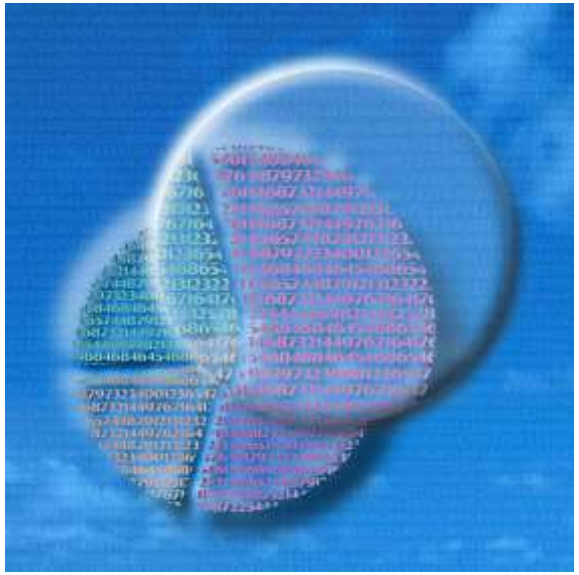


Responsible quantification

Andrea Saltelli
Open Evidence Research, Open University of Catalonia

Universitat Oberta de Catalunya

Centro per l'Eccellenza e gli Studi Transdisciplinari (CEST), Young Scholar Initiative of the Institute for New Economic thinking (INET) and OECD

OPEN EVIDENCE

Forecasting the future for sustainable development
Approaches to Modelling and the Science of Prediction
June 16, 2021

Where to find this talk: www.andreasaltelli.eu

Sociology and ethics of quantification

Espeland, W.N., Stevens, M.L., 2008. A sociology of quantification. Eur. J. Sociol. 49, 401–436. https://doi.org/10.1017/S0003975609000150

“what qualities are specific to rankings, or indicators, or models, or algorithms?”

Elizabeth
Popp Berman

E. Popp Berman and D. Hirschman, The Sociology of Quantification: Where Are We Now?, Contemp. Sociol., vol. in press, 2017.

Mennicken, A., Espeland, W.N., 2019. What’s New with Numbers? Sociological Approaches to the Study of Quantification. Annu. Rev. Sociol. 45, 223–245. https://doi.org/10.1146/annurev-soc-073117-041343

Why ethics of quantification is needed now

Andrea Saltelli
Open Evidence Research, Universitat Oberta de Catalunya, Barcelona, Spain

Antonio Andreoni
UCL Institute for Innovation and Public Purpose; South African Research Chair in Industrial Development, University of Johannesburg, South Africa

Wolfgang Drechsler
Tallinn University of Technology, Estonia;
UCL Institute for Innovation and Public Purpose;
Davis Center at Harvard University, United States

Jayati Ghosh
University of Massachusetts Amherst, United States;
UCL Institute for Innovation and Public Purpose

Rainer Kattel
UCL Institute for Innovation and Public Purpose

Ingrid H. Kvangraven
Department of Politics, University of York

Ismael Rafols
Centre for Science and Technology Studies, Leiden University, the Netherlands

Erik S. Reinert
Tallinn University of Technology, Estonia;
UCL Institute for Innovation and Public Purpose

Andy Stirling
Science Policy Research Unit, University of Sussex

Ting Xu
School of Law at the University of Essex

IIPP UCL Institute for Innovation and Public Purpose

WORKING PAPER
WP 2021/05

UCL

… our world is structured by numbers, visible and invisible, where truth is conveyed and reality constructed

Numbers are seductive, performative, confer to their masters' epistemic power and legitimacy

Governing the modern state, or even contesting it, without numbers is impossible

Numbers are the prevalent means to express value in our societies … Access & production of numbers reflect and reinforce power imbalances

IIPP UCL Institute for Innovation and Public Purpose

WORKING PAPER
WP 2021/05

Humanities & Social Sciences Communications

Article | Open Access | Published: 19 August 2020

From sociology of quantification to ethics of quantification

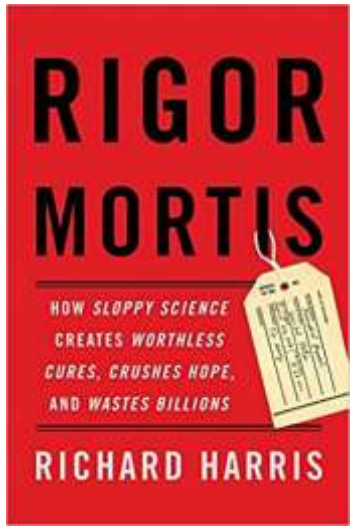
Andrea Saltelli & Monica Di Fiore

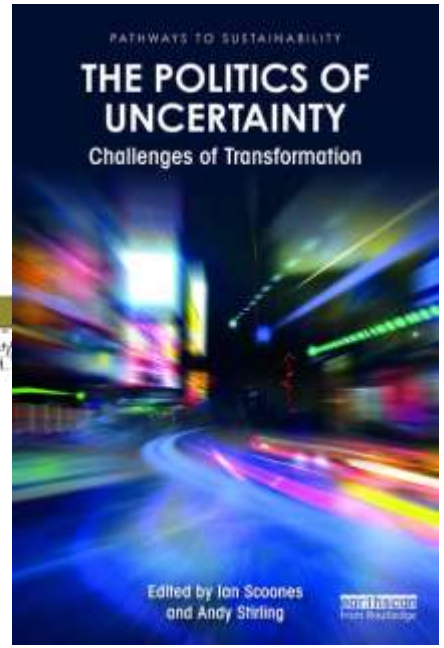
» Vie

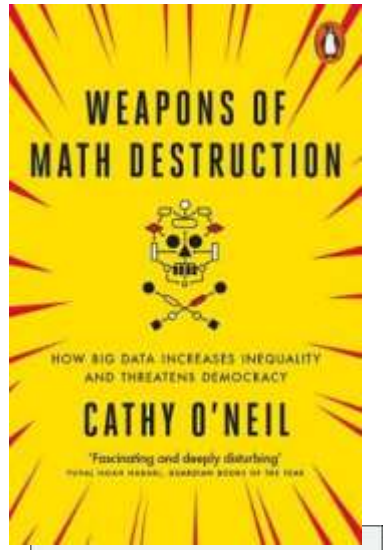
Humanities and Social Sciences Communications **7**, Article number: 69 (2020) | Cite this article

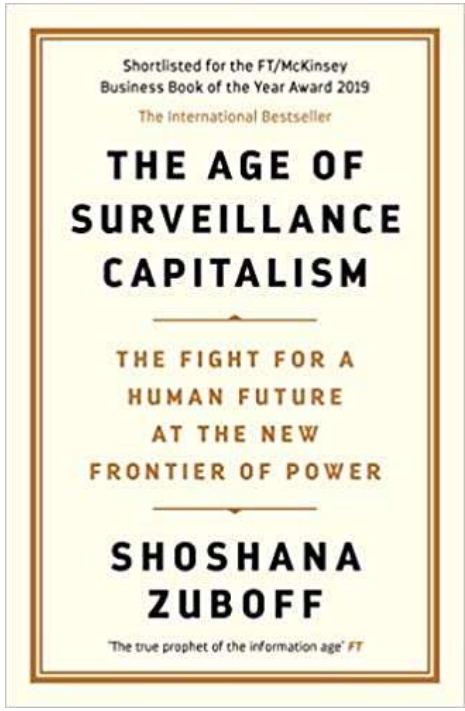
852 Accesses | **25** Altmetric | Metrics

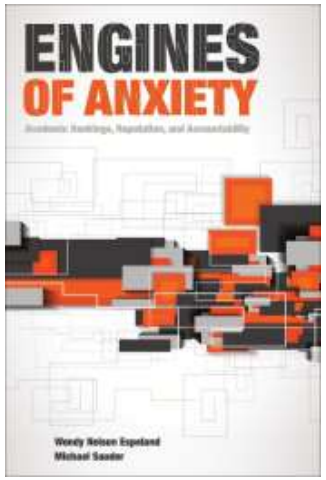
An explosion of works, from within and without, from many disciplines

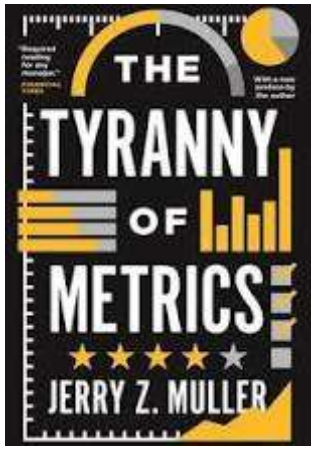


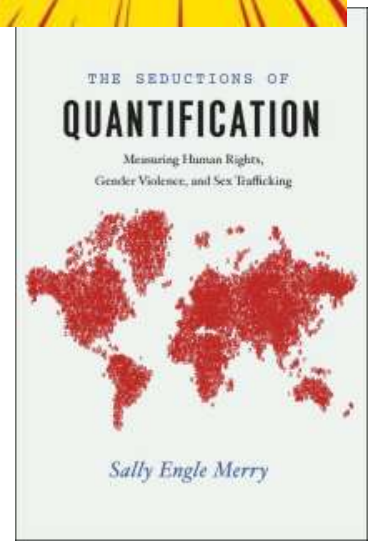


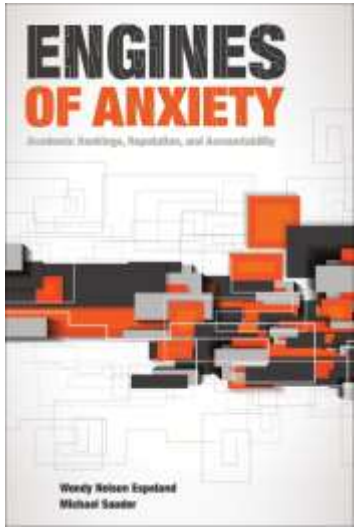




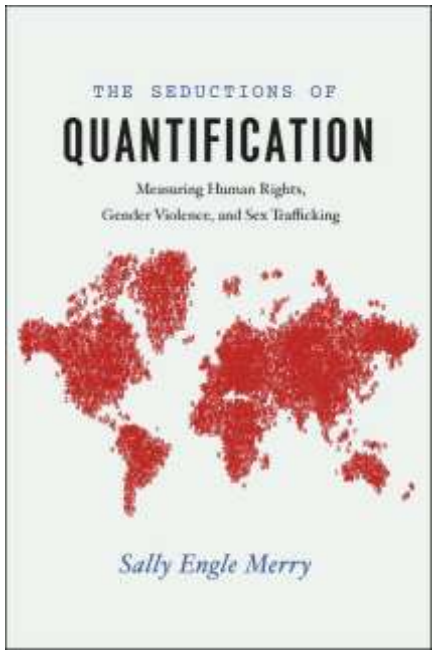




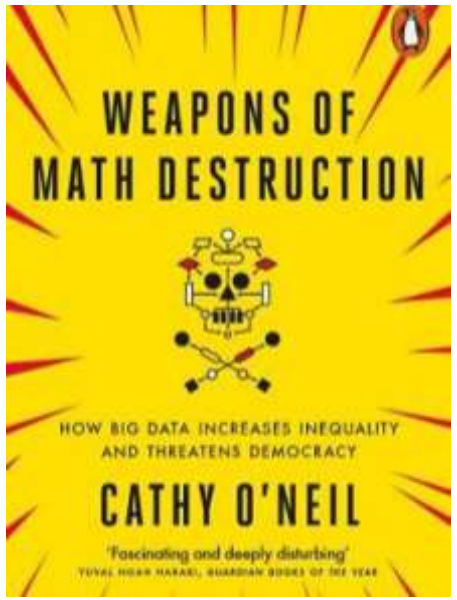




Numbers and their 'reactivity' (Espeland and Sauder, 2016)



Incumbent numbers affect what society will measure in the future (Merry 2016)



Numbers "create the environment that justifies their assumptions" (O'Neil, 2016)

Statistical and mathematical modelling

COMMENT · 24 JUNE 2020

Five ways to ensure that models serve society: a manifesto

Pandemic politics highlight how predictions need to be transparent and humble to invite insight, not blame.

