model’ of science’s input to policy

- Protecting science from the political interference…
- Preventing possible abuse of science…
- … and scientific information driven by agendas…
- Prescribes a clear demarcation between the institutions (and individuals) who provide the science, and those where it is used.

Funtowicz, S. 2006. What is Knowledge Assessment? In Guimarães Pereira, Â., Guedes Vaz, S. and Tognetti, S. (eds) Interfaces between Science and Society. Greenleaf Publishers, Sheffield.

The demarcation model is challenged in more recent epistemologies:

'Post Normal Science' (Funtowicz and Ravetz, 1993), 'Co-production of knowledge' model (Jasanoff, 1996).

Sheila Jasanoff

Funtowicz, S. O. & Ravetz, J. R. 1993. Science for the post-normal age. Futures, 25(7), 739-755.

Jasanoff, S. 1996, Beyond Epistemology: Relativism and Engagement in the Politics of Science. Social Studies of Science. 26(2) 393-418.

Childhood obesity: The challenge of policy development in areas of post-normal science

***Speaker**: Sir Peter Gluckman (Chief Science Advisor to the Prime Minister, Co-Chair of the WHO Commission on Ending Childhood Obesity)*

Post Normal Science's model of Extended Participation: (1) across disciplines – acknowledging that different disciplines see though different lenses, and (2) across communities of both experts and stakeholders;

From 'speaking truth to power' towards 'working deliberatively within imperfections';

Science is but one among a plurality of relevant knowledges;

Facts become 'extended facts'.

Funtowicz, S. O. & Ravetz, J. R. 1993. Science for the post-normal age. Futures, 25(7), 739–755.

Gluckman, P., 2014, Policy: The art of science advice to government, Nature, 507, 163–165.

Where did this separation originate?

Francis Bacon
(1561-1626)

Magnalia Naturae, in the New Atlantis (1627), '*Wonders of nature, in particular with respect to human use*'

Demarcation is part of the Cartesian dream of man as master and possessor of nature, of prediction and control, of Bacon's wonders of science and Condorcet's mathematique sociale…

Nicolas de Caritat,
marquis de Condorcet
(1743- 1794)

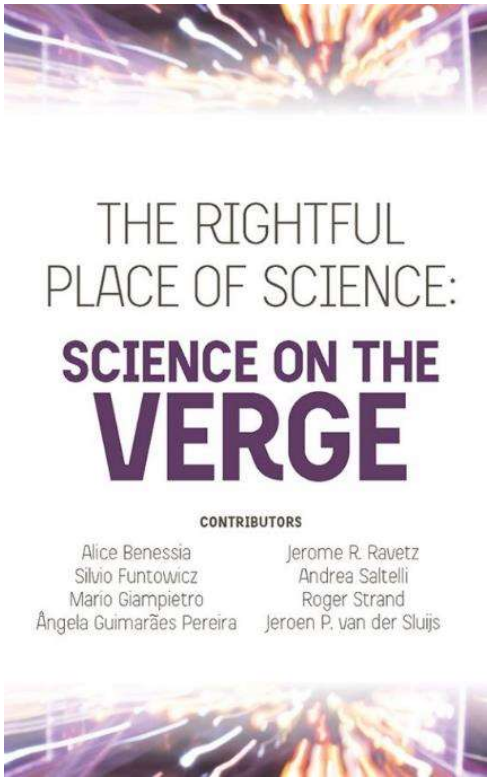
'Sketch for a Historical Picture of the Progress of the Human Spirit'

René
Descartes
(1596-1650)

Discourse on Method
(1637)

We were nourished (and professionally trained) with the principles of the Cartesian dream.

This has profound governance implications due to the centrality of science in the formulation & adjudication of policy (dual legitimacy arrangement).



Discussion points

- Demarcating or not demarcating? (Appealing or not appealing to the neutrality of experts?). Build an argument for and one against.

- When an expert is not neutral is he/she dishonest?

Sensitivity auditing in the IA toolbox

Time to look at the EC own guidelines: what do they about sensitivity auditing ?

http://ec.europa.eu/smart-regulation/guidelines/docs/br_toolbox_en.pdf

p. 392

… where there is a major disagreement among stakeholders about the nature of the problem, … then sensitivity auditing is more suitable but sensitivity analysis is still advisable as one of the steps of sensitivity auditing.

p. 393

Sensitivity auditing, [⋯] is a wider consideration of the effect of all types of uncertainty, including structural assumptions embedded in the model, and subjective decisions taken in the framing of the problem.
[⋯]
The ultimate aim is to communicate openly and honestly the extent to which particular models can be used to support policy decisions and what their limitations are.

p. 393

"In general sensitivity auditing stresses the idea of honestly communicating the extent to which model results can be trusted, taking into account as much as possible all forms of potential uncertainty, and to anticipate criticism by third parties."

p. 393

“In particular, one should avoid giving the impression of false confidence by “quantification at all costs”. In some cases there is simply not enough data, or the process is too complex, to give a meaningful quantitative prediction.”

Responsible quantification under extended peer communities and sensitivity auditing

Sensitivity auditing

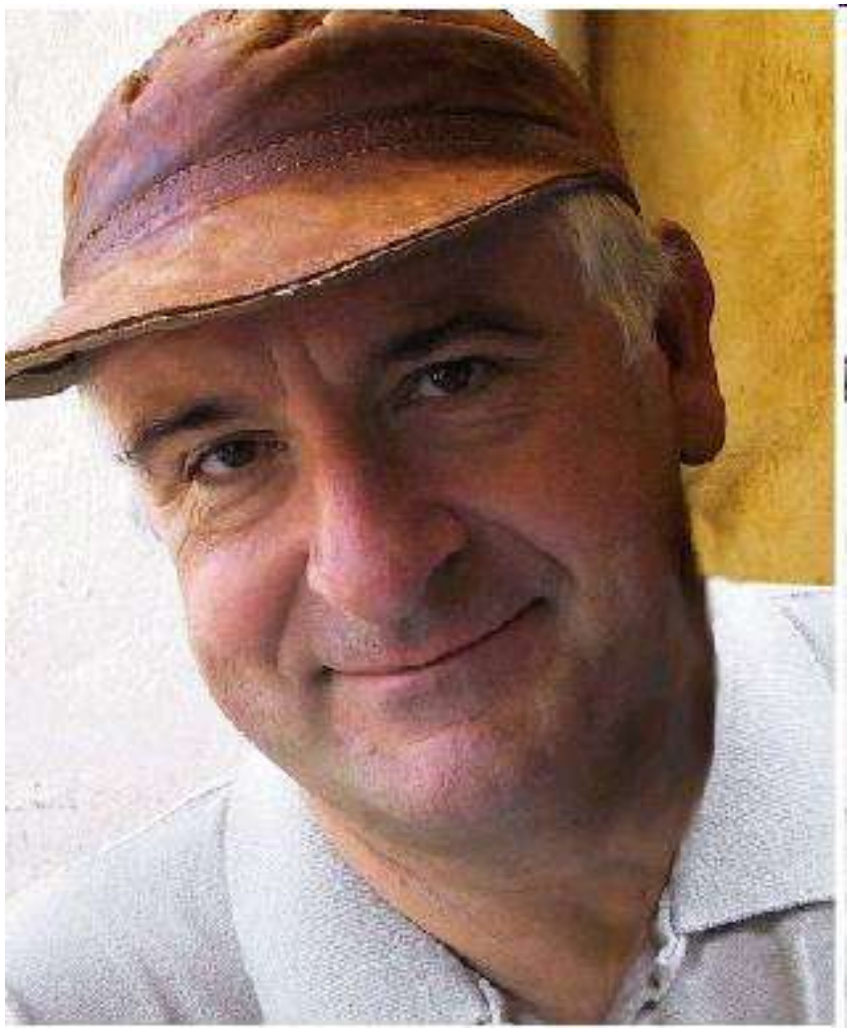
- Originates from uncertainty & sensitivity analysis
- Addresses model-based evidence used for policy

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.

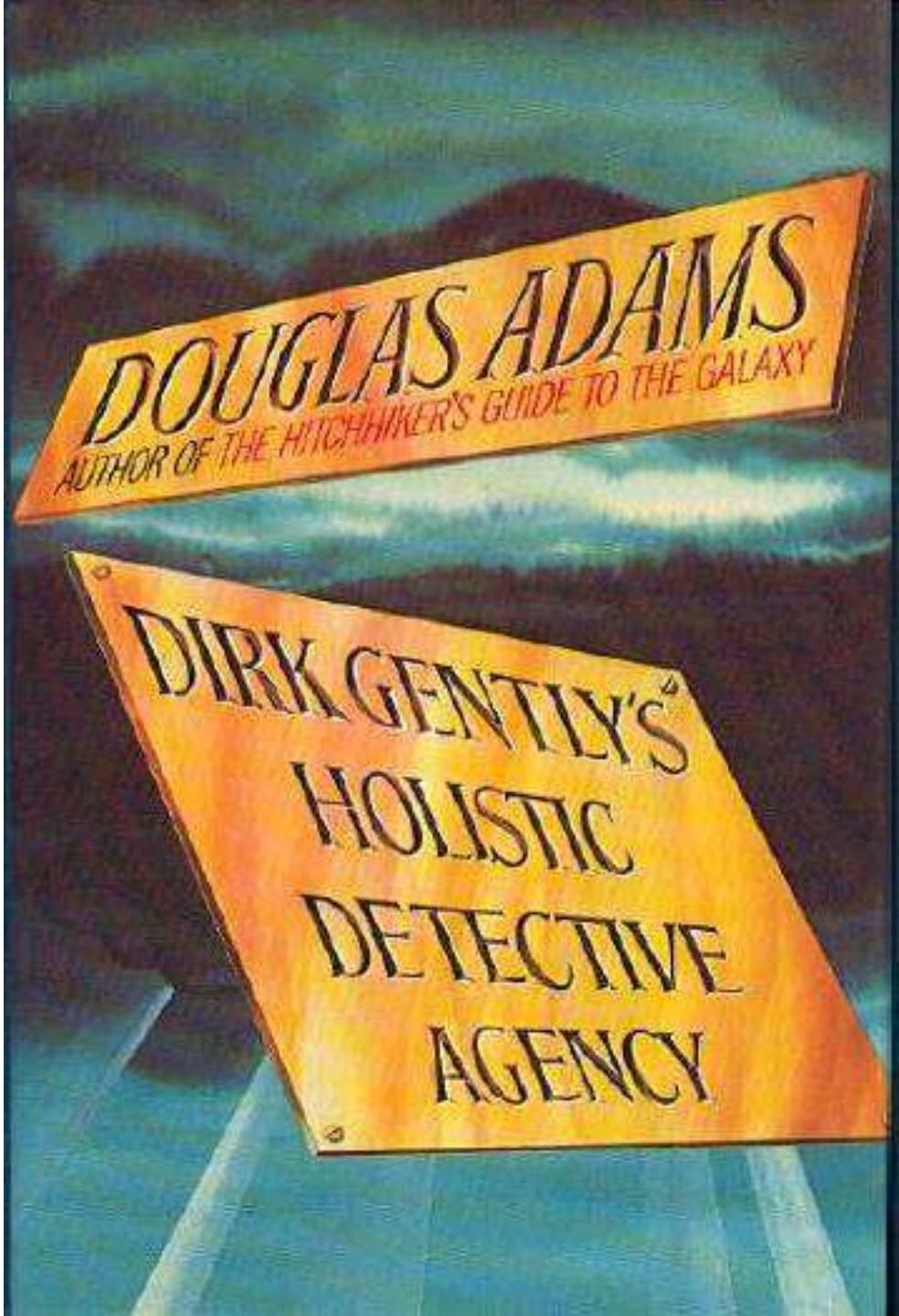
Saltelli, A., Funtowicz, S., When all models are wrong: More stringent quality criteria are needed for models used at the science-policy interface, Issues in Science and Technology, Winter 2014, 79-85.
http://issues.org/30-2/andrea/

RULE ONE: Check against rhetorical use of mathematical modelling

The instrumental use of mathematical modelling to advance one's agenda can be termed rhetorical, or strategic, like the use of Latin by the elites and the clergy in the classic age.



