



Sensitivity auditing, with digressions

Science for Policy: Post-Normal Science in Practice. Symposium hosted by the Centre for the Study of the Sciences & the Humanities, University of Bergen, December 10-11, 2014

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Sensitivity auditing in pills:



- Conceived for mathematical modelling
- Comes from uncertainty & sensitivity analysis
- Addresses model-based evidence used for policy
- Inspired by PNS readings and companies
- Overlaps significanlty with NUSAP
- Main motivation: crisis within crises ...

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/





Crises first



Crisis of trust



"the great ideas which once inspired Europe seem to have lost their attraction, only to be replaced by the bureaucratic technicalities of its institutions."



"As the European Union has expanded, there has been growing mistrust on the part of citizens towards institutions considered to be aloof, engaged in laying down rules perceived as insensitive to individual peoples, if not downright harmful"





Issues with trust <u>also</u> in the science ...





Issues with trust / quality in the scientific enterprise

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



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

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

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



"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.





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



Philip Mirowski

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.





An ethical problem?



Issues with trust / quality in the scientific enterpriseThe centrality of ethics for quality (1971).

"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.



Jerome R. Ravetz



The conventional wisdom



"[...] four fundamental conditions that need to successfully addressed for a healthy science system. These are: strong science funding; excellent infrastructure, facilities, and campuses; robust career propositions; and finally, autonomy of academic institutions."

Dirk Jan van den Berg, To See the Future of Science We Need to Look Beyond the '2.0 Paradigm', huffingtonpost.co.uk, December 9, 2014





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



The Reinhart and Rogoff affair

"... 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

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Mirowski on DSGE



"...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?"



Philip Mirowski



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...



More Heat than Light Economics as Social Physics, Physics as Nature's Economics PHILIP MIROWSKI

→ 1991







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Erik Reinert

How Rich Countries Got Rich . . . and Why Poor Countries Stay Poor Public Affairs (October 7, 2008)





Journal of Post-Keynesian Economics, Winter 1994-95, 17(2).



Marion Fourcade, Etienne Ollion, and Yann Algan, The Superiority of Economists, discussion paper 14/3, Max Planck Sciences Po Center on Coping with Instability in Market

Societies. 2014.





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In relation to the predicaments of evidence based policy and the possible diseases of economics:



Ravetz, J., 1971, Op.Cit., p. 366 [Chapter on IMMATURE AND INEFFECTIVE FIELDS OF INQUIRY]

[...] The situation becomes worse when an immature or ineffective field is enlisted in the work of resolution of some practical problem. In such an uncontrolled and perhaps uncontrollable context, where facts are few and political passions many, the relevant immature field functions to a great extent as a 'folk-science'. This is a body of accepted knowledge whose function is not to provide the basis for further advance, but to offer comfort and reassurance to some body of believers.



Thomas Piketty

















Piketty and the Crisis of Neoclassical Economics | John Bellamy Foster | Monthly Review

MR monthlyreview.org/2014/11/01/piketty-and-the-crisis-of-neoclassical-economics/

Piketty's failure to relate inequality to power is not, it should be stressed, a particular failure on his part, but rather a general fault of neoclassical economics, tied to its position of ideological hegemony.

Daron Acemoglu and James Robinson



→ 2012

... quintessential vitious circle between inequality and rent seeking / corruption



School of Nicholas Georgescu-Roegen



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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





- More complex institutional arrangements
- More literacy ←→More IT
- More hybridization of roles, styles
- Changing styles of science's governance
- Issues with trust / quality in the scientific enterprise
- More controversy (wicked issues)







New directions for evidence based policy

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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.

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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."

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Much about the same happens in evidence based policy ... routinely morphed into policy based evidence ...

"the more knowledge is produced in hybrid arrangements, the more the protagonists will insist on the integrity, even veracity of their findings" ...

Grundmann, R., 2009, The role of expertise in governance processes, Forest Policy and Economics 11, 398–403, citing Latour, B., 1993. We Have Never Been Modern. Cambridge, Harvard UP.





Evidence based policy was always tricky ...



Karl Pearson (a social Darwinist) suggests not wasting resources on social programs as:"No degenerate and feeble stock will ever be converted into healthy and sound stock by the accumulated effects of education, good laws, and sanitary surroundings"

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Karl Pearson



Pearson, K., 1892, The Grammar of Science, Walter Scott Publisher, London, p.32.

Jerry Ravetz uses this example to falsify the naïve belief that "'scientific method' can be applied in a simple and straightforward fashion to [practical] problems", Ravetz, J., Op. Cit., p.346



Separating the evidence from the policy: the 'demarcation model' of science's input to policy.



'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.





Silvio Funtowicz



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"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).



Anne Glover

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.



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The demarcation model is challenged in more recent epistemologies, mostly based on the impossibility to achieve separation between facts and values. Alternatives are offered by 'Post Normal Science' (Funtowicz and Ravetz, 1991, 1992, 1993) and by the 'Co-production of knowledge' (Jasanoff, 1996) models.

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Funtowicz, S. O., & Ravetz, J. R., 1991. A new scientific methodology for global environmental issues. In R. Costanza (Ed.), Ecological economics: The science and management of sustainability (pp. 137–152). New York, NY: Columbia University Press.

Funtowicz, S. O., & Ravetz, J. R. 1992. Three types of risk assessment and the emergence of postnormal science. In S. Krimsky & D. Golding (Eds.), Social theories of risk (pp. 251–273). Westport, CT: Greenwood.

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.



RULE ONE: Check against rhetorical use of mathematical modelling

And the second s

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'



European Commission 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:

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



RULE TWO: Adopt an 'assumption hunting' attitude;

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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 ...





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



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





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

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



RULE THREE: detect <u>GIGO</u> (Garbage In, Garbage Out) Science or pseudo-science

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RULE THREE: detect 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.







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.>>



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



Commission



William Nordhaus, University of Yale



Nicholas Stern, London School of Economics

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 onClimate Change, SCIENCE, 317, 201-202, (2007).





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'







... but foremost Stern says:
changing assumptions → important effect
when instead he should admit that:
changing assumptions → all changes a lot







% loss in GDP per capita





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



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 >>

A CUIDE TO Econometrics FITTH ROTTION PRTER RENNEDS



Doubts raised over Europe's green energy plan

European Commission

'Host of custions' from advisors.

Economic model lacks transportney

By F98a Clark in Landsa

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> Frid Capriss has here an strategy convoluted for many yrars and has held prottions an holles ranging from Groeoria energy sognlater to the escatty's Public



"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



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"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."



European Commission 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/





[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.

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[...] 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."





^{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



RULE SIX: Do the right sums



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

Com

RETURN TO REASON







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



Expertise and responsibility

- Experts as stakeholders among many, with their occupational psychoses.
- Example: most analyses offered as input to policy are framed as cost benefit analysis (monetization, the occupational psychosis of economists) or risk analyses.
- Techniques (such as CBA) is never neutral; according to Winner (1986) ecologists should not fall into the trap of CBA.

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.





Rule 6



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Environmental Modelling & Software 25 (2010) 1508-1517



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



How to avoid a perfunctory sensitivity analysis

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RULE SEVEN: Explore diligently the space of the assumptions

European

How coupled ladders are shaken in most of available literature





How to shake coupled ladders





END

Recent papers available at: <u>www.andreasaltelli.eu</u>