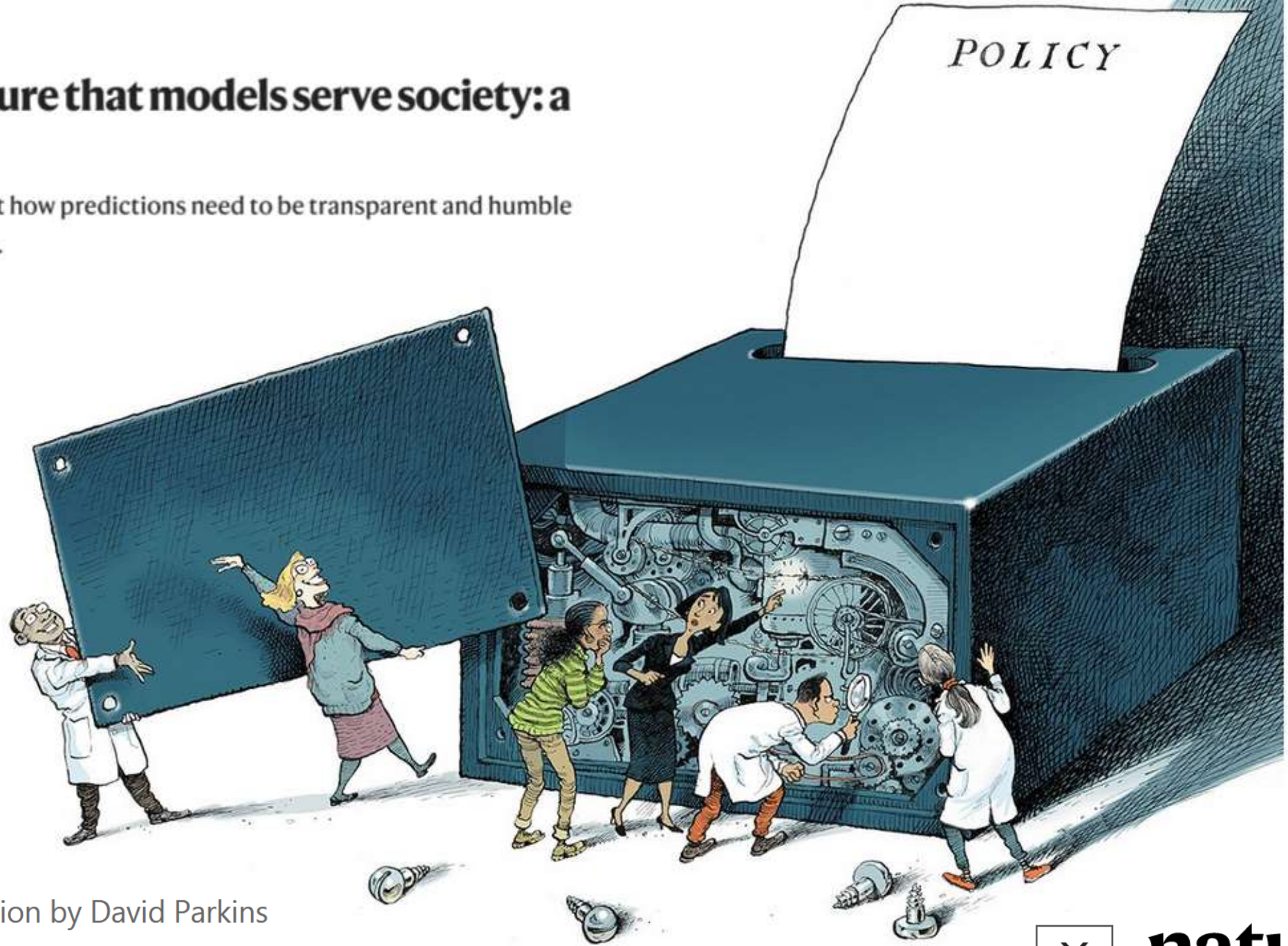


Illustration by David Parkins

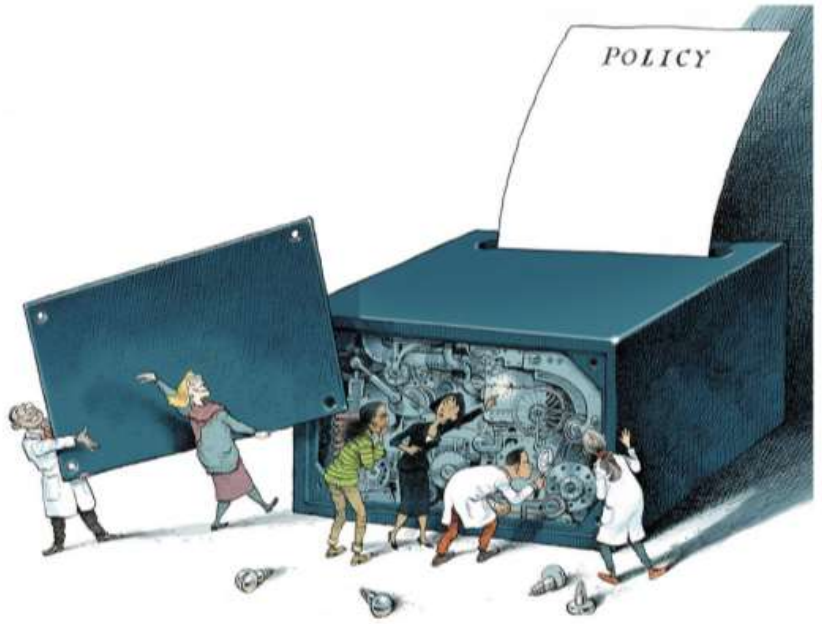
nature

nature

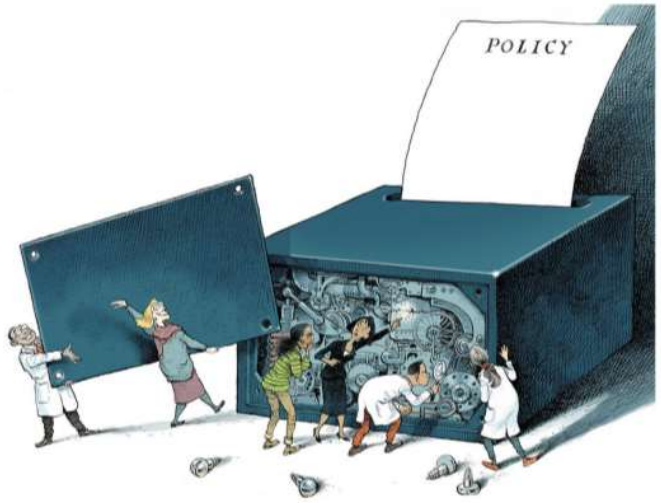
Andrea Saltelli, Gabriele Bammer, Isabelle Bruno, Erica Charters, Monica Di Fiore, Emmanuel Didier, Wendy Nelson Espeland, John Kay, Samuele Lo Piano, Deborah Mayo, Roger Pielke Jr, Tommaso Portaluri, Theodore M. Porter, Arnald Puy, Ismael Rafols, Jerome R. Ravetz, Erik Reinert, Daniel Sarewitz, Philip B. Stark, Andrew Stirling, Jeroen van der Sluijs & Paolo Vineis

3 modellers Lo Piano, Puy, Saltelli
2 experts models and society Pielke, van der Sluijs
3 statisticians Mayo, Stark, Portaluri
2 statactivistes Bruno, Didier
2 economists Kay, Raynert
1 epidemiologist Vineis

2 sociologists of quantification Espeland, Porter
3 STS scholars Bammer, Sarewitz, Stirling
1 philosopher Ravetz
1 historian Charters
1 political scientists Di Fiore
1 expert RRI - Open Science Rafols

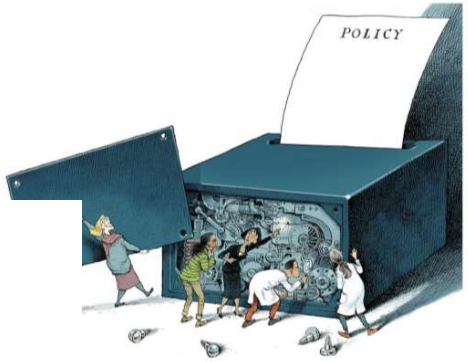


COVID has put mathematical models in the limelight



➔ Power & controversy

Power



The New York Times

Behind the Virus Report That Jarred the U.S. and the U.K. to Action

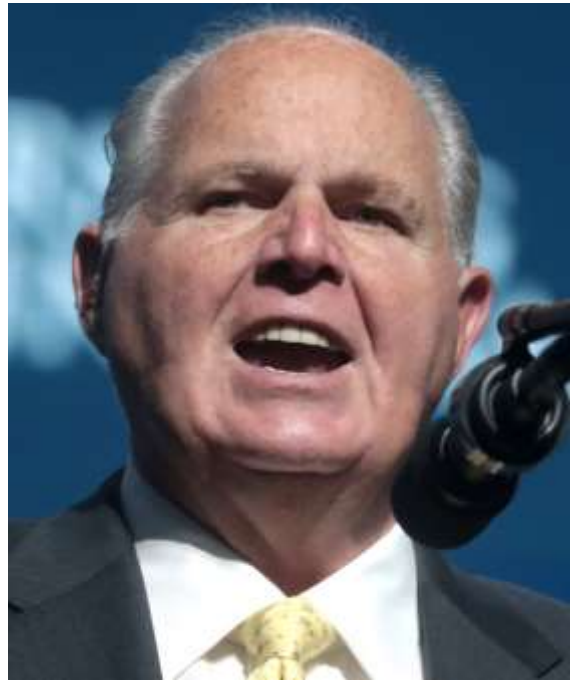
It wasn't so much the numbers themselves, frightening though they were, as who reported them: Imperial College London.

Landler, Mark, and Stephen Castle. 2020. Behind the Virus Report That Jarred the U.S. and the U.K. to Action - The New York Times.

Conflicts, when questions of urgency, stakes, values and uncertainty collide

Rush Limbaugh

"Wild-Ass Covid numbers … The minute I hear anybody start talking about models and modeling, I blanch"



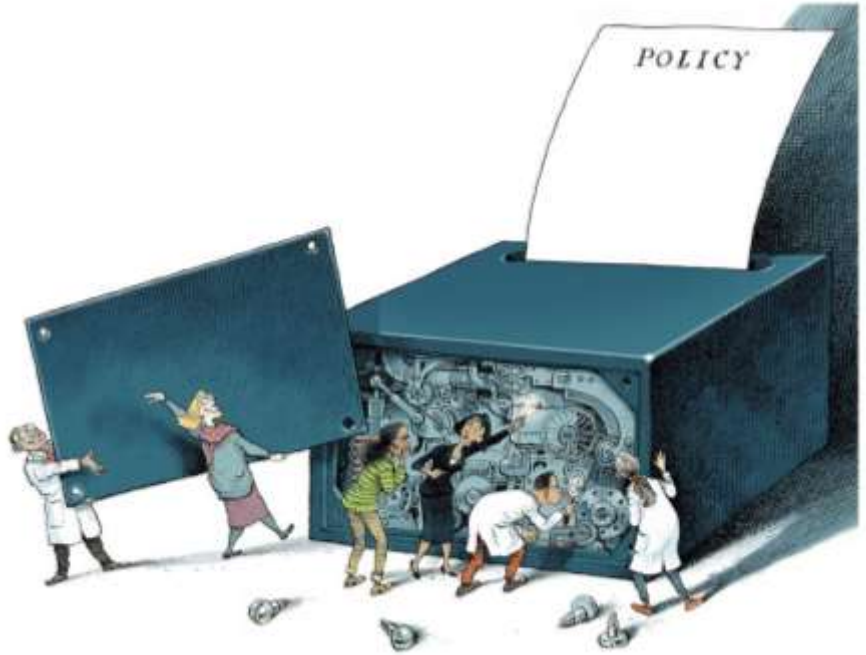
Rhodes, Tim, and Kari Lancaster. 2020. "**Mathematical Models as Public Troubles in COVID-19 Infection Control: Following the Numbers**", Health Sociology Review 1-18. doi: 10.1080/14461242.2020.1764376

Mind the assumptions

Assess uncertainty and sensitivity

Mind the hubris

Complexity can be the enemy of relevance



Mind the framing

Match purpose and context

Mind the consequences

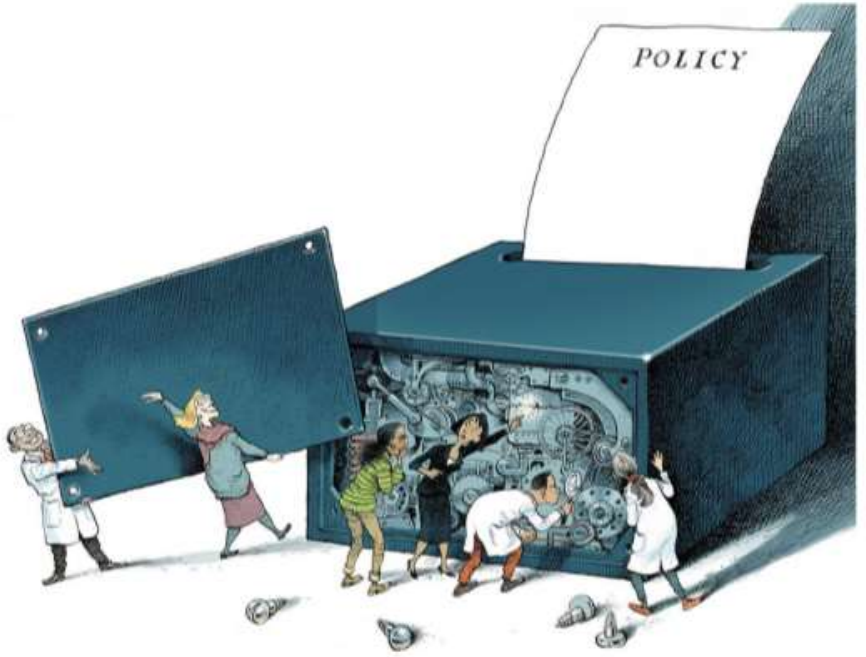
Quantification can backfire

Mind the unknowns

Acknowledge ignorance

Mind the assumptions

Assess uncertainty and sensitivity



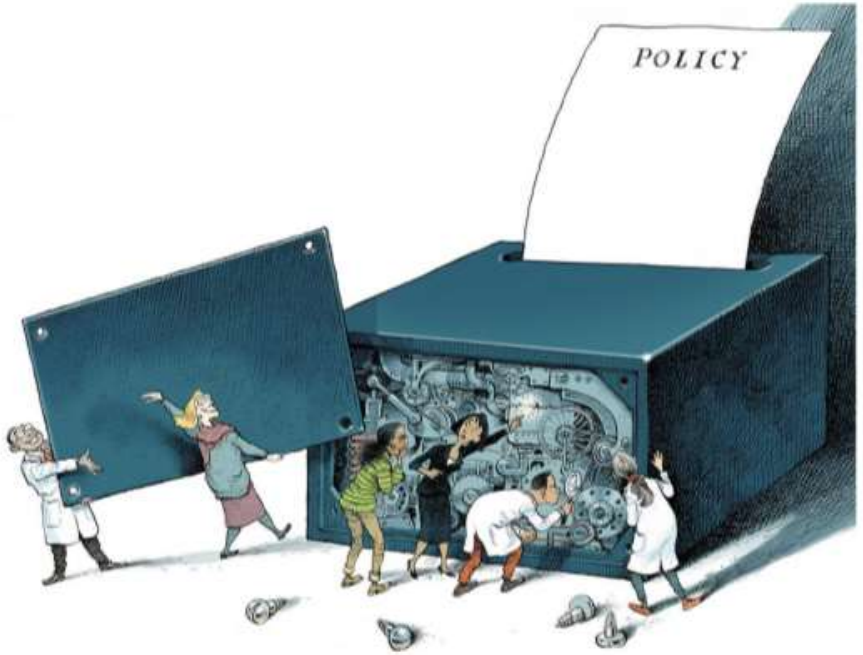
… models require input values for which there is no reliable information…