Pocket Books 1987, p.69



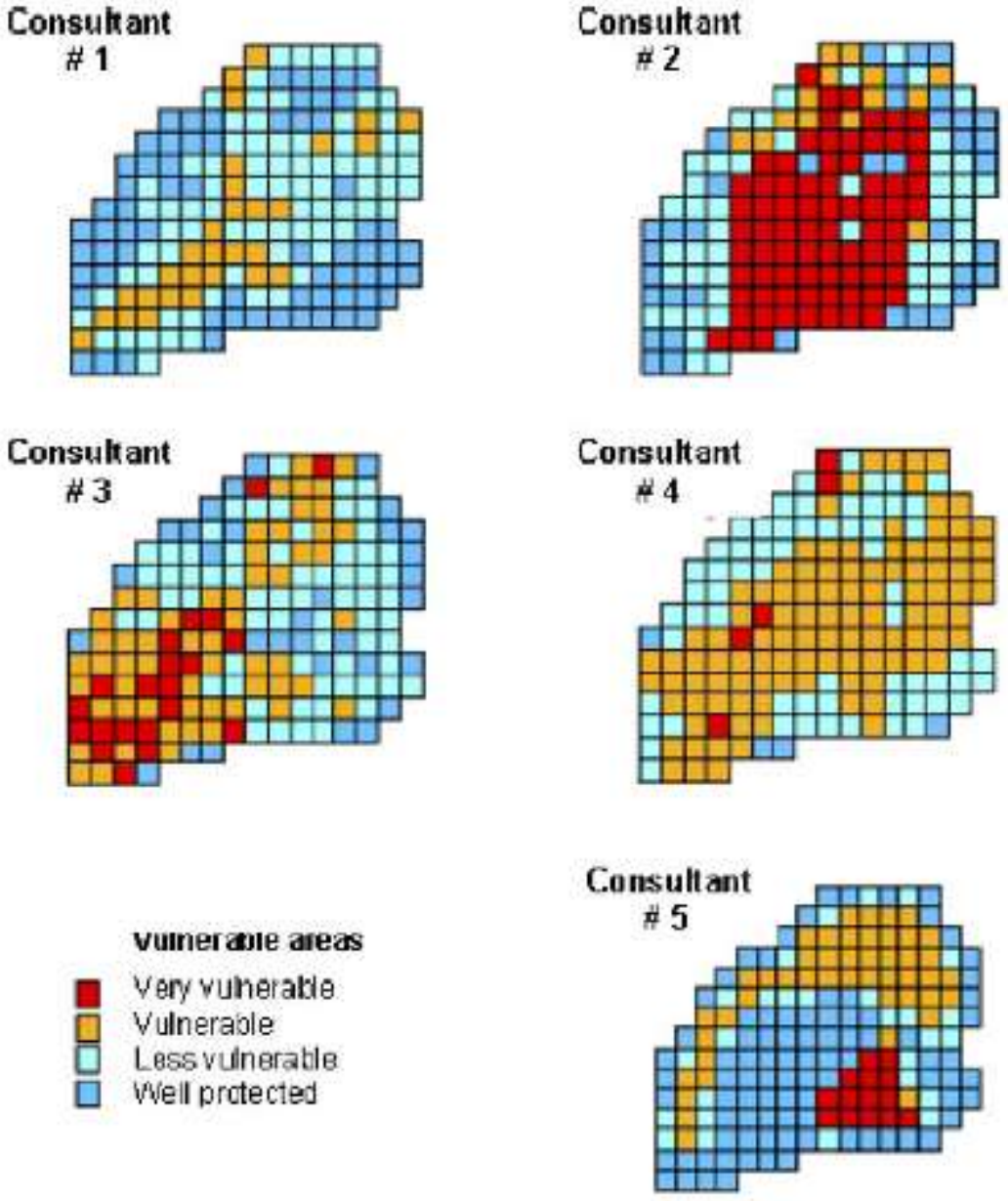
RULE ONE: Check against rhetorical use of mathematical modelling

"Well, Gordon's great insight was to design a program which allowed you to specify in advance what decision you wished it to reach, and only then to give it all the facts. The program's task, […], was to construct a plausible series of logical-sounding steps to connect the premises with the conclusion."

Model structure uncertainty…

5 consultants, each using a different model were given the same question:
"which parts of this particular area are most vulnerable to pollution and need to be protected?"

(Refsgaard et al, 2006)



This and next two slides: Courtesy of Dr. Jeroen P. van der Sluijs, Centre for the Studies the Sciences and the Humanities (SVT), University of Bergen (NO)

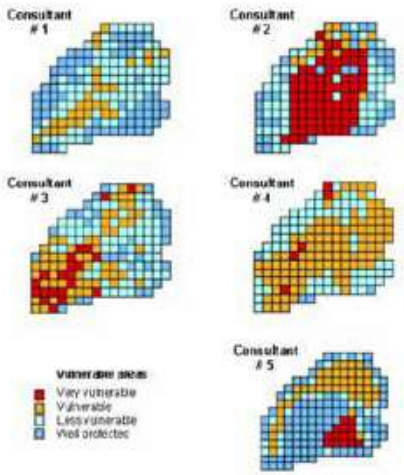


Fig. 1. Model predictions on aquifer vulnerability towards nitrate pollution for a 175 km² area west of Copenhagen [11].

How to act upon such uncertainty?

- **Bayesian** approach: 5 priors. Average and update likelihood of each grid-cell being red with data (but oooops, there is no data and we need decisions now)
- IPCC approach: Lock the 5 consultants up in a room and don't release them before they have **consensus**
- **Nihilist** approach: Dump the science and decide on an other basis
- **Precautionary** robustness approach: protect all grid-cells
- **Academic bureaucrat** approach: Weigh by citation index (or H-index) of consultant.
- Select the consultant that you **trust** most
- Real life approach: Select the consultant that best fits your **policy agenda**
- Post normal: explore the relevance of our ignorance: **working deliberatively within imperfections**

3 framings of uncertainty

'deficit view'

- Uncertainty is provisional
- Reduce uncertainty, make ever more complex models
- *Tools:* quantification, Monte Carlo, Bayesian belief networks

  - ***Speaking truth to power***

'evidence evaluation view'

- Comparative evaluations of research results
- *Tools:* Scientific consensus building; multi disciplinary expert panels
- focus on robust findings

  - ***Speaking [consensus] to power***

'complex systems view / *post-normal* view'

- Uncertainty is intrinsic to complex systems
- Openly deal with deeper dimensions of uncertainty
- *Tools:* Knowledge Quality Assessment

  - ***Working deliberatively within imperfections***

The IFPRI had raised about $460,000 for the modeling, which would have provided insights to help policymakers [⋯]

When economist Carl Pray heard about plans for the first international assessment of agricultural research, a gold standard sprang to mind: the Intergovernmental Panel on Climate Change (IPCC). But things didn't turn out the way he expected.

IPCC has been pivotal in proving that climate change is real and linking it to human activities. As an agricultural economist at Rutgers University who has worked in many poor countries, Pray is convinced that agricultural research—and genetic modification in

mentally, socially and economically sustainable development through the generation, access to, and use of agricultural knowledge, science and technology?" Critics say this broad mandate made conflict inevitable and stunted the assessment's analytical rigor.

On several key issues, consensus proved elusive. Industry scientists and some academics—mainly agricultural economists and plant biologists—believe the assessment was "hijacked" by participants who oppose genetically modified (GM) crops and other common

the outcome. They note that the voice and experience of small-scale farmers, particularly women, have finally been brought to the fore by the assessment. "It really deals with issues of power, influence, and benefits," says Marcia Ishii-Eiteman of the Pesticide Action Network North America in San Francisco, California. Toby Kiers, who studies sustainable agriculture at Vrije University in Amsterdam, the Netherlands, agrees. "For technology to be most effective, farmers must be at the center, influencing how it is developed, delivered, and

[⋯] But Greenpeace [⋯] objected that the models were not "transparent".

Source: Dueling visions for an hungry world, Erik Stokstad, 14 MARCH 2008, 319 SCIENCE

we reduce hunger and poverty, improve rural livelihoods, and facilitate equitable, environ-

* www.agassessment.org

community-based knowledge.

- Create space for diverse voices and include social scientists in policy.

Watson, then the World Bank's chief scientist, suggested that the bank review the entire range of agricultural technologies and policies. Convinced that agricultural research should be considered in the context of the myriad factors

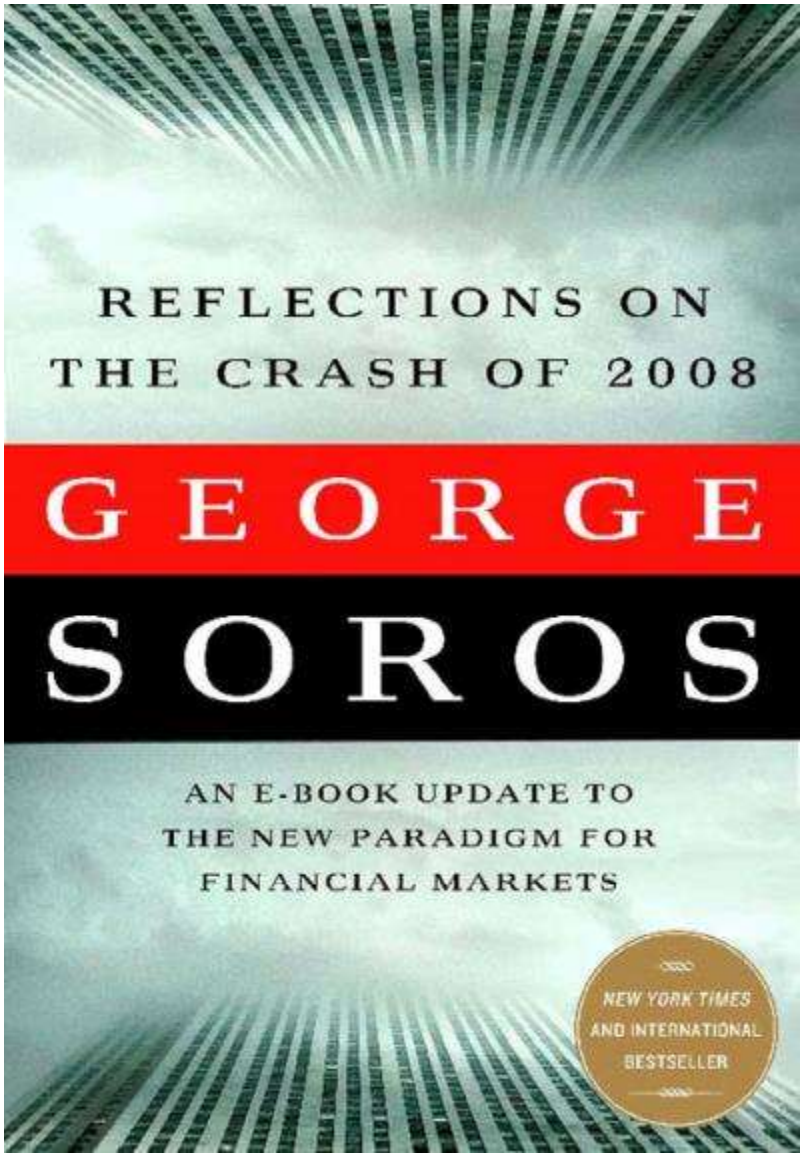
We just can't predict, says N. N. Taleb, and we are victims of the ludic fallacy, of delusion of uncertainty, and so on. Modelling is just another attempt to 'Platonify' reality…

Written before the financial crisis

Nassim Nichola Taleb, The Black Swan, Penguin, London 2007

Postulate of 'radical fallibility':

"Whenever we acquire some useful knowledge, we tend to extend it to areas where it is no longer applicable"



Models by their nature are like blinders. In leaving out certain things, they focus our attention on other things. They provide a frame through which we see the world.

Joseph E. Stiglitz, 2011, RETHINKING MACROECONOMICS: WHAT FAILED, AND HOW TO REPAIR IT, Journal of the European Economic Association August 2011 9(4):591–645

Caeteris are never paribus!

The rethorical question Keynes asks is (Keynes, 1940):

"It will be remembered that the seventy translators of the Septuagint were shut up in seventy separate rooms with the Hebrew text and brought out with them, when they emerged, seventy identical translations. Would the same miracle be vouchsafed if seventy multiple correlators were shut up with the same statistical material?“

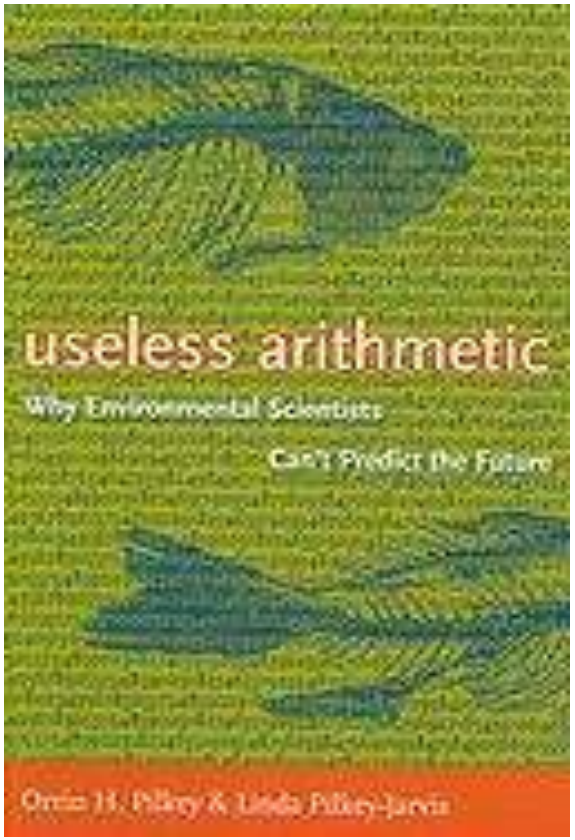
Keynes, J. M. , 1940, On a Method of Statistical Business-Cycle Research. A Comment, The Economic Journal, Vol. 50, No. 197 (Mar., 1940), 154-156.

Philip Mirowski

"…To be fair, DSGE and similar macroeconomic models were first conceived as theorists' tools. But why, then, are they being relied on as the platform upon which so much practical policy advice is formulated? And what has caused them to become, and to stay, so firmly entrenched?"

The quote reported is from Miller, B., 2010, Opening Address, The Hearing Charter of the House Committee on Science and Technology and sworn testimony of economists Sidney Winter, Scott Page, Robert Solow, David Colander and V.V. Chari. See book on this slide.

RULE ONE: Check against rhetorical use of mathematical modelling



Useless Arithmetic: Why Environmental Scientists Can't Predict the Future by Orrin H. Pilkey and Linda Pilkey-Jarvis

'Quantitative mathematical models used by policy makers and government administrators to form environmental policies are seriously flawed'

RULE ONE: Check against rhetorical use of mathematical modelling

The problem of legitimization – quantitative analysis as a rhetorical or ritual device - the story of Nobel prize laureate Kenneth Arrow:

"The commanding general is well aware that the forecasts are no good. However, he needs them for planning purposes"(Szenberg, 1992).

p. 393

"Modellers could usefully consider the following principles:

1

- Before entering into contractual arrangements with third party consultants, consider the full spectrum of available models […] [and check that] the complexity of the model is justified by the quality of information used to calibrate it, i.e. that a large model is not being used rhetorically to convey a spurious impression of accuracy."

RULE TWO: Adopt an 'assumption hunting' attitude;

What was 'assumed out'? What are the tacit, pre-analytic, possibly normative assumptions underlying the analysis?

E.g. in 'Bogus Quantification: Uses and Abuses of Models' John Kay uncovers that the UK transport WebTAG model (the standard for transport policy simulation) needs as input 'Annual Percentage Change in Car Occupancy up to 2036.'

John Kay, London School Economics, Columnist Financial Times

John Kay's approach is called 'Assumptions hunting' in Dutch circles …

John Kay, Financial Times

Watch the videos from the workshop 'Significant digits. Responsible Use of Quantitative Information', Brussels, 11,9-10 June 2015.

https://ec.europa.eu/jrc/en/event/conference/use-quantitative-information

Philip Stark,
University of Berkeley

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

On the contribution of external cost calculations to energy system governance: The case of a potential large-scale nuclear accident

Erik Laes [a,*], Gaston Meskens [b], Jeroen P. van der Sluijs [c]

Contents lists available at ScienceDirect

Environmental Modelling & Software

journal homepage: www.elsevier.com/locate/envsoft

A method for the analysis of assumptions in model-based environmental assessments

Penny Kloprogge [a], Jeroen P. van der Sluijs [a,b,*], Arthur C. Petersen [c]

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

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Erik Laes [a,*], Gaston Meskens [b], Jeroen P. van der Sluijs [c]

'[…] calculation of the external costs of a potential large-scale nuclear accident […] 'An [analysis] resulted in a list of 30 calculation steps and assumptions' …

Who should do the hunting? Implication of Rule 2 for participatory approaches introducing a worked example from flood management.

Lane, S. N., Odoni, N., Landström, C., Whatmore, S. J., Ward, N. and Bradley, S., 2011. "Doing flood risk science differently: an experiment in radical scientific method." Transactions of the Institute of British Geographers, 36: 15-36.

Transactions of the Institute of British Geographers
Royal Geographical Society with IBG
Advancing geography and geographical learning

Doing flood risk science differently: an experiment in radical scientific method

S N Lane*, N Odoni*, C Landström**, S J Whatmore**, N Ward† and S Bradley‡

Trans Inst Br Geogr NS 36 15–36 2011
ISSN 0020-2754

[…] knowledge regarding flooding was co-produced. This illustrates a way of working with experts, both certified (academic natural and social scientists) and noncertified (local people affected by flooding), […] We reveal a deep and distributed understanding of flood hydrology across all experts, certified and uncertified, …

Years of modeling stream flow and cost/benefit ratios for flood protection structures had failed to consider an alternative intervention—upstream storage of flood waters—until local stakeholders were brought into the modeling process.

According to Lane and colleagues, upstream storage was neglected in the models because of the "use of a pit-filling algorithm that made sure that all water flows downhill"!

p. 393

"Modellers could usefully consider the following principles:

2

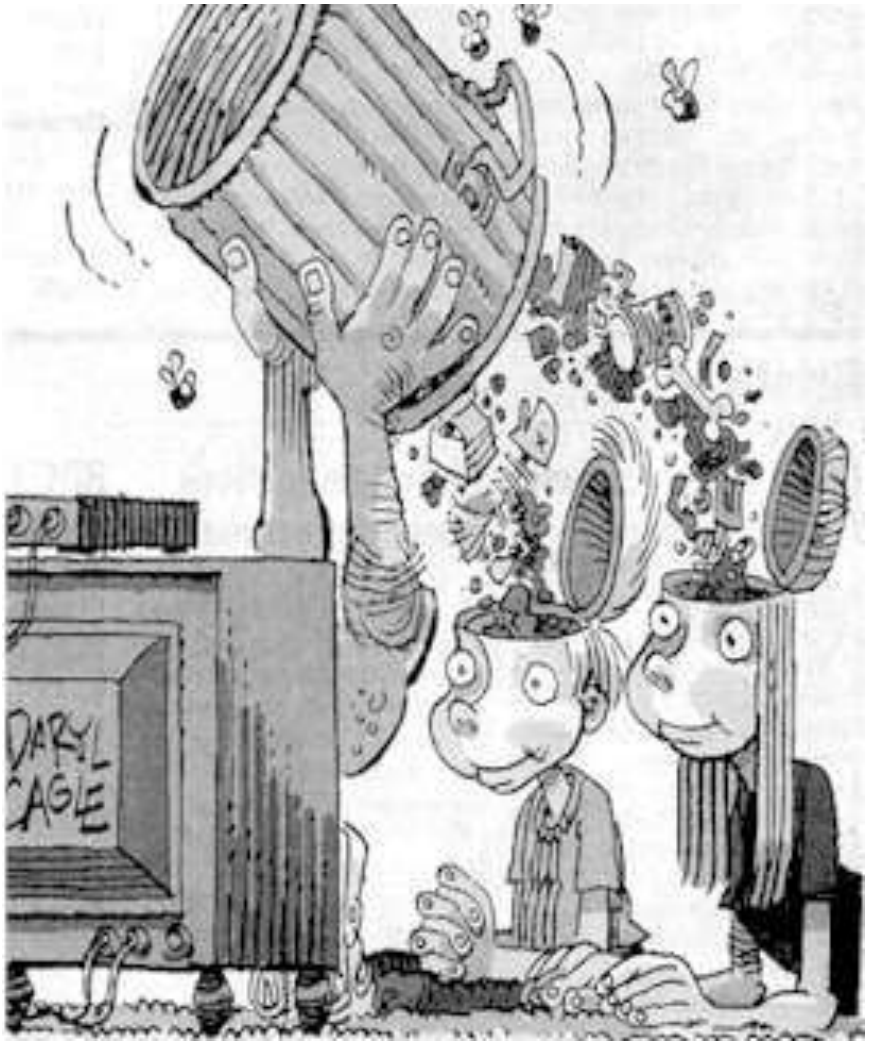
- Critically examine all model assumptions. Are there implicit or hidden assumptions which a third party might point to? Would it be possible to evaluate the impact of taking a different approach to tackle the issue? "

Discussion points

- Can I recall an example of ‘excessive’ or exaggerated quantification (hyper-precision)
- Am I haunted by a hidden assumptions, or by an elephants in the room nobody else sees? C
- Can rule 2 lead to paralysis by analysis?