…global uncertainty and sensitivity analyses are often not done. Anyone turning to a model for insight should demand them …

Mind the assumptions

Assess uncertainty and sensitivity

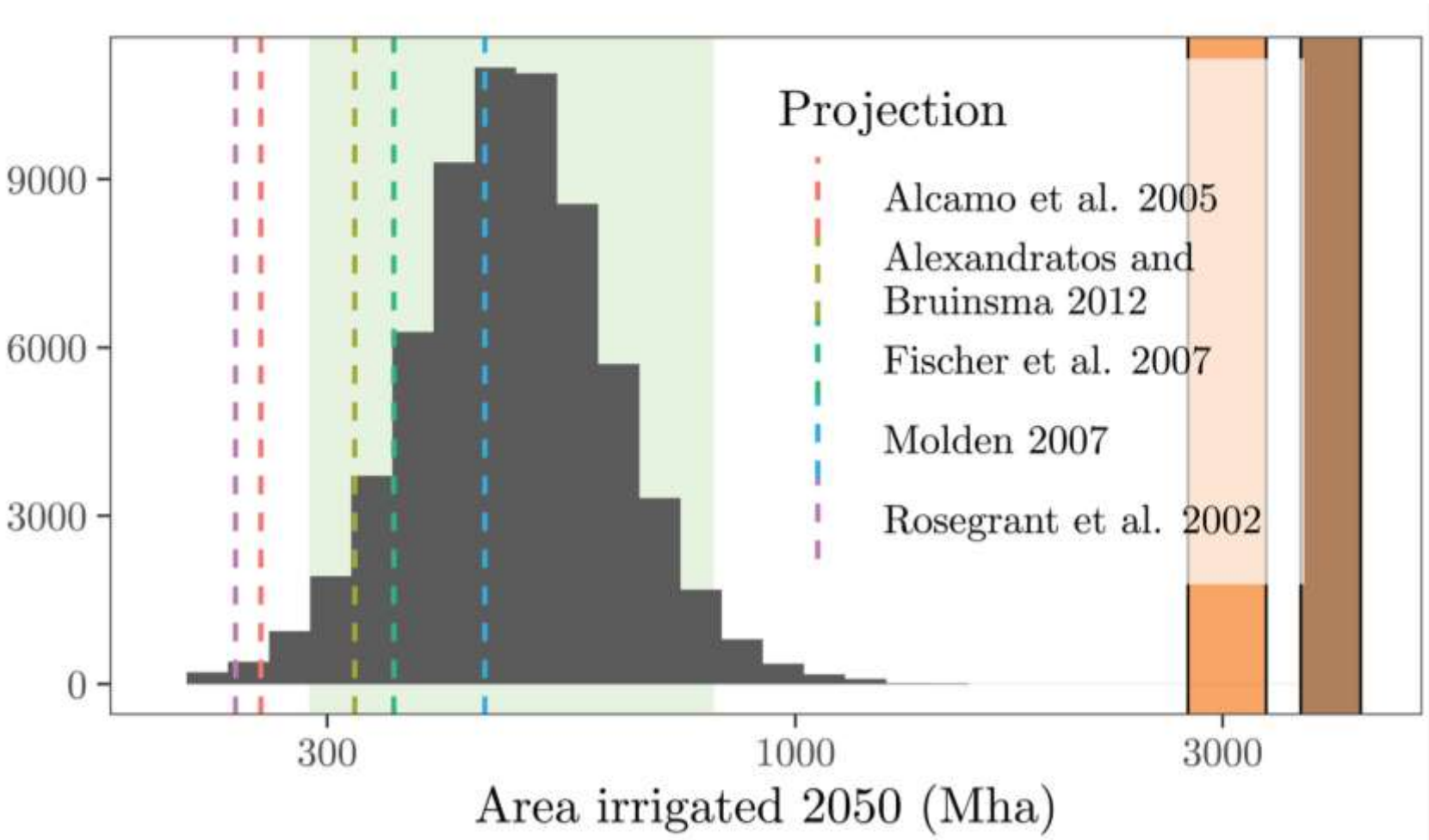
… this may lead to interesting discoveries …



Geophysical Research Letters

Current Models Underestimate Future Irrigated Areas

A. Puy ✉, S. Lo Piano, A. Saltelli First published: 17 April 2020 https://doi.org/10.1029/2020GL087360 |



Models ask as input information which we don't have – The case of WEBTAG

John Kay

J. A. Kay, "Knowing when we don't know," 2012, https://www.ifs.org.uk/docs/john_kay_feb2012.pdf

WebTAG: Annual Percentage Change in Car Occupancy (% pa) up to 2036

Journey Purpose	Weekday					Weekend	All Week
	7am-10am	10am-4pm	4pm-7pm	7pm-7am	Weekday Average		
Work	-0.48	-0.4	-0.62	-0.5	-0.44	-0.48	-0.45
Non - Work (commuting and other)	-0.67	-0.65	-0.53	-0.47	-0.59	-0.52	-0.56

Global Environmental Change 20 (2010) 298–302

Contents lists available at ScienceDirect

Global Environmental Change

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

Sensitivity analysis didn't help. A practitioner's critique of the Stern review

Andrea Saltelli *, Beatrice D'Hombres

Joint Research Centre, Institute for the Protection and Security of the Citizen, Ispra, Italy

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

Nicholas Stern,
London School of Economics

William Nordhaus,
University of Yale
Nobel 'Economics' 2018

Stern, N., 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).

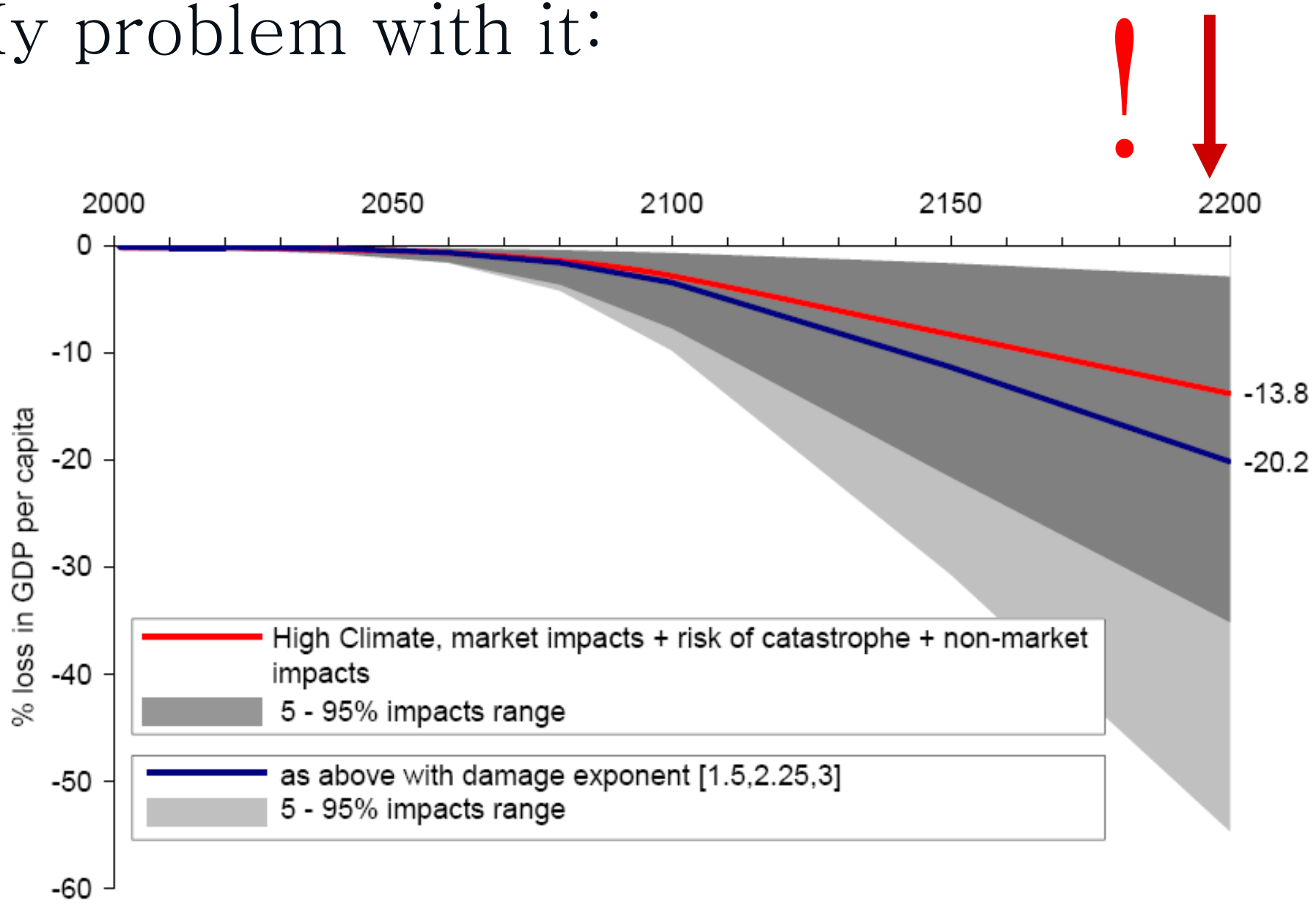
The Stern – Nordhaus exchange on *SCIENCE*

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 problem with it:

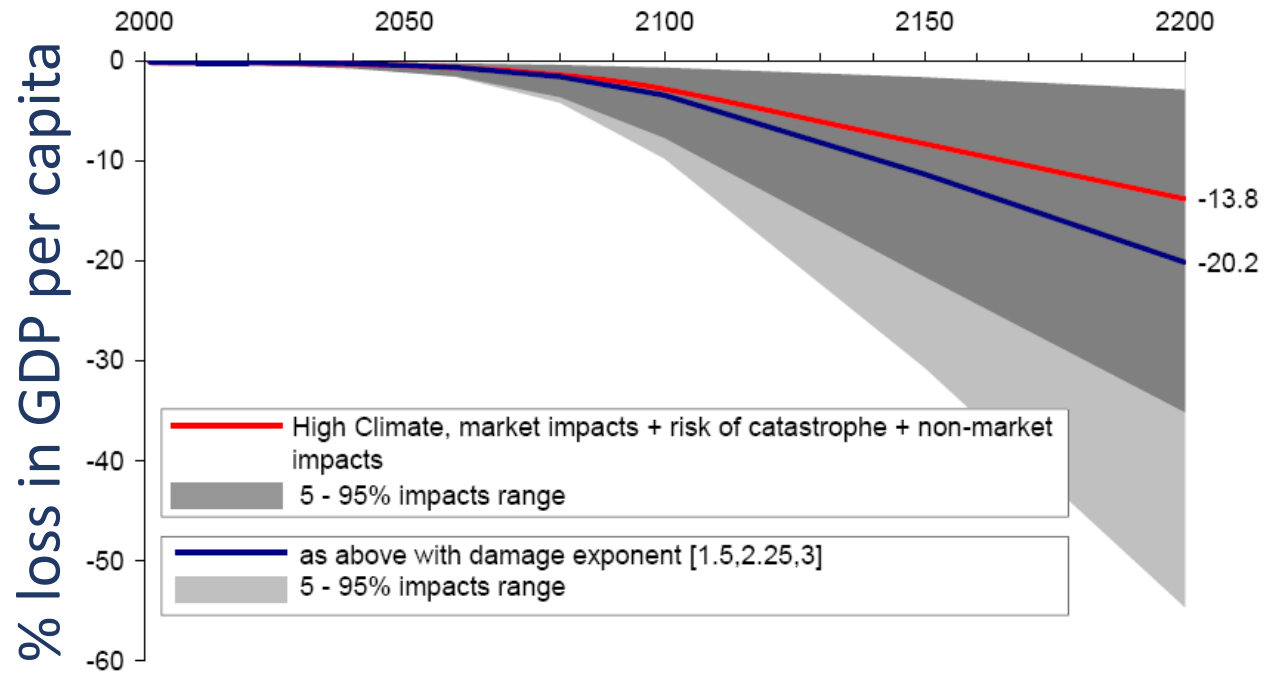


… but foremost Stern says:

changing assumptions → important effect

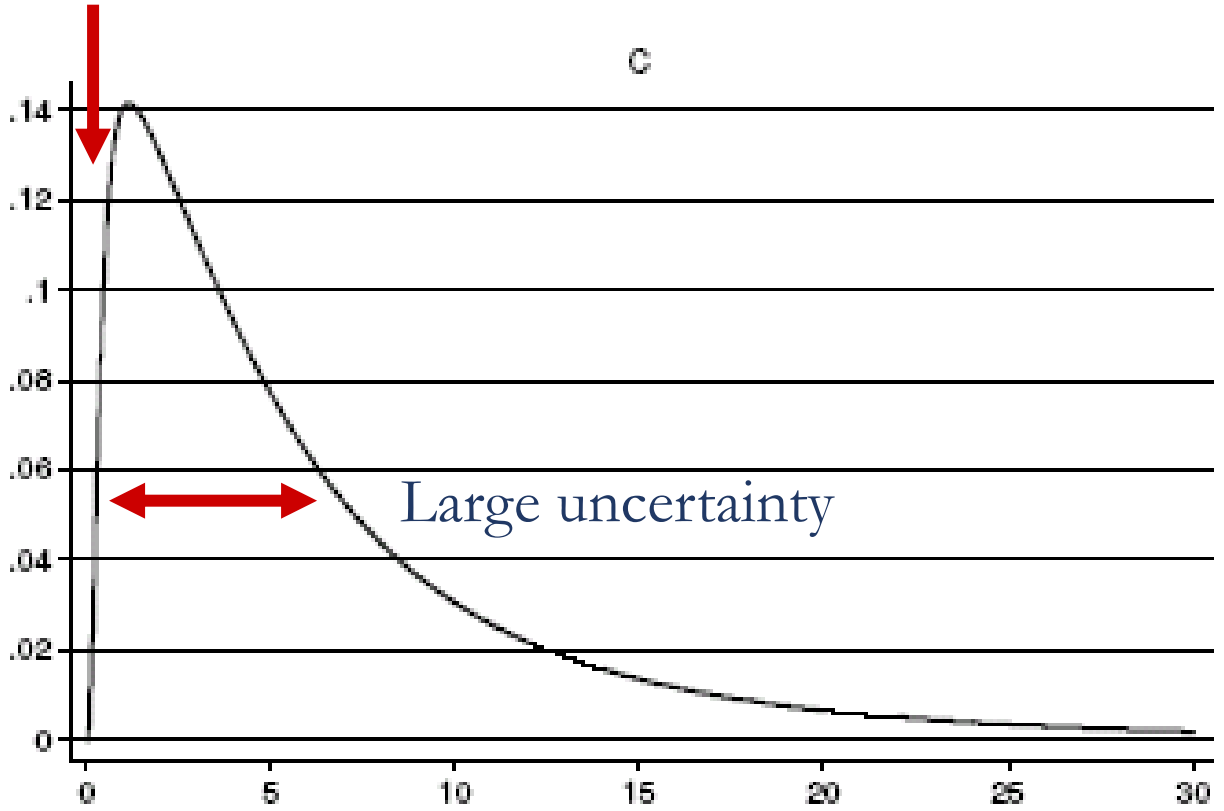
when instead he should admit that:

changing assumptions → all changes a lot

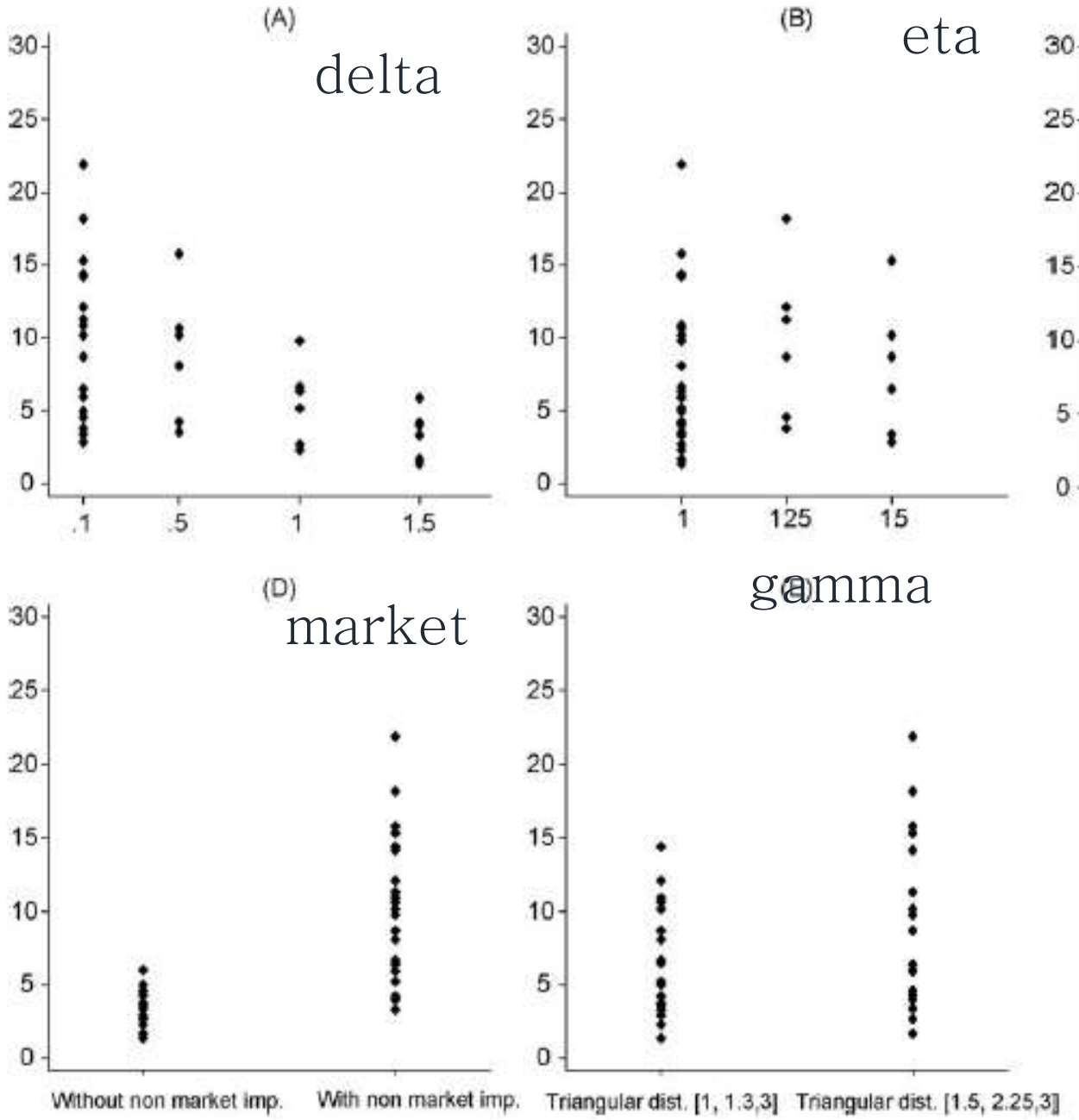


How was it done? A reverse engineering of the analysis

Missing points



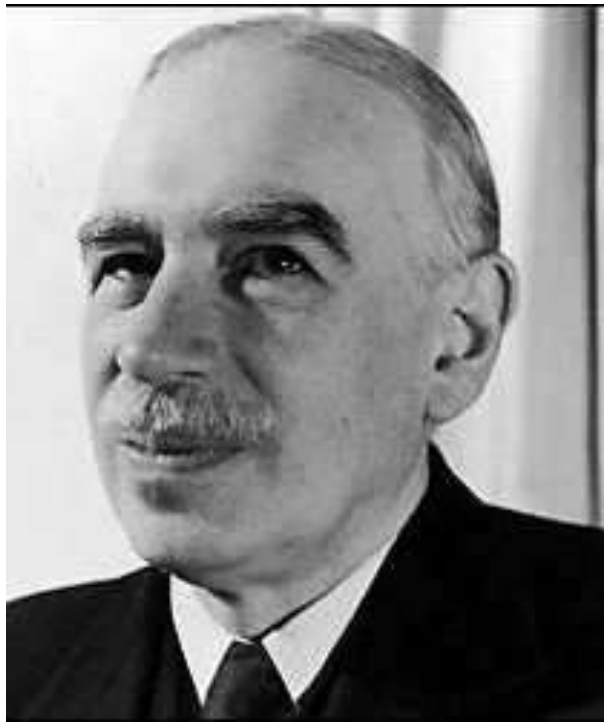
% loss in GDP per capita



Sensitivity analysis,

supports Stern: not all is driven by discount factors parameters delta and eta

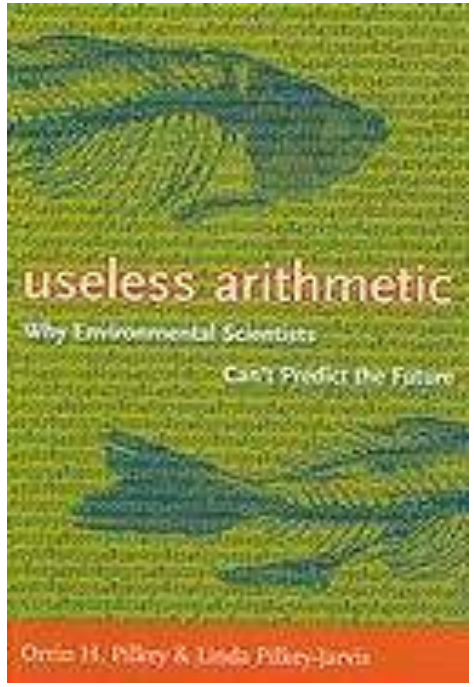
The criticism applies to both Stern and Nordhaus – both frame the debate around numbers which are …



… precisely wrong

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.

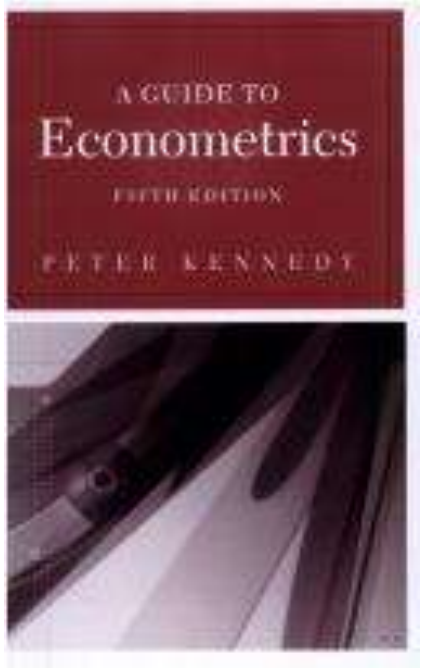
Orrin H. Pilkey



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

Peter Kennedy, A Guide to Econometrics.

One of the ten commandments of applied econometrics according to Peter Kennedy:



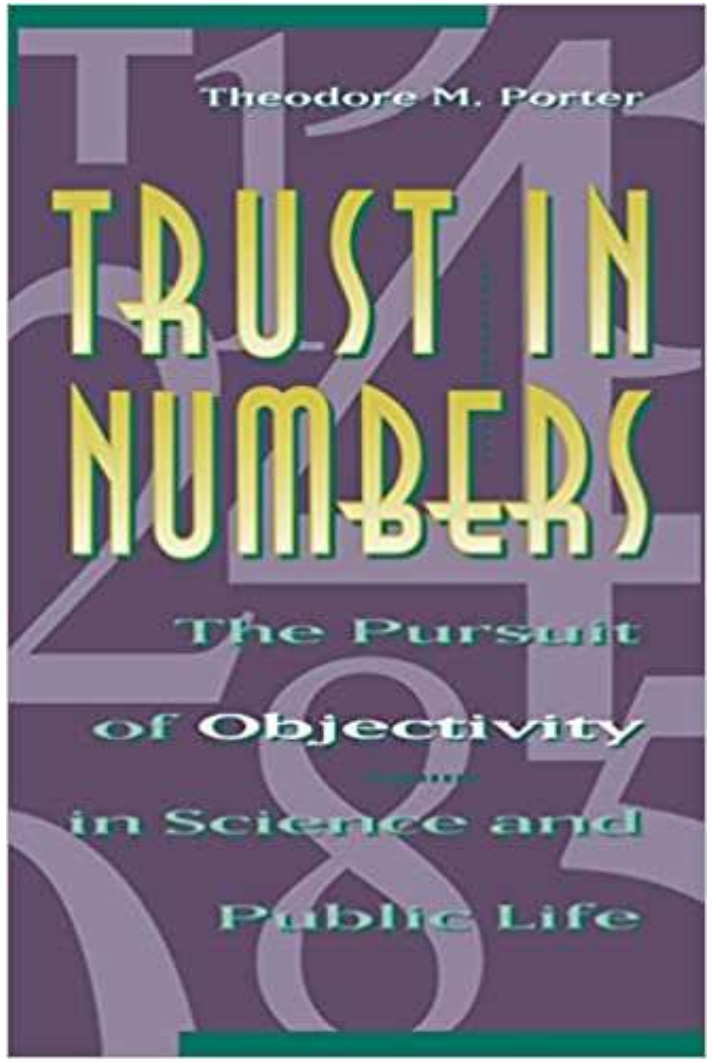
Peter Kennedy

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

"One reason these methods [global sensitivity analysis] are rarely used is their honesty seems destructive;"

"or, to put it another way, a fanatical commitment to fanciful formal models is often needed to create the appearance of progress"

Tantalus on the Road to Asymptopia, Edward E. Leamer, 2010 *Journal of Economic Perspectives*, **24**, (2), 31–46.