RULE THREE: detect GIGO (Garbage In, Garbage Out)

Science or pseudo-science



What is GIGO (Garbage In, Garbage Out) Science or pseudo-science "where uncertainties in inputs must be suppressed lest outputs become indeterminate"

From: Uncertainty and Quality in Science for Policy, by Silvio Funtowicz and Jerry Ravetz, Springer 1990.

Funtowicz & Ravetz's GIGO (Garbage In, Garbage Out) Science – or pseudo-science – "where uncertainties in inputs must be suppressed least outputs become indeterminate"

Leamer's 'Conclusions are judged to be sturdy only if the neighborhood of assumptions is wide enough to be credible and the corresponding interval of inferences is narrow enough to be useful'.

p. 393

"Modellers could usefully consider the following principles:

3

- Be careful not to over or under-estimate uncertainties in model input parameters. […] Where uncertainty is particularly difficult to quantify, it may be better to discuss it in qualitative terms rather than give a spurious impression of accuracy."

RULE FOUR: find sensitivities before sensitivities find you;

THE NEW YORKER

"Carmen Reinhart and Kenneth Rogoff […] famous (now infamous) research that conservative politicians around the world had seized upon to justify pennypinching Policies …"

John Cassidy, April 2013 issue

"… rising levels of government debt are associated with much weaker rates of economic growth, indeed negative ones …"

It was instead a coding error uncovered by three researchers at the university of Michigan.

"In Britain and Europe, great damage has been done as a result."

THE NEW YORKER

“The fact that software is commercial is no guarantee that it does what it's supposed to do” (Philip B. Stark)

http://www.stat.berkeley.edu/~stark/Preprints/auditingPosition09.htm#excel

Philip B. Stark

Perils of placing faith in a thin theory

By Wolfgang Münchau April 21, 2013

Reinhart and Rogoff told policy makers what they wanted to hear

John Kenneth Galbraith [about] Milton Friedman: "Milton's misfortune was that his policies had been tried." […]

As for Profs Reinhart and Rogoff, I suspect that they, too, will be mostly remembered for the fact that their policies have been tried.

RULE FOUR: find sensitivities before sensitivities find you;

From: Saltelli, A., D'Hombres, 2010, Sensitivity analysis didn't help. A practitioner's critique of the Stern review, *GLOBAL ENVIRONMENTAL CHANGE*, 20, 298-302.

The case of Stern's Review – Technical Annex to postscript

Nicholas Stern, London School of Economics

William Nordhaus, University of Yale

Stern, N., Stern Review on the Economics of Climate Change. UK Government Economic Service, London, www.sternreview.org.uk.

Nordhaus W., Critical Assumptions in the Stern Review on Climate Change, SCIENCE, 317, 201-202, (2007).

RULE FOUR: find sensitivities before sensitivities find you;

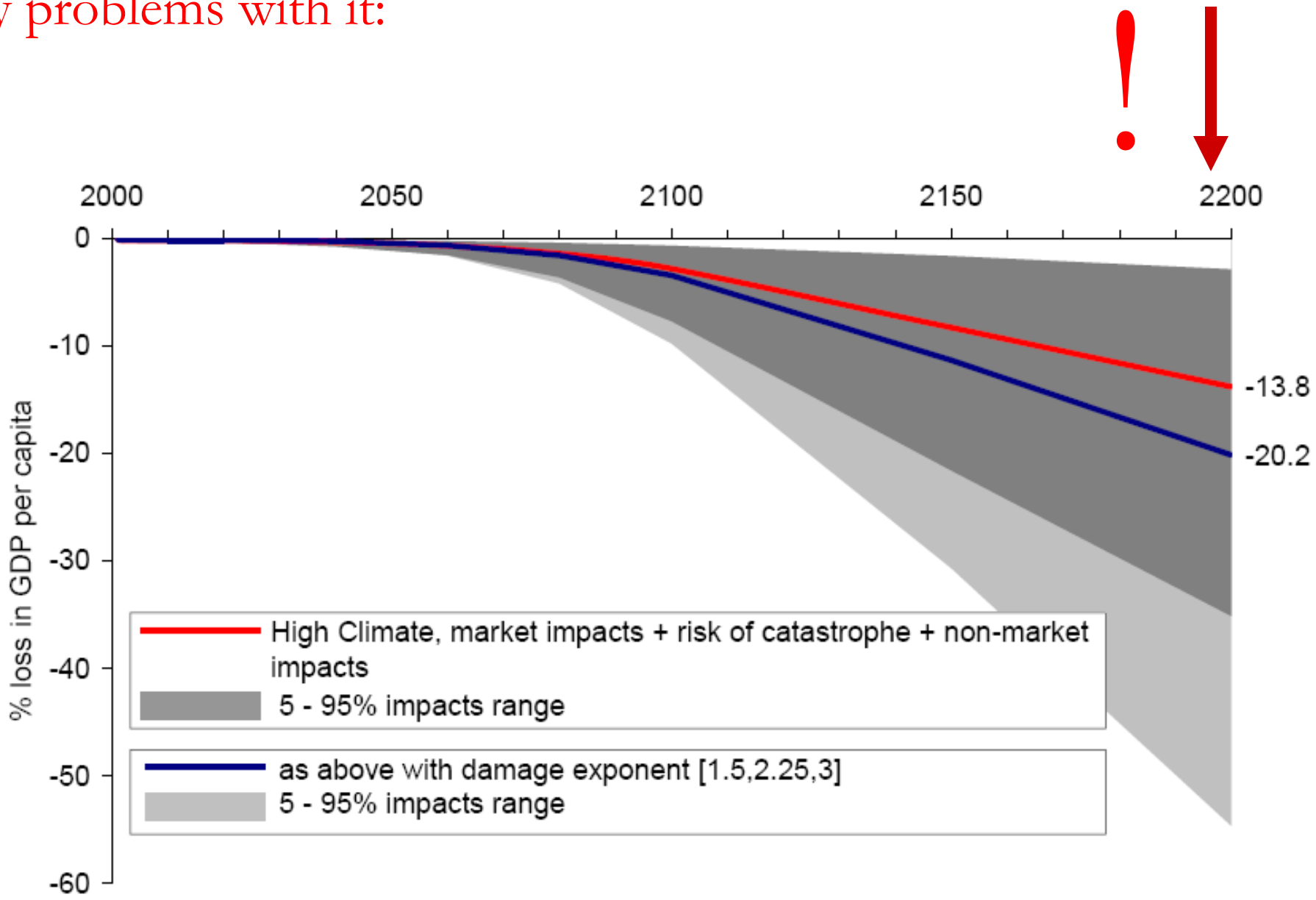
The Stern - Nordhaus exchange on *SCIENCE*

1) Nordhaus falsifies Stern based on 'wrong' range of discount rate

2) Stern's complements its review with a postscript: a sensitivity analysis of the cost benefit analysis

3) Stern infers: My analysis shows robustness'

My problems with it:

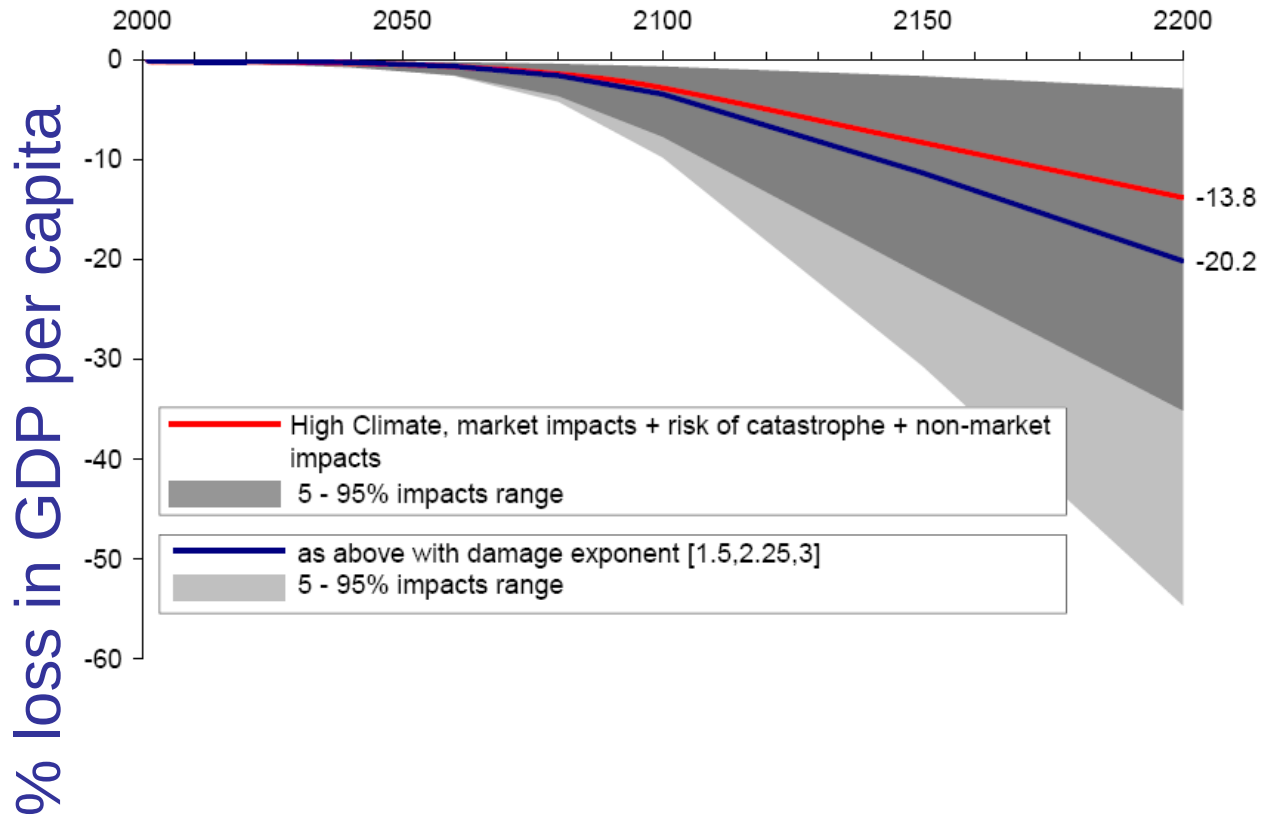


… but foremost Stern says:

changing assumptions → important effect

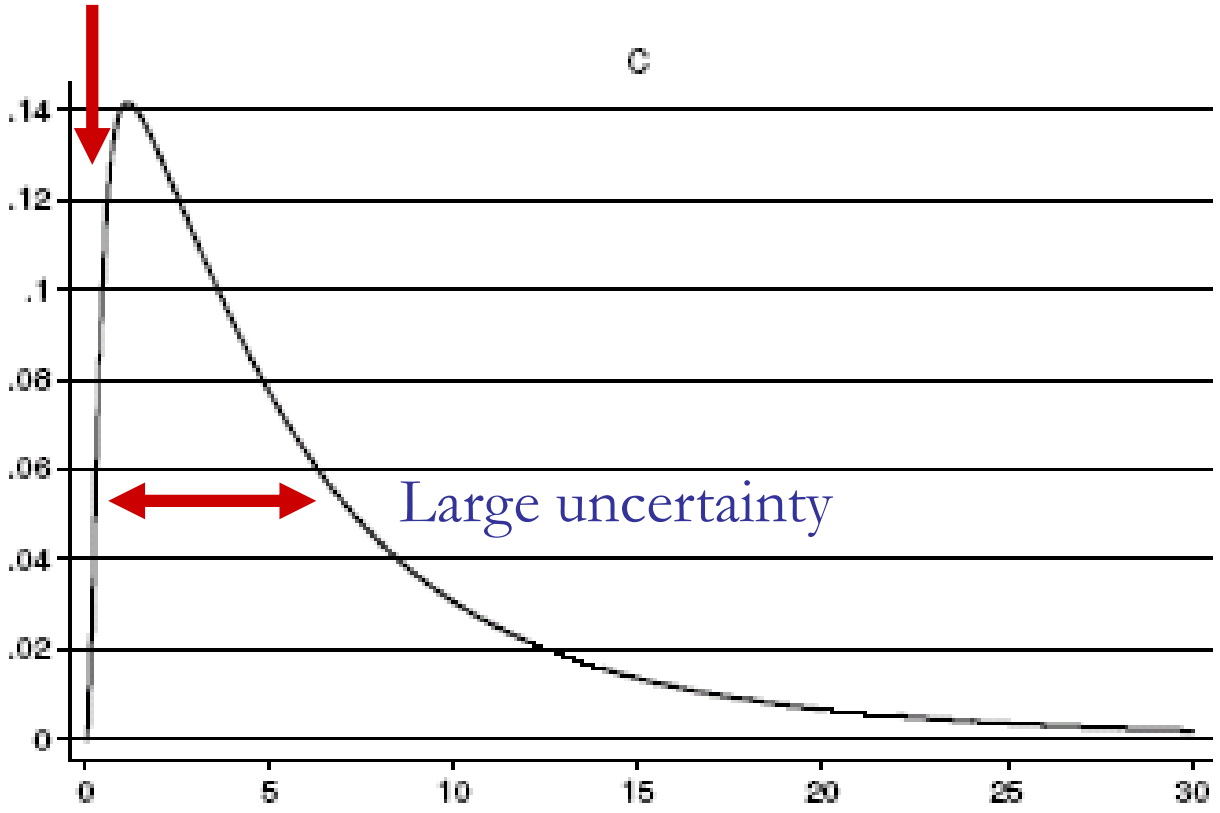
when instead he should admit that:

changing assumptions → all changes a lot



How was it done? A reverse engineering of the analysis

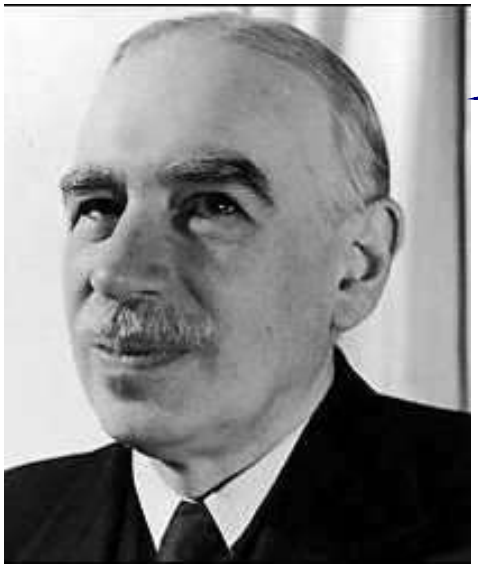
Missing points



% loss in GDP per capita

RULE FOUR: find sensitivities before sensitivities find you;

Same criticism applies to Nordhaus – both authors frame the debate around numbers which are …



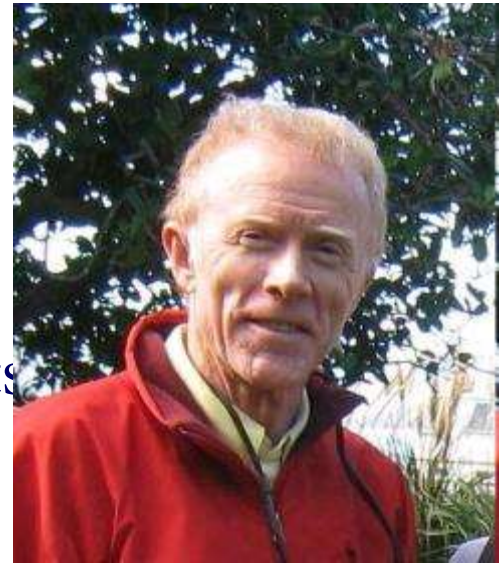
… precisely wrong

… and the story continues to these days …

Saltelli, A., Stark, P.B., Becker, W., and Stano, P., 2015, Climate Models As Economic Guides Scientific Challenge or Quixotic Quest?, Issues in Science and Technology, Volume XXXI, Issue 3, spring 2015.

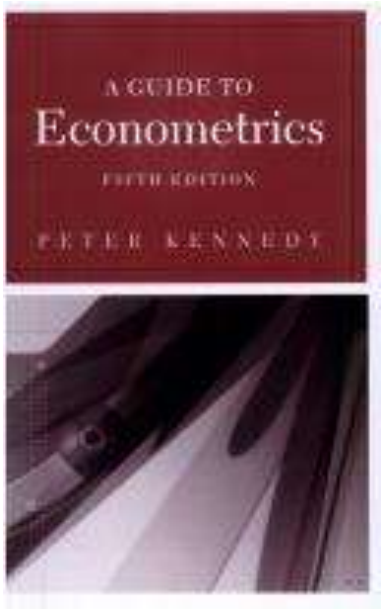
Saltelli, A., Funtowicz, S., Giampietro, M., Sarewitz, D., Stark, P.B., van der Sluijs, J.P., 2016, Climate costing is politics not science, Nature, 14 April, 532, 177.

RULE FOUR: find sensitivities before sensitivities find you;



Peter Kennedy, A Guide to Econometrics.
Anticipating criticism by applying sensitivity analysis. This is one of the ten commandments of applied econometrics:

<<Thou shall confess in the presence of sensitivity.
Corollary: Thou shall anticipate criticism >>



RULE FIVE: aim for transparency

Doubts raised over Europe's green energy plan

'Host of questions' from advisers

Economic model lacks transparency

By Pilar Clark in London

A coal-fired plant in Germany: the credibility of plans to cut EU emissions has been called into question by experts

RULE FIVE: aim for transparency

"Experts have "raised a host of questions" about how the European Commission's use of a non-transparent model could affect the energy review, according to a leaked report by energy specialists chosen by Brussels to advise on the forthcoming "Energy Roadmap to 2050"
FT November 6, 2011

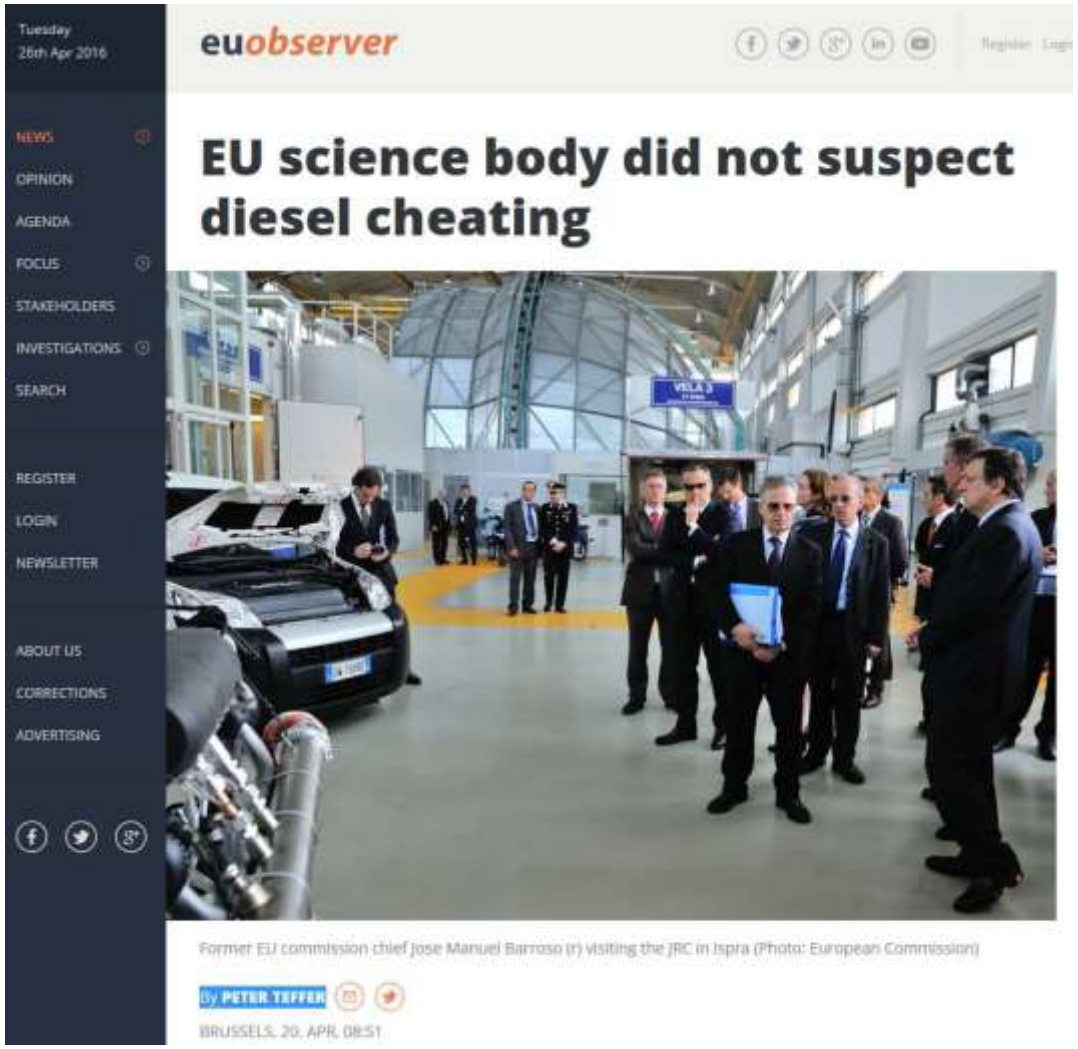
RULE FIVE: aim for transparency

"The credibility of a European energy review has been cast into doubt by experts who point out that long-term plans to cut carbon emissions are based on an economic model owned by a single Greek university that cannot be independently scrutinised."