Cost benefit analysis: chapter 7 in Porter's book Trust in Numbers", Princeton, 1995

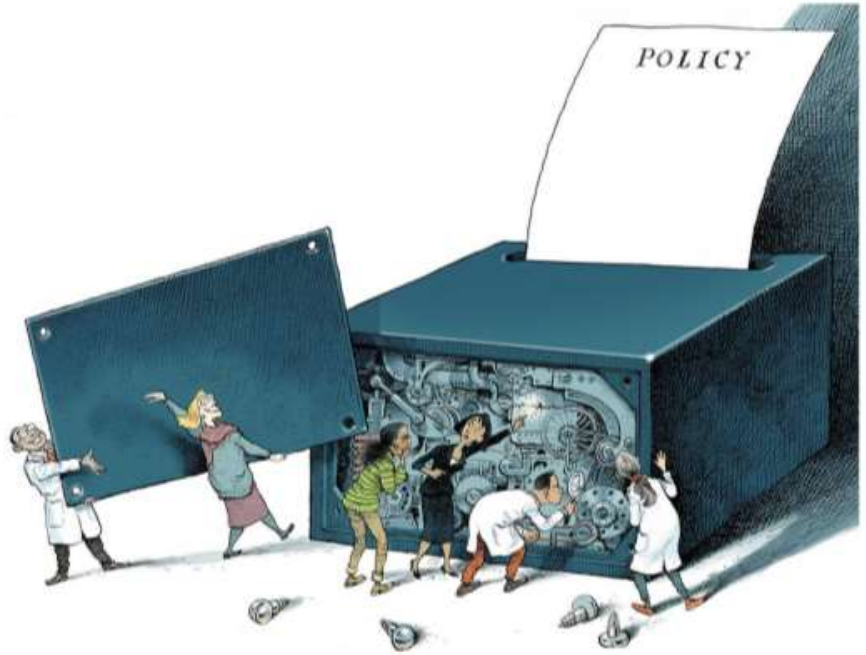
Theodor Porter

Mind the assumptions

Assess uncertainty and sensitivity

Mind the hubris

Complexity can be the enemy of relevance



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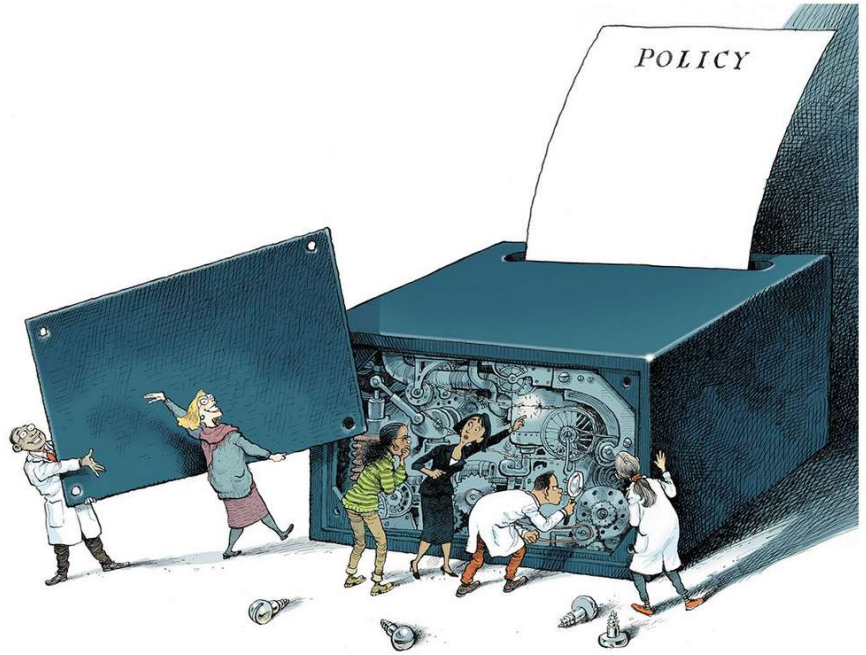
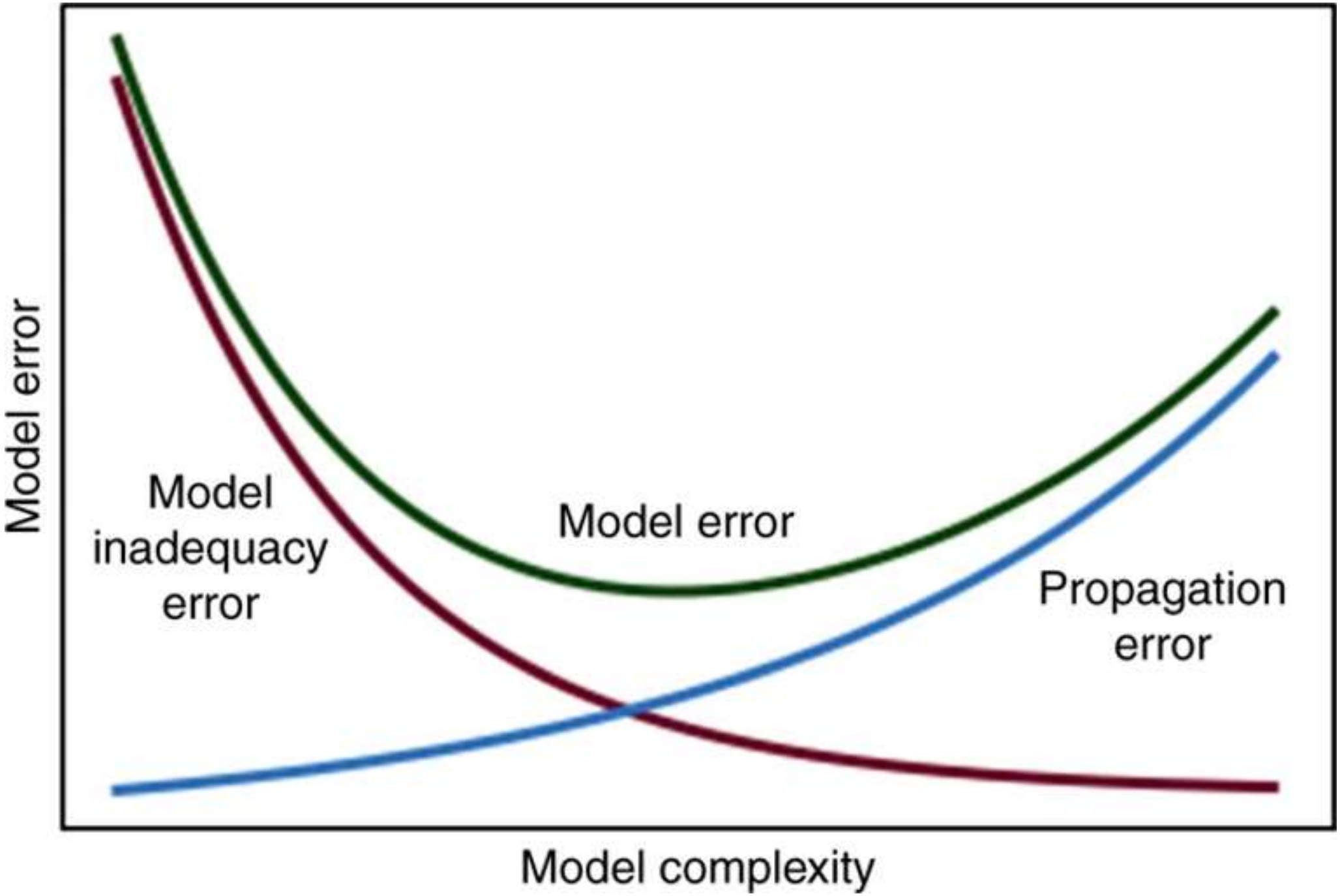
Complexity can be the enemy of relevance

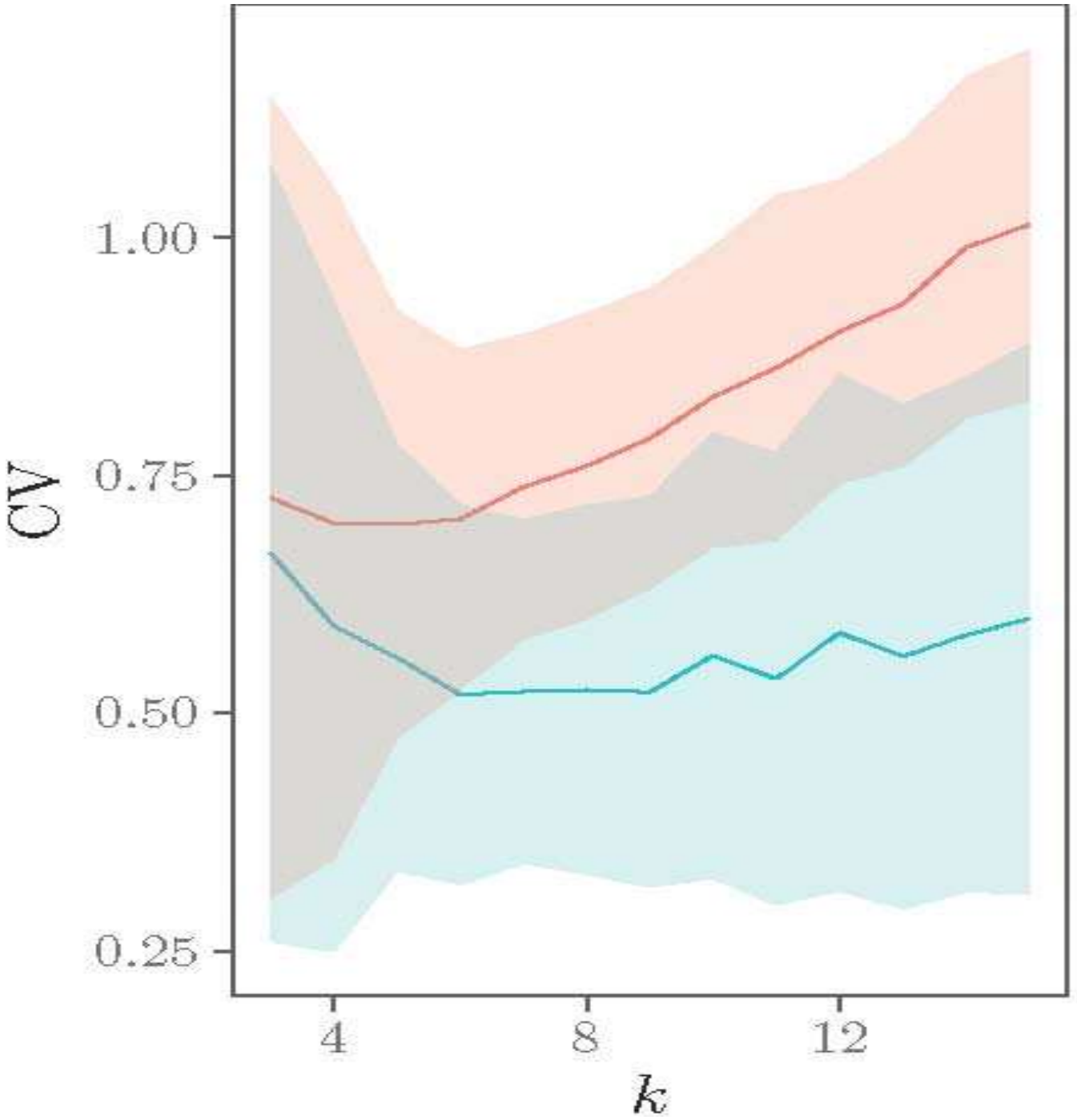


… many are seduced by the idea of adding complexity in an attempt to capture reality more accurately, but…

SUPPLEMENTARY INFORMATION

1. Additional information and references >260 references


Model error
Model inadequacy error
Model error
Propagation error
Model complexity



O'Neil conjecture

CV=coeff. of variation=
STD/mean
k model dimensionality

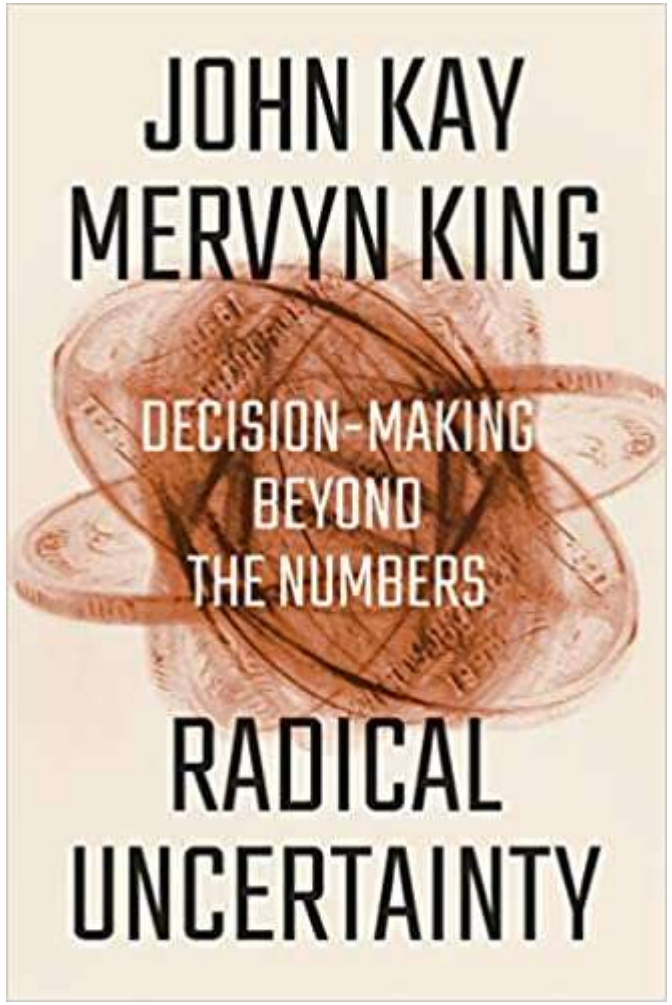
Interactions

Up to the k-th order

Up to the n-th order

with $n \leq k$

From A. Puy et al, "Effective dimension and model uncertainty", **paper in progress**