RULE FIVE: aim for transparency

20 Apr 2016, by Peter Teffer

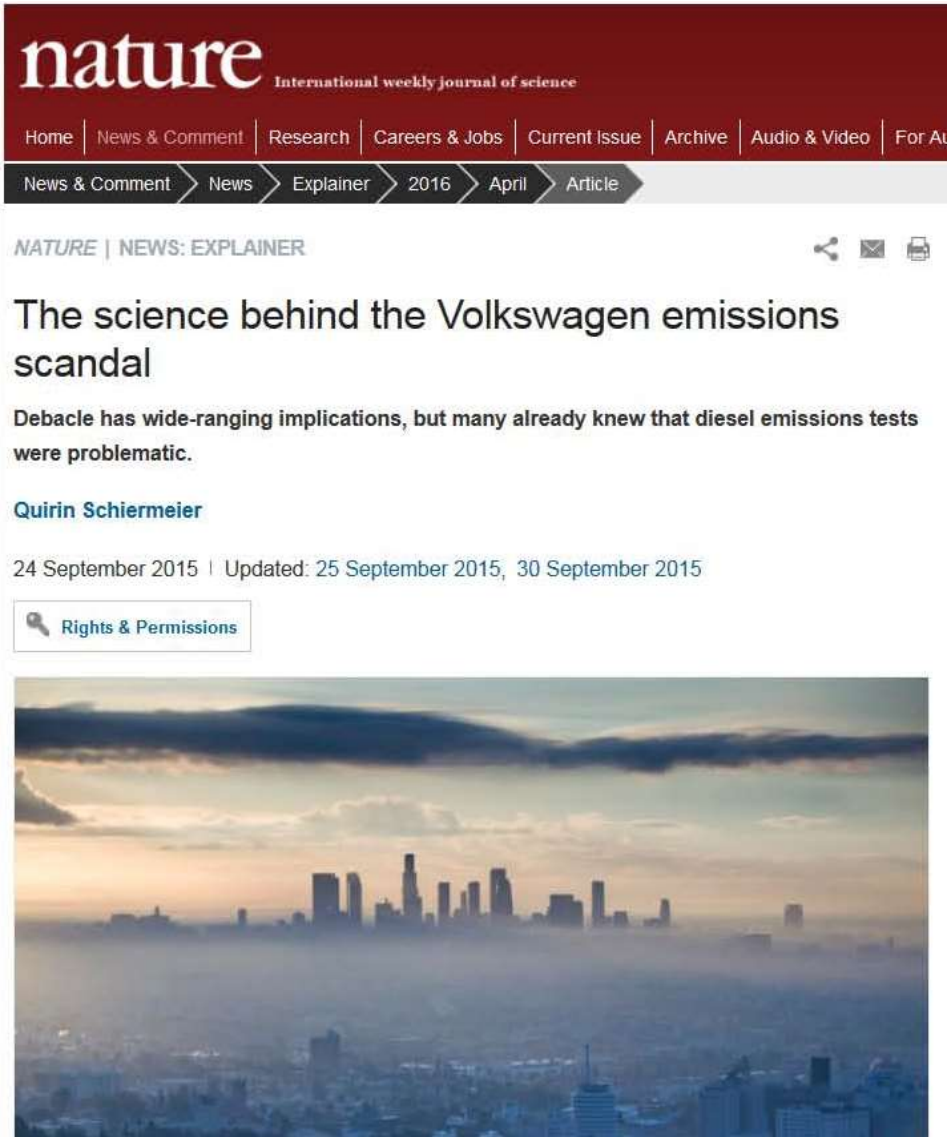
The EU's Joint Research Centre did not have the mandate to check for the illegal software, known as defeat devices, its representative told MEPs.



RULE FIVE: aim for transparency

In 2011 JRC reported that average on-road emissions of tested diesel vehicles exceed allowed limits by up to 14 times[…] In 2012 JRC compared NOx emissions [and found that VW models] still exceeded the existing emissions standard by about 260%.

All available in published peer reviewed papers



nature International weekly journal of science

Home | News & Comment | Research | Careers & Jobs | Current Issue | Archive | Audio & Video | For Au

News & Comment > News > Explainer > 2016 > April > Article

NATURE | NEWS: EXPLAINER

The science behind the Volkswagen emissions scandal

Debacle has wide-ranging implications, but many already knew that diesel emissions tests were problematic.

Quirin Schiermeier

24 September 2015 | Updated: 25 September 2015, 30 September 2015

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Part IX

Office of Management and Budget

Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies; Notice; Republication

The OMB about transparency

http://www.whitehouse.gov/omb/inforeg/

RULE FIVE: aim for transparency

[models should be made available to a third party so that it can] use the same data, computer model or statistical methods to replicate the analytic results reported in the original study.

[…] The more important benefit of transparency is that the public will be able to assess how much an agency's analytic result hinges on the specific analytic choices made by the agency.

Friday, February 22, 2002
Graphic - Federal Register, Part IX
Office of Management and Budget
Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies; Notice; Republication
http://www.whitehouse.gov/omb/inforeg/

This was 2002

House Republicans Aim To Limit Power Of Environmental Protection Agency

This is 2014

The Huffington Post | by Robin Wilkey (/robin-wilkey)

Posted: 02/07/2014 6:18 pm EST | Updated: 02/08/2014 10:59 am EST

The bill, dubbed the Secret Science Reform Act would force the EPA to publicly release its research on a topic before issuing a policy recommendation, and require that the research be "reproducible." Supporters claim the bill will increase transparency in public policy, while opponents have accused the bill's authors of trying to keep the EPA from doing its job.

I

113TH CONGRESS
2D SESSION

H. R. 4012

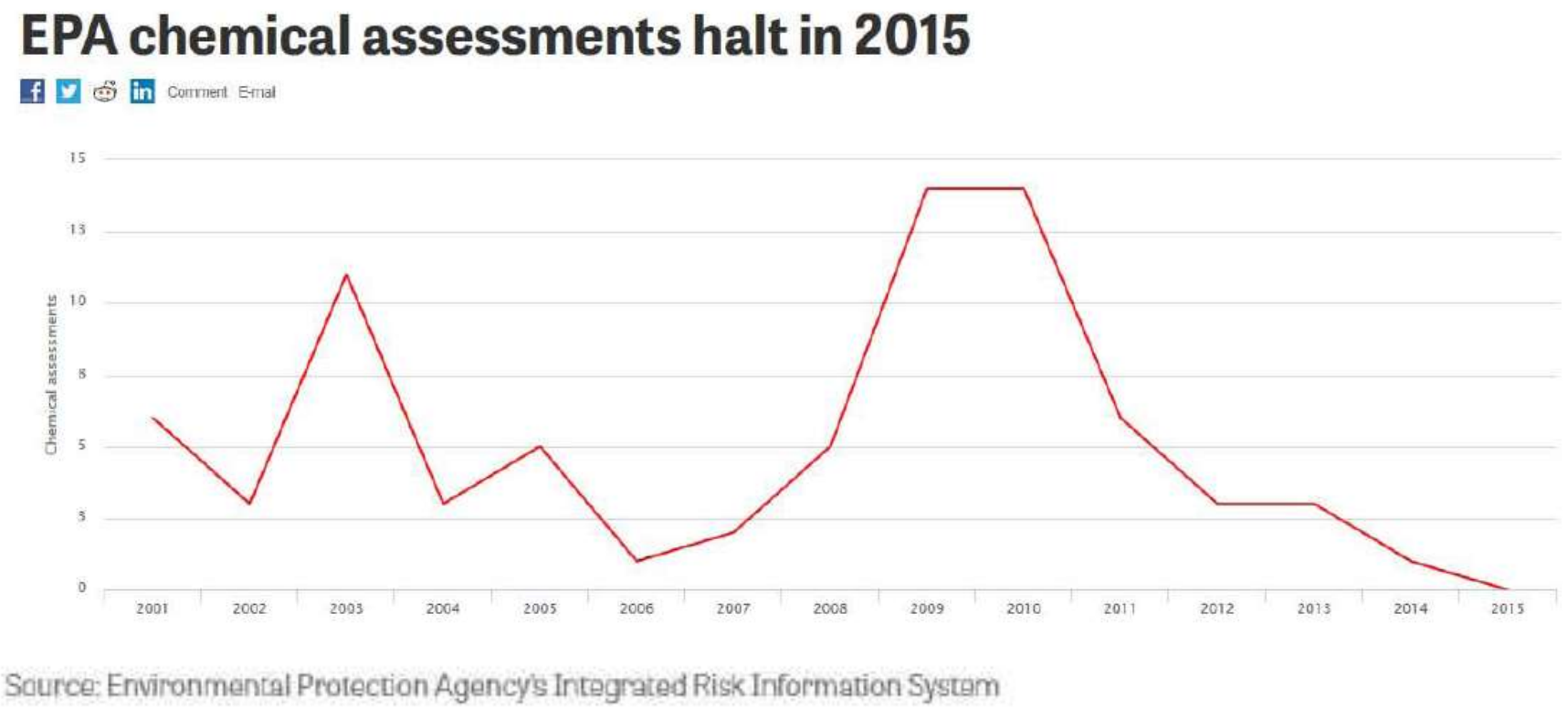
To prohibit the Environmental Protection Agency from proposing, finalizing, or disseminating regulations or assessments based upon science that is not transparent or reproducible.

http://beta.congress.gov/bill/113th-congress/house-bill/4012
Accessed May 2014

Meet the ‘rented white coats’ who defend toxic chemicals, by David Heath

The Center for Public Integrity
Winner of the 2014 Pulitzer Prize

How EPA assessment of hazardous chemicals has come to an halt



http://www.publicintegrity.org/2016/02/08/19223/meet-rented-white-coats-who-defend-toxic-chemicals

WORLD VIEW *A personal take on events*

MICHAEL TEMCHINE

Reproducibility will not cure what ails science

A bill to make data for environmental regulation more transparent reveals the fuzzy boundary between science and ideology, argues **Daniel Sarewitz**.

The bill is discussed in this comment on Nature from Dan Sarewitz:
Quality used against regulation, but Republicans and Democrats both appeal to a neutral (demarcated) science when this fits the respective agendas…

p. 393

"Modellers could usefully consider the following principles:

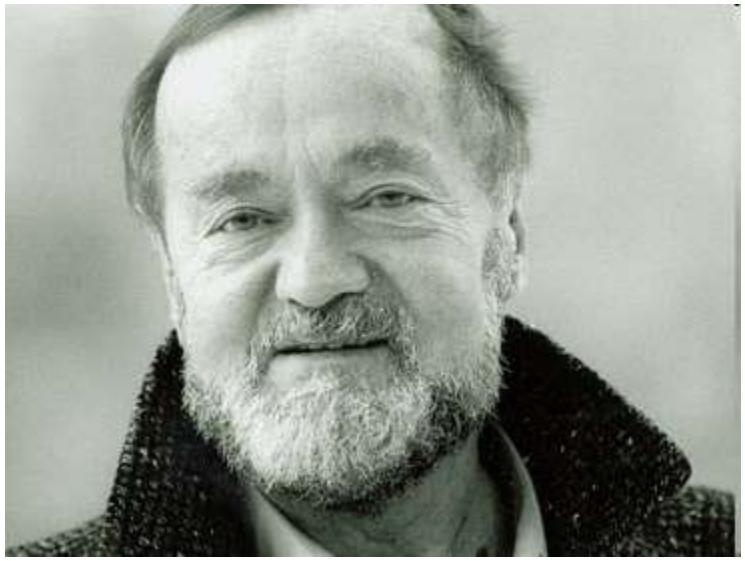
4

- Aim for transparency – when relevant and possible the model calculations should be checked by third parties.

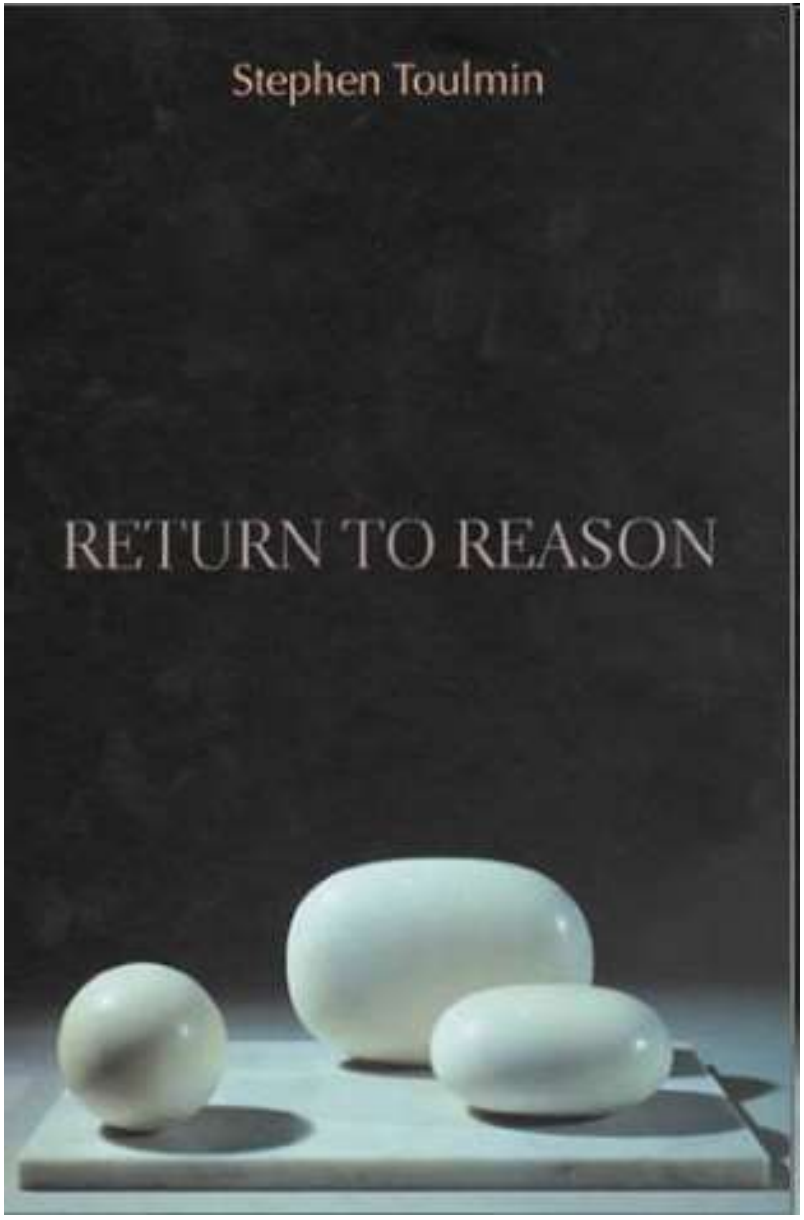
Discussion points

- When it comes to quantification does the end justify the means?
- Can I recall an instance where uncertainties have been either amplified or deflated instrumentally?
- Can rule 3-5 lead to paralysis by analysis?

RULE SIX: Do the right sums



Do the sum right
Versus
Do the right sums
(Stephen Toulmin)
A plea for reasonableness
versus rationality



RULE SIX: Do the right sums

Peter Kennedy's commandment of applied econometrics: 'Thou shall answer the right question', Kennedy 2007

Expertise and responsibility
Rule 6

- Experts as stakeholders among many, with their occupational psychoses.
- Already discussed: most analyses offered as input to policy are framed as cost benefit analysis (monetization, the occupational psychosis of economists) or risk analyses.

Langdon Winner

Winner, L., 1986. The Whale and the Reactor: a Search for Limits in an Age of High Technology. The University of Chicago Press, 1989 edition.

Frames

- Contrary to the popular belief that climate sceptics don't know about climate science Dan Kahan (2014) has observed that the more a person is informed about climate science, the more he or she is likely to be polarized on the issue in either direction.

Frames

- The expression ‘tax relief’ is apparently innocuous but it suggests that tax is a burden, as opposed to what pays for road, hospitals, education and other infrastructures of modern life (Lakoff, 2004).

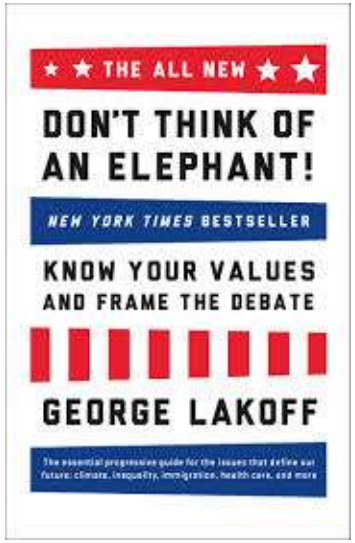
Frames

- Published road accident statistics record the conditions of the driver as to alcohol or drug use but not the make and year of the car or its safety features (Gusfield, 1981).

Gusfield, J. (1981). The Culture of Public Problems. Drinking-Driving and the Symbolic Order. The University of Chicago Press.

The issue of frames. How do we perceive the world. Socially constructed ignorance etc.

George Lakoff



Lakoff, G., 2010, Why it Matters How We Frame the Environment, Environmental Communication: A Journal of Nature and Culture, 4:1, 70–81.

Lakoff, G., 2004–2014, Don't think of an elephant: know your values and frame the debate, Chelsea Green Publishing.

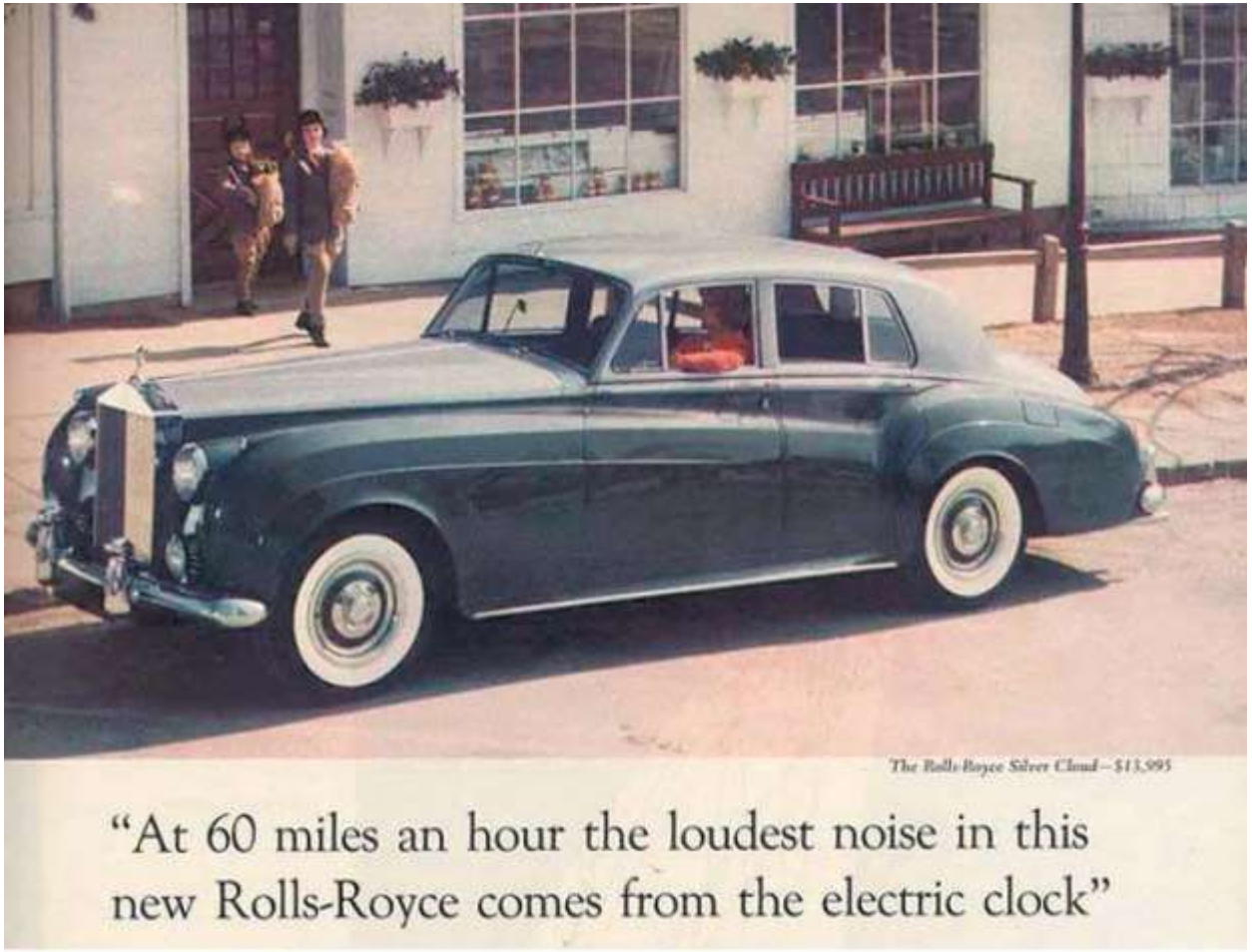
For a summary see http://www.andreasaltelli.eu/file/repository/Hypocognition_Etc.pdf