At times the simpler model gets it right because it makes the right assumptions

Predicting world fatalities from AIDS

WHO model did not consider that an HIV-positive sex worker who sleeps with 10 different people is more likely to spread the disease than someone who sleeps with the same person ten times

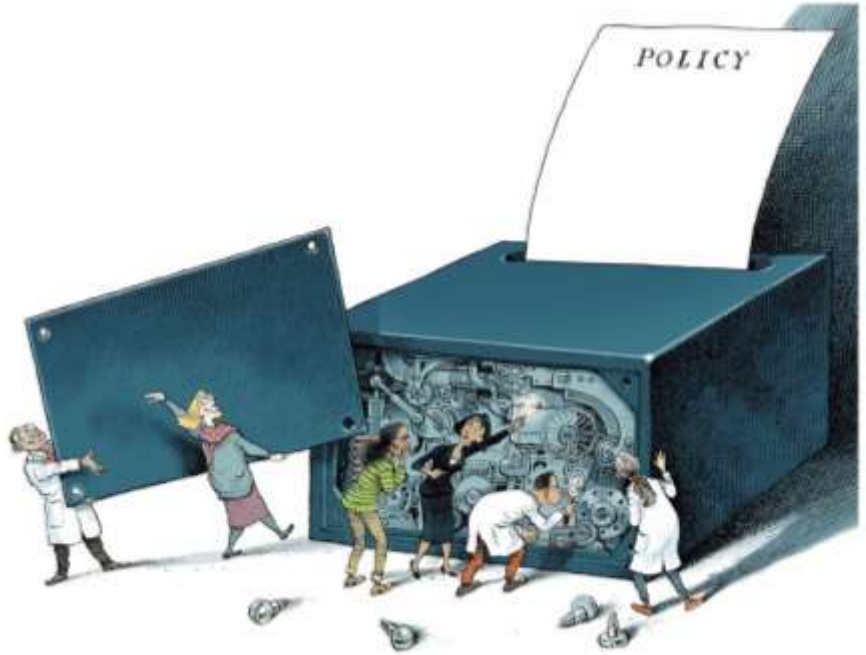
Kay, J. A. & King, M. A. *Radical uncertainty : decision-making beyond the numbers*. (W. W. Norton & Company, 2020).

Mind the assumptions

Assess uncertainty and sensitivity

Mind the hubris

Complexity can be the enemy of relevance



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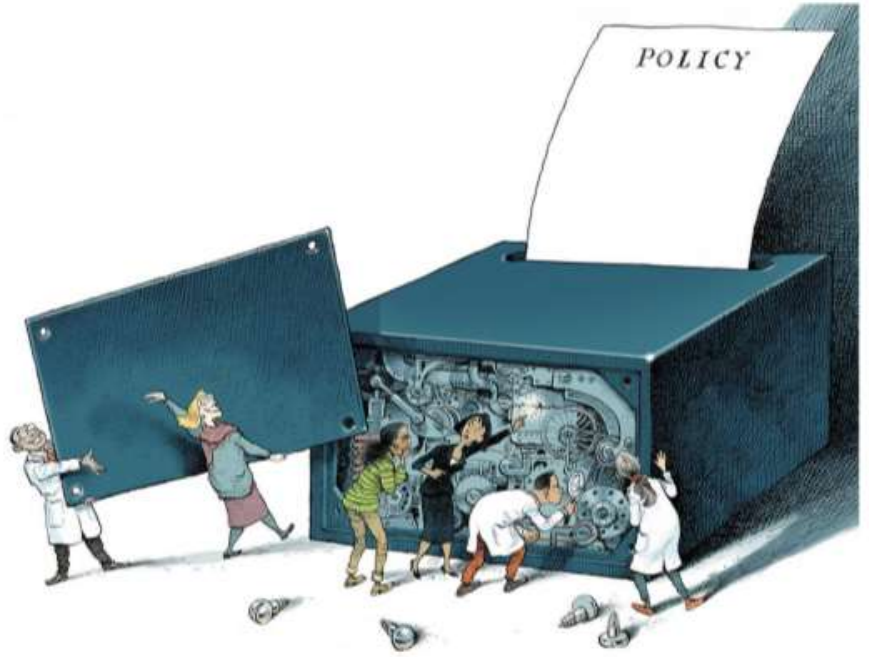


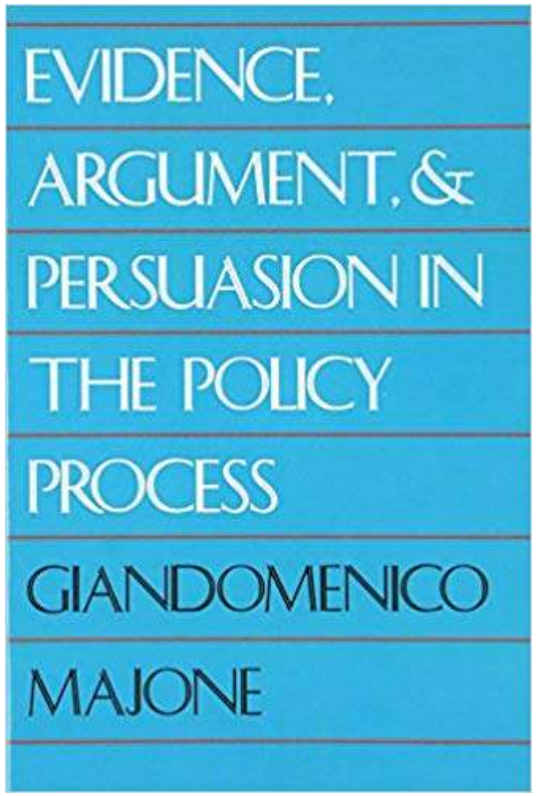
… models will reflect the interests, disciplinary orientations and biases of the developers…

SUPPLEMENTARY INFORMATION

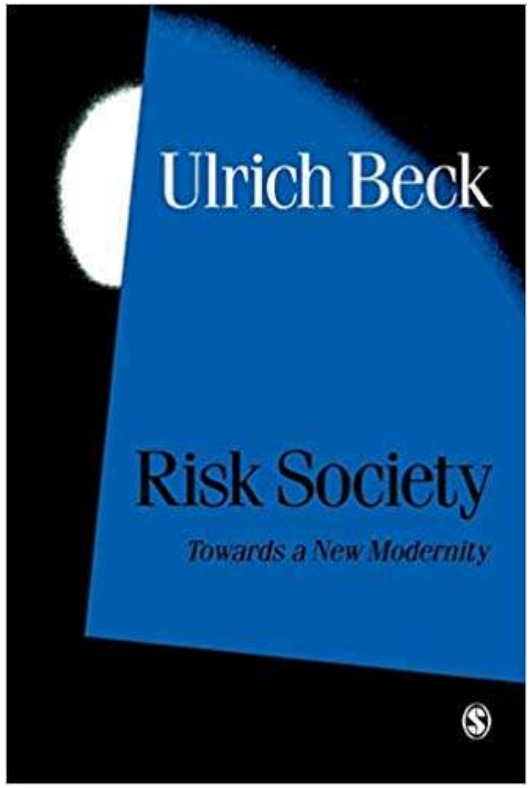
1. Additional information and references >260 references

From Ulrich Beck to Giandomenico Majone: the technique is never neutral

Ulrich Beck
(1944 –2015)



1989



1992 (1986)

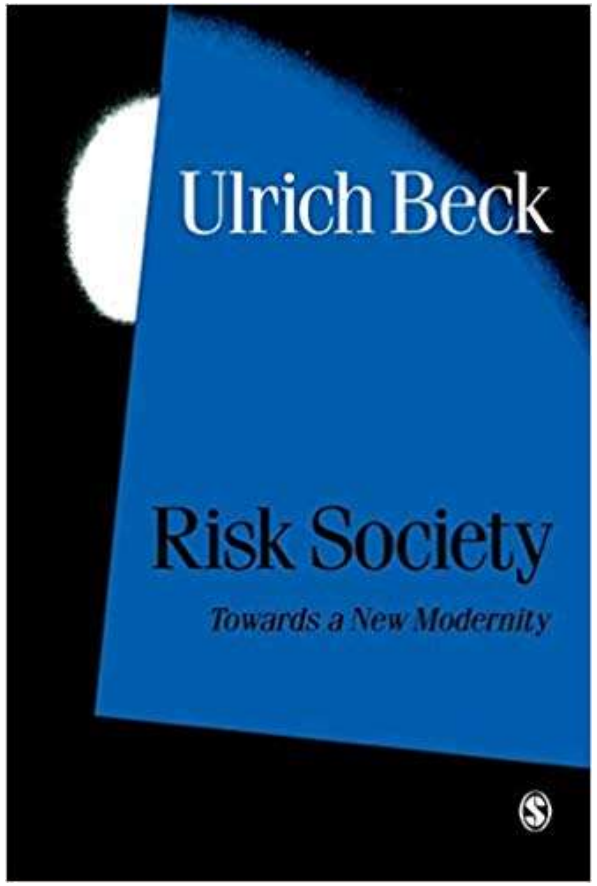
ELSEVIER

Environmental Science & Policy
Volume 106, April 2020, Pages 87-98

The technique is never neutral. How methodological choices condition the generation of narratives for sustainability

Andrea Saltelli [a, b], Lorenzo Benini [c], Silvio Funtowicz [a], Mario Giampietro [d, e], Matthias Kaiser [a], Erik Reinert [a, f], Jeroen P. van der Sluijs [a, g, h]

“It is not uncommon for political programs to be decided in advance simply by the choice of what expert representatives are included in the circle of advisers.”



1992 (1986)

Ulrich Beck
(1944 –2015)

The technique is never neutral. How methodological choices condition the generation of narratives for sustainability

Environmental Science & Policy
Volume 106, April 2020, Pages 87-98

Andrea Saltelli [a, b], Lorenzo Benini [c], Silvio Funtowicz [a], Mario Giampietro [d, e], Matthias Kaiser [a], Erik Reinert [a, f], Jeroen P. van der Sluijs [a, g, h]

Combine more lenses, including Post-normal science (PNS), Bioeconomics, and Non-Ricardian economics

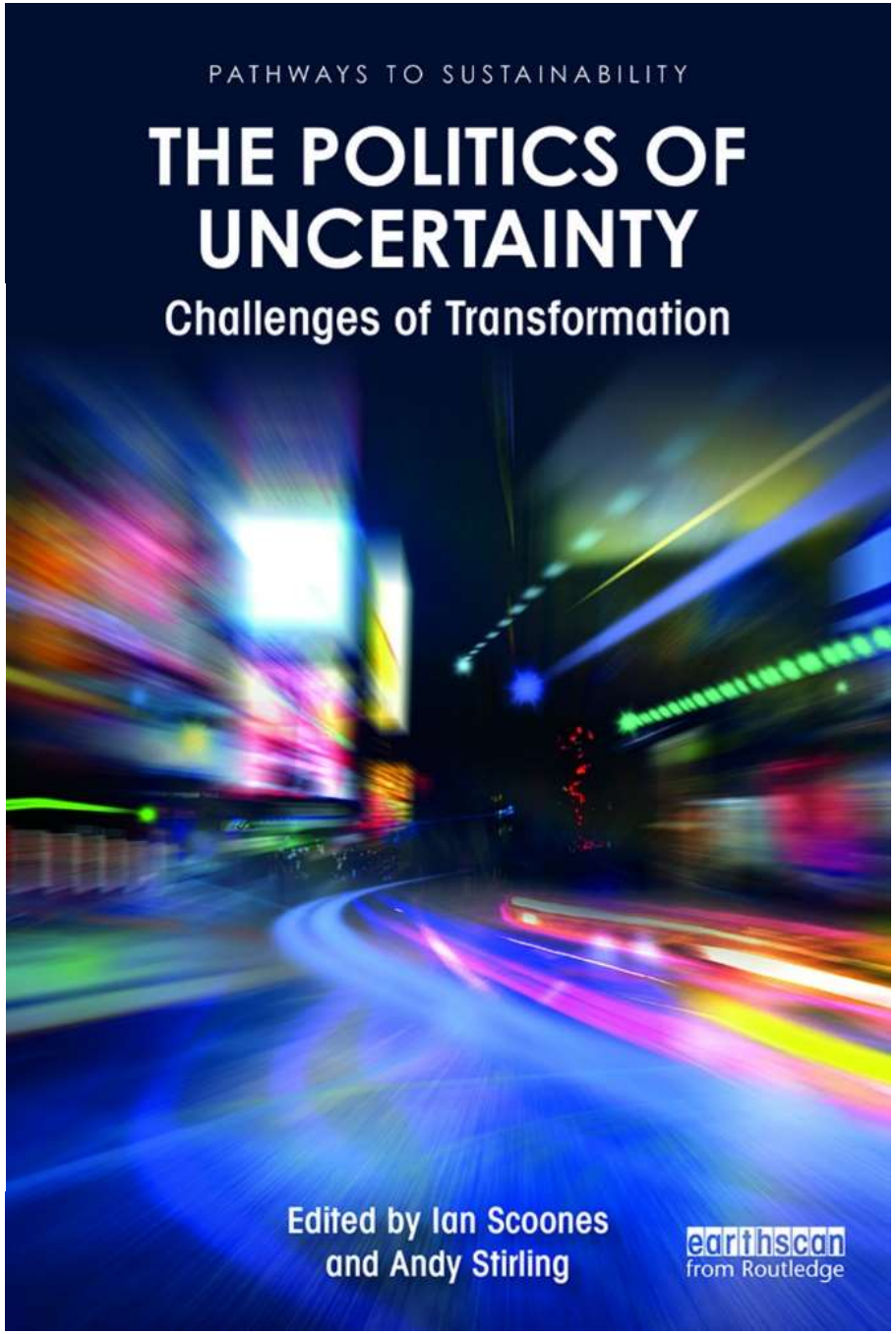
On reductionism

4

THE UNRAVELLING OF TECHNOCRATIC ORTHODOXY?