Why Free Markets Make Fools of Us

Cass R. Sunstein

OCTOBER 22, 2015 ISSUE

Phishing for Phools: The Economics of Manipulation and Deception
by George A. Akerlof and Robert J. Shiller
Princeton University Press, 272 pp., $24.95



An advertisement for Rolls-Royce from the late 1950s

Frames and narratives

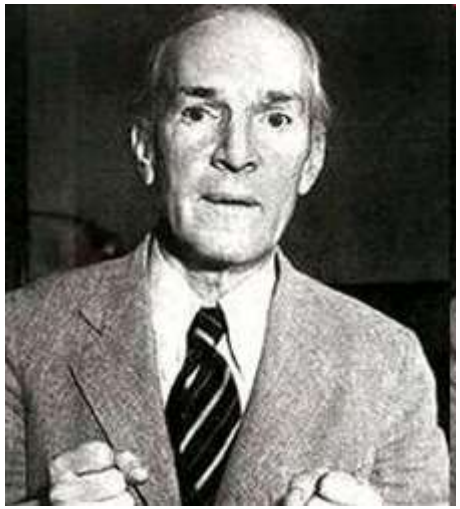
For Akerlof and Shiller – against what the 'invisible hand' would contend – economic actors have no choice but to exploit frames to 'phish' people into practices which benefit the actors not the subject phished. Implication for democracy.

George Akerlof

Robert R. Shiller

On the persistence of narratives

"If is difficult to get a man to understand something when his salary depends upon his not understanding it."



Upton Sinclair

Discussion points

- Can I recall an example of a framing which did not sound right to me?

RULE SEVEN: Explore diligently the space of the assumptions

Environmental Modelling & Software 25 (2010) 1508–1517

Contents lists available at ScienceDirect

Environmental Modelling & Software

journal homepage: www.elsevier.com/locate/envsoft

How to avoid a perfunctory sensitivity analysis

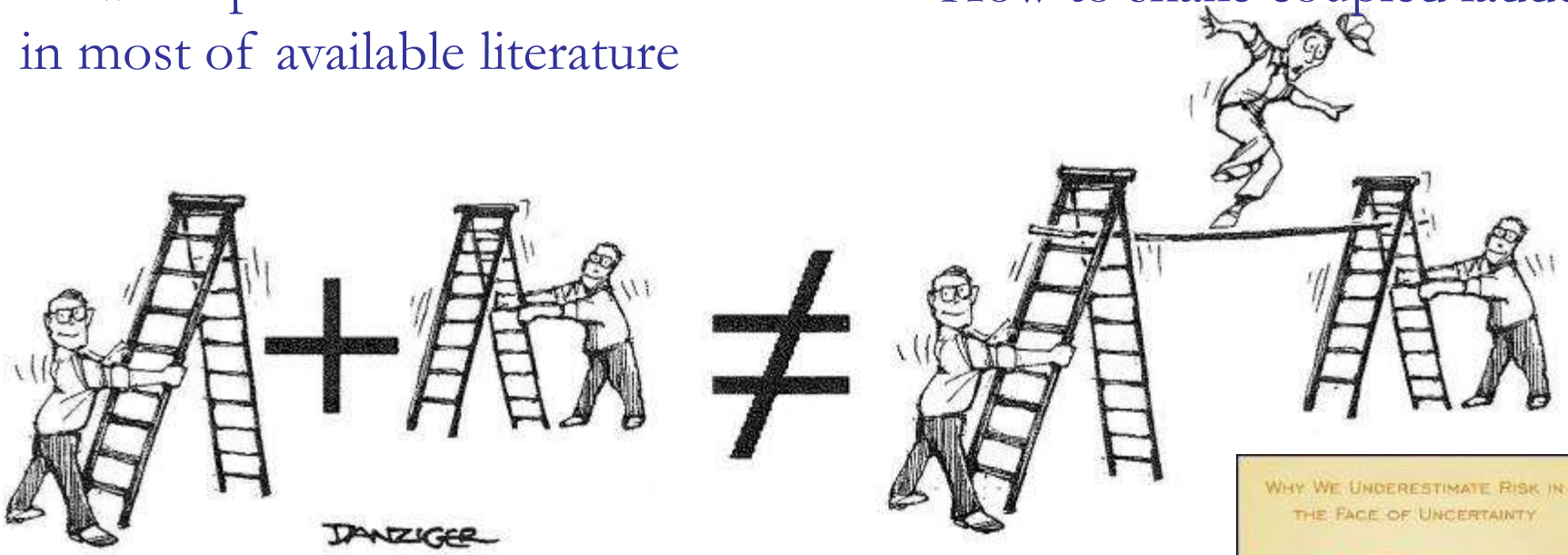
Andrea Saltelli*, Paola Annoni

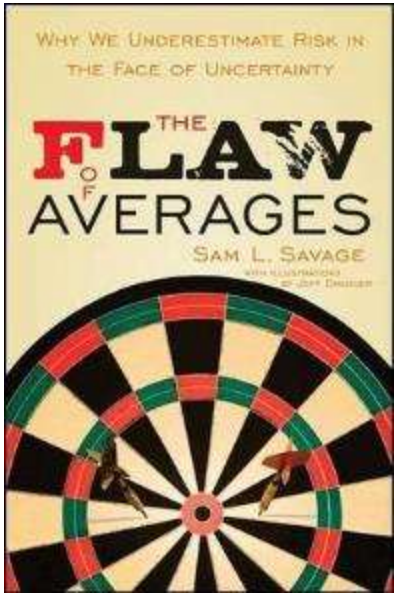
Joint Research Center, Institute for the Protection and Security of the Citizen, via E.Fermi, 2749, Ispra VA 21027, Italy

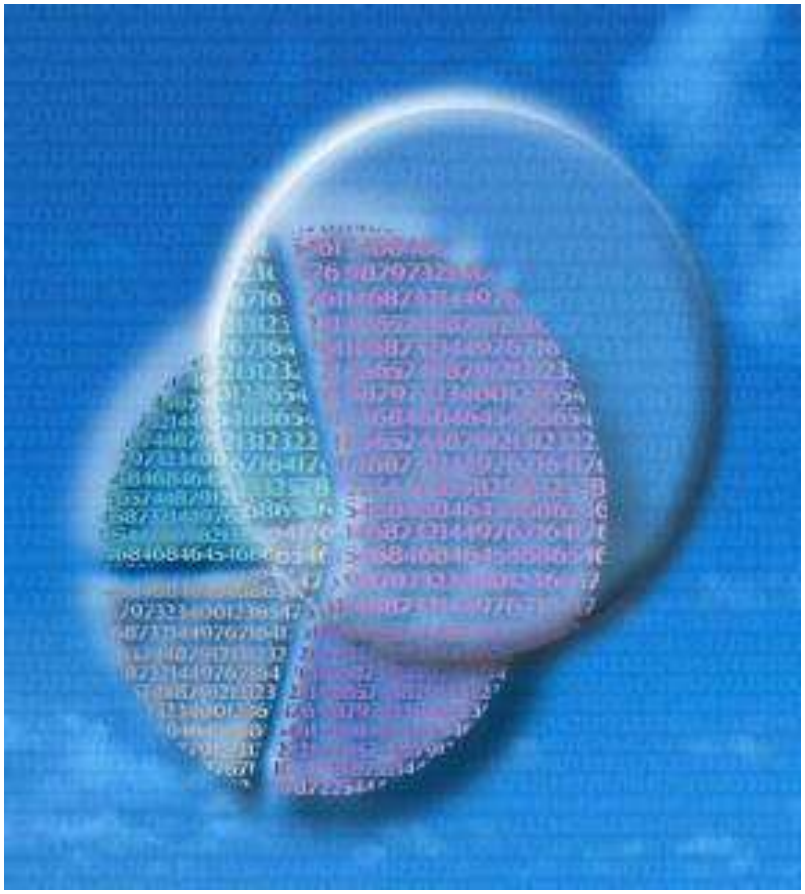
RULE SEVEN: Explore diligently the space of the assumptions

How coupled ladders are shaken in most of available literature

How to shake coupled ladders







END

Twitter:
@andreasaltelli

Frames

- Contrary to the popular belief that a GMO-averse person is a risk- or technology-averse individual, an important EC study (Marris, 2001) has shown that GMO aversion is linked to frames where risk plays a very minimal role (and alimentary risk plays no role at all).

Questions about GMO deemed relevant by citizens (Marris, 2001)

- Why do we need GMOs? What are the benefits?
- Who will benefit from their use?
- Who decided that they should be developed and how?
- Why were we not better informed about their use in our food, before their arrival on the market?
- Why are we not given an effective choice about whether or not to buy and consume these products?
- Do regulatory authorities have sufficient powers and resources to effectively counter-balance large companies who wish to develop these products?

Marris, C., Wynne, B., Simmons P., and Weldon, S. 2001. Final Report of the PABE research project funded by the Commission of European Communities, Contract number: FAIR CT98-3844 (DG12 - SSMI), December 2001.

Frames; GMO presented as a food scare.

"Montpelier is America's only McDonald's-free state capital. A fitting place, then, for a law designed to satisfy the unfounded fears of foodies [⋯] genetically modified crops, declared safe by the scientific establishment, but reviled as Frankenfoods by the Subarus-and-sandals set", (The Economist, 2014).

The Economist, Vermont v science, The little state that could kneecap the biotech industry, May 10th 2014

Edward E. Leamer, 1990, Let's Take the Con Out of Econometrics, American Economics Review, 73 (March 1983), 31-43.

<<I have proposed a form of organised sensitivity analysis that I call "global sensitivity analysis" in which a neighborhood of alternative assumptions is selected and the corresponding interval of inferences is identified.
Conclusions are judged to be sturdy only if the neighborhood of assumptions is wide enough to be credible and the corresponding interval of inferences is narrow enough to be useful.>>