Contemporary knowledge politics in technology regulation

Patrick van Zwanenberg



Frames as hypocognition & Socially constructed ignorance

Steve Rayner

Rayner, S., 2012, Uncomfortable knowledge: the social construction of ignorance in science and environmental policy discourses, Economy and Society, 41:1, 107-125.

Rayner's (2012) strategies to deal with "uncomfortable knowledge".

Denial, Dismissal, Diversion, Displacement

Model based

Rayner, S., 2012, Uncomfortable knowledge: the social construction of ignorance in science and environmental policy discourses, Economy and Society, 41:1, 107-125.

Displacement: “The model we have developed tells us that real progress is being achieved” (The focus in now the model not the problem).

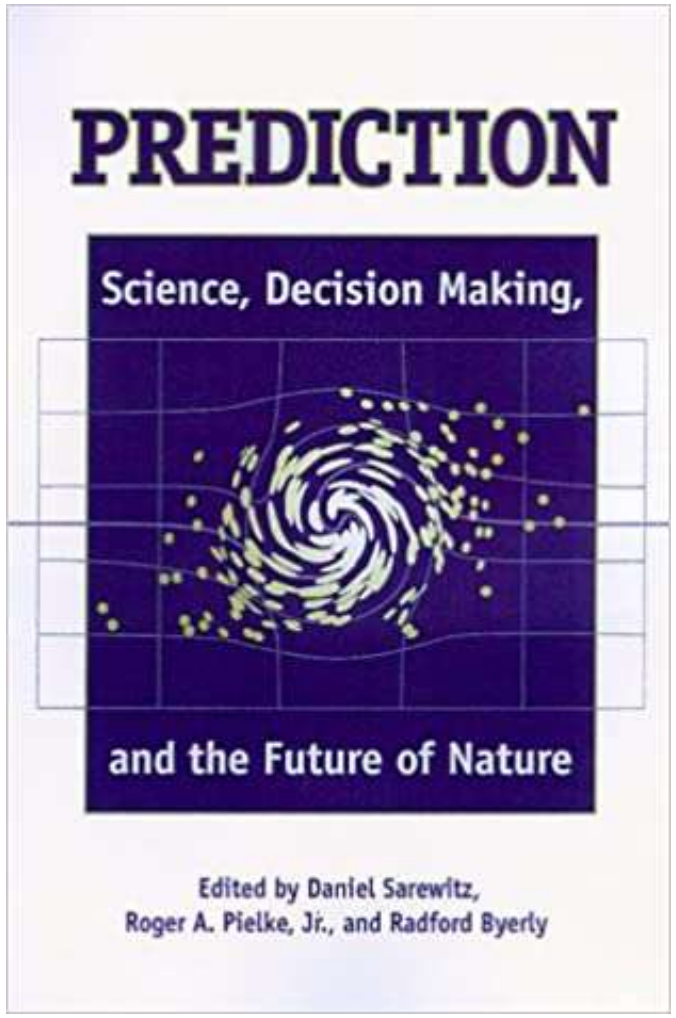
Rayner, S., 2012, Uncomfortable knowledge: the social construction of ignorance in science and environmental policy discourses, Economy and Society, 41:1, 107-125.

Example of displacement: Chesapeake Bay Program (CBP) modelling work

"Bay models are used to track nutrient loads to ensure the cap is not exceeded"

➔The model results – rather than the actual measurements, become the substance of use

Rayner, S., 2012, Uncomfortable knowledge: the social construction of ignorance in science and environmental policy discourses, Economy and Society, 41:1, 107-125.



Model GENESIS for beach erosion

US Army Corps of Engineers ®

Manipulated to support coastal-engineering projects

It neglected the role of extreme event

Sarewitz, D., Pielke, R. A. & Byerly, R. *Prediction: Science, Decision Making, and the Future of Nature* (Island Press, 2000).

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‡

Involve stakeholders, accommodate multiple views and promote transparency, replication and analysis of sensitivity and uncertainty

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.

[…] knowledge regarding flooding was co-produced … experts, both certified (academic natural and social scientists) and noncertified (local people affected by flooding)

➔ 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.

Upstream storage was neglected in the models because of the "use of a pit-filling algorithm that made sure that all water flows downhill"!

Mind the assumptions

Assess uncertainty and sensitivity

Mind the hubris

Complexity can be the enemy of relevance

Mind the framing

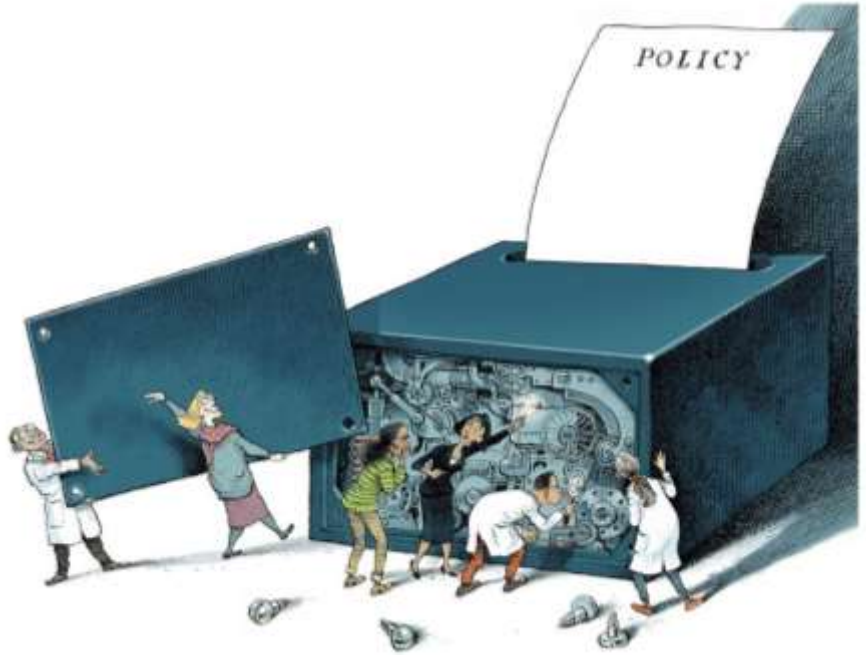
Match purpose and context

Mind the consequences

Quantification can backfire

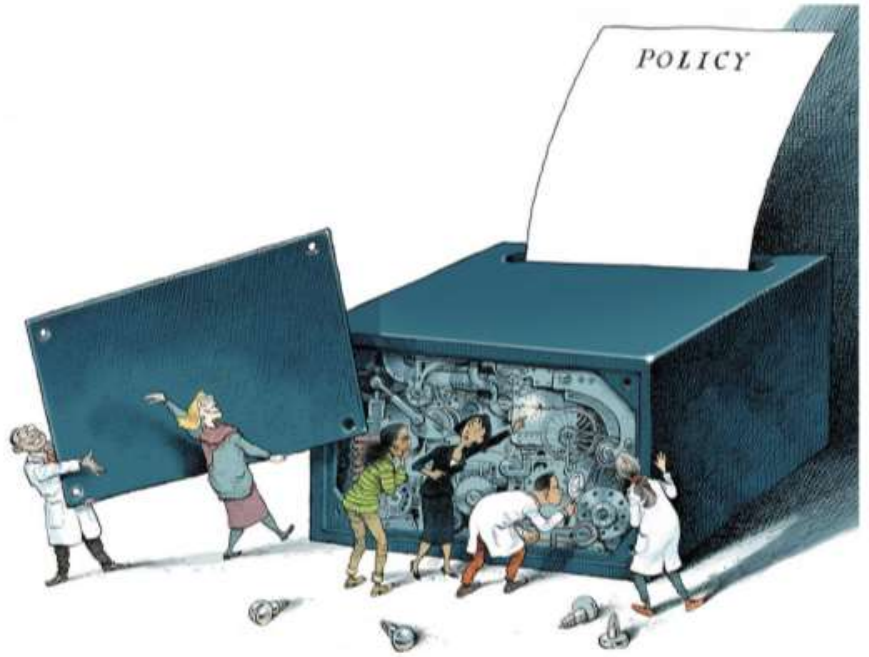
Mind the unknowns

Acknowledge ignorance



Mind the consequences

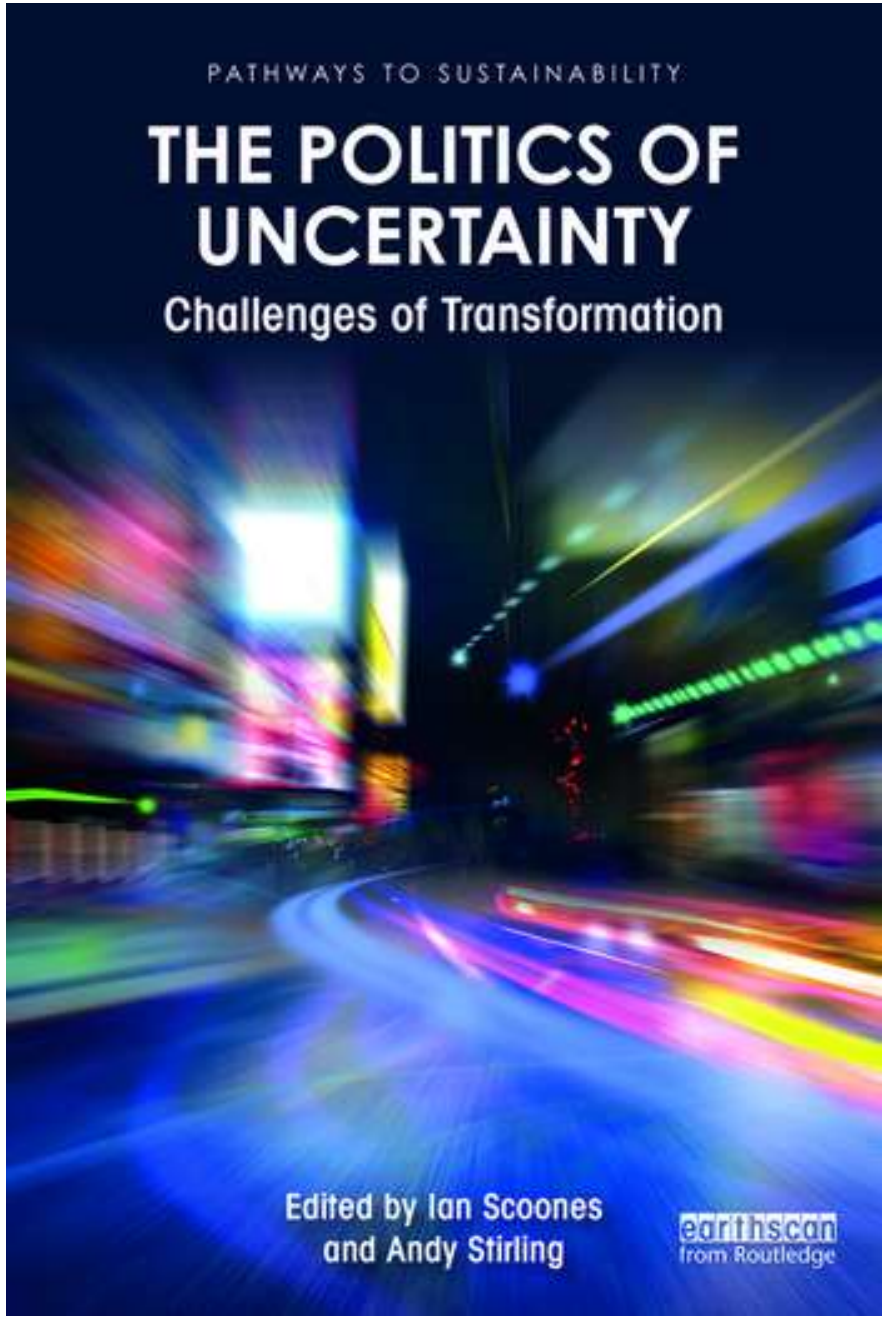
Quantification can backfire



From the risk of financial products to the management of costal zones to the models for disaster insurance bad modelling may lead to wrong decisions

SUPPLEMENTARY INFORMATION

1. Additional information and references >260 references



3

SHARING RISKS OR PROLIFERATING UNCERTAINTIES?

Insurance, disaster and development

Leigh Johnson

Model-based parametric insurance led to dramatic consequences for developing countries experiencing draughts

Open access: https://www.taylorfrancis.com/books/politics-uncertainty-ian-scoones-andy-stirling/e/10.4324/9781003023845

An ethical problem in the use of models in economics?

Dangers of mathematization of economics

Wolfgang Drechsler

Erik S. Reinert

Paul Romer

Philip Mirowski

W. Drechsler, “On the possibility of quantitative-mathematical social science, chiefly economics,” *J. Econ. Stud.*, vol. 27, no. 4/5, pp. 246–259, 2000.

E. S. Reinert, “Full circle: economics from scholasticism through innovation and back into mathematical scholasticism,” *J. Econ. Stud.*, vol. 27, no. 4/5, pp. 364–376, Aug. 2000.

P. Romer, “Mathiness in the Theory of Economic Growth,” *Am. Econ. Rev.*, vol. 105, no. 5, pp. 89–93, May 2015.

Mirowski, Philip. 2013. Never Let a Serious Crisis Go to Waste: How Neoliberalism Survived the Financial Meltdown. Verso.

Paul Romer's Mathiness = use of mathematics to veil normative stances

"The style that I am calling mathiness lets academic politics masquerade as science"

P. M. Romer, "Mathiness in the Theory of Economic Growth," Am. Econ. Rev., vol. 105, no. 5, pp. 89–93, May 2015.

The Trouble With Macroeconomics

PAUL ROMER
Stern School of Business
New York University

Wednesday 14th September, 2016

"striking parallels between the characteristics of string-theorists in particle physics and postreal Macroeconomists"

Outspoken World Bank chief economist Paul Romer exits

Emails reveal clashes over issues ranging from grammar to methodology

© EPA

Shawn Donnan in Washington JANUARY 25 2018

FT FINANCIAL TIMES

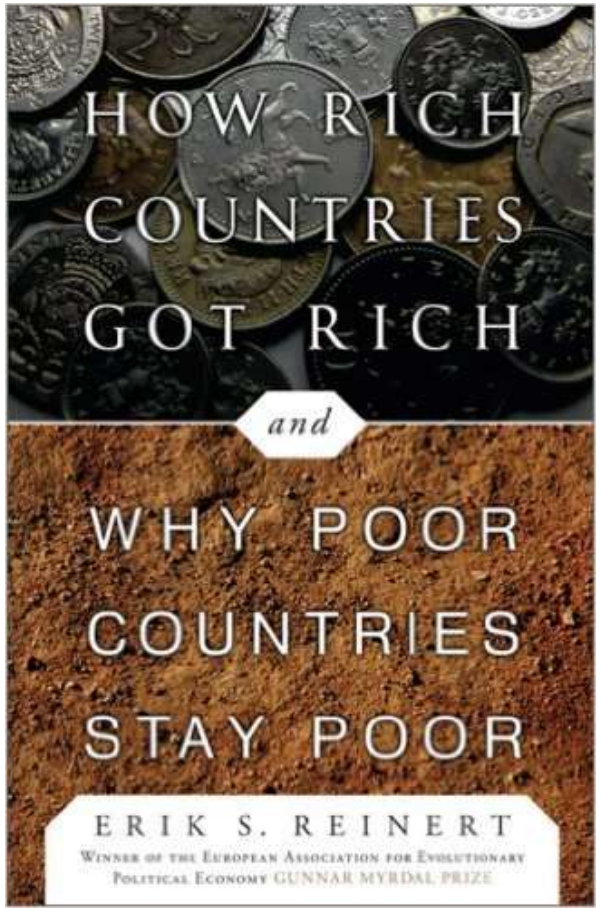
Methodological & normative conflicts, including over the methodology used in the World Bank's "Doing Business" rankings – Romer accused the bank staff of manipulating the data for political reasons (Chile, Michelle Bachelet)

https://www.ft.com/content/be72f8e2-0144-11e8-9650-9c0ad2d7c5b5
https://www.reuters.com/article/us-worldbank-economist-romer-idUSKBN1FD38Y

Economics has reverted to scholasticism

… forgetting an important continental tradition

… implications for developments



Altered States: Cartesian and Ricardian dreams

Erik S. Reinert
Tallinn University of Technology
UCL Institute for Innovation and Public Purpose

Monica di Fiore
Institute for Cognitive Sciences and Technologies, Consiglio Nazionale delle Ricerche

Andrea Saltelli
Open Evidence Research, Universitat Oberta de Catalunya (UOC)

Jerome R. Ravetz
Institute for Science, Innovation and Society, University of Oxford

WORKING PAPER
WP 2021/07

Caeteris are never paribus

Ceteris paribus or caeteris paribus is a Latin phrase meaning "all other things being equal" or "other things held constant" or "all else unchanged“ (Wikipedia)

The case of DSGE, dynamic stochastic general equilibrium models

Rational expectations of agents
Efficient market hypothesis

Philip Mirowski

Philip Mirowski, 2013, Never let a serious crisis go wasted, Verso Books.

The US senate and Queen Elisabeth perplexed…

Philip Mirowski, 2013, Never let a serious crisis go wasted, Verso Books.

DSGE hearing in the US senate, with sworn testimony of economists such as **Sidney Winter, Scott Page, Robert Solow, David Colander and V.V. Chari**, to understand how 'theorists tools' had come to be used as policy instruments and why these instruments were all but useless in anticipating the economic crisis

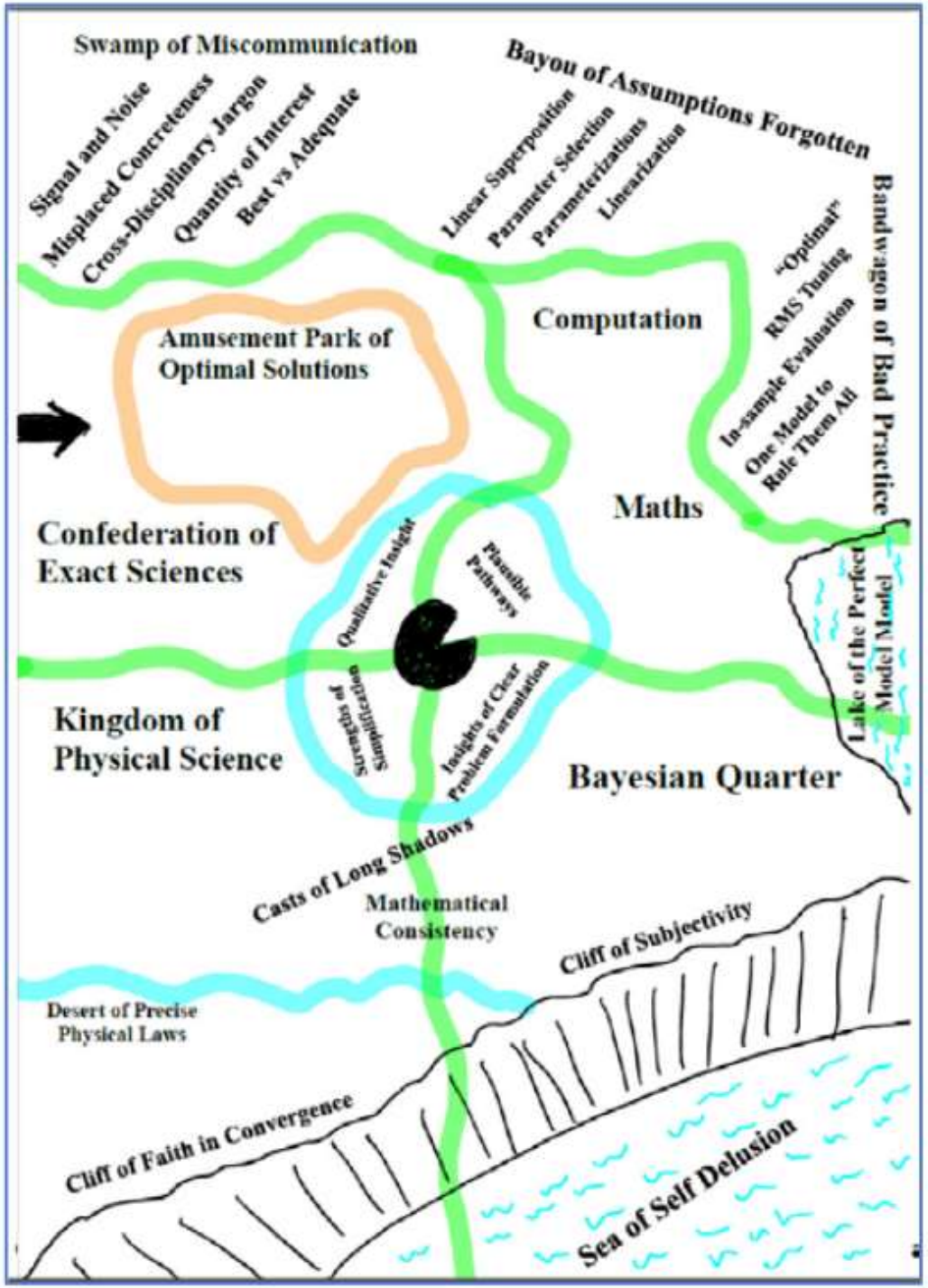
Economics
The Open-Access, Open-Assessment E-Journal

Discussion Paper
No. 2019-23 | March 08, 2019 | http://www.economics-ejournal.org/economics/discussionpapers

Escape from model-land

Erica L. Thompson and Leonard A. Smith

"Beware 'optimal' model-land quantities obtained from imperfect simulations"



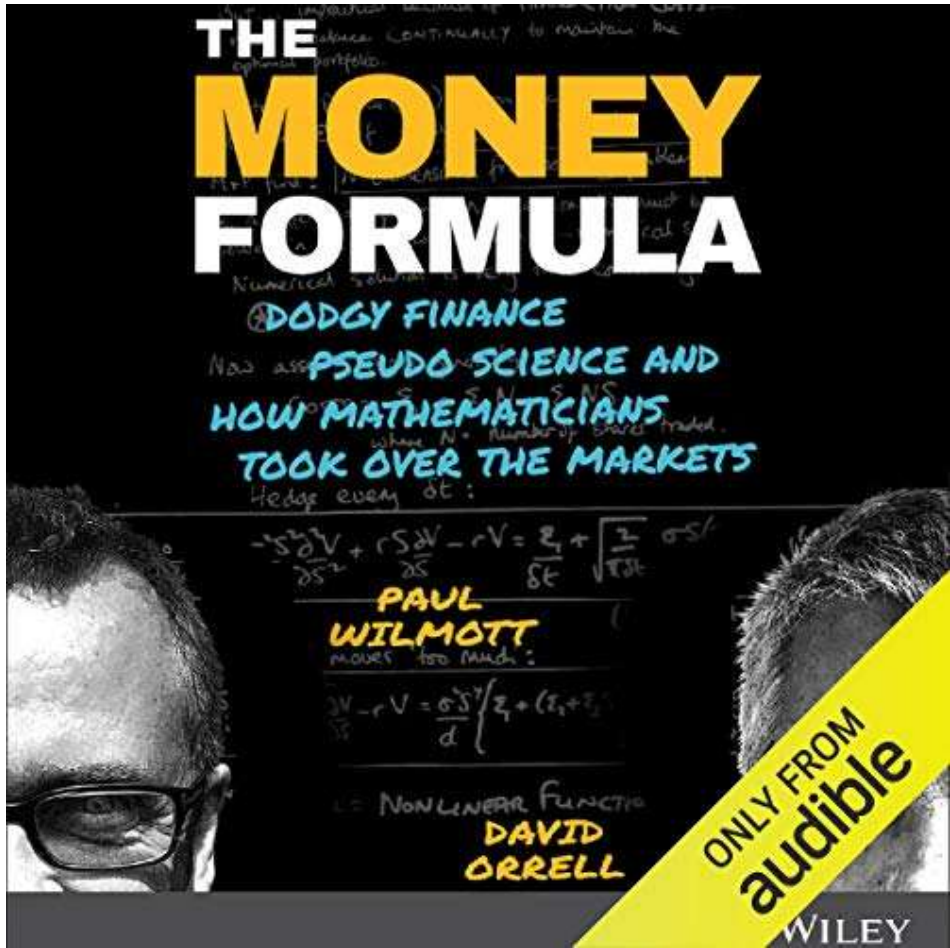
FELIX SALMON BUSINESS 02.23.2009 12:00 PM

Recipe for Disaster: The Formula That Killed Wall Street

$$\Pr[T_A<1, T_B<1] = \Phi_2(\Phi^{-1}(F_A(1)), \Phi^{-1}(F_B(1)), \gamma)$$

Modelling gamma as a constant calibrated during periods of market growth simplified the pricing of financial products (e.g. CDO) but led to disasters when the market went the other way

https://www.wired.com/2009/02/wp-quant/



New WHO estimates: Up to 190 000 people could die of COVID-19 in Africa if not controlled

07 May 2020

Brazzaville – Eighty-three thousand to 190 000 people in Africa could die of COVID-19 and 29 million to 44 million could get infected in the first year of the pandemic if containment measures fail, a new study by the World Health Organization (WHO) Regional Office for Africa finds. The research, which is based on prediction modelling, looks at 47 countries in the

Speculative scenario in which ten uncertain input probabilities are increased by an arbitrary 10% — as if they were truly equally uncertain — with no theoretical or empirical basis for such a choice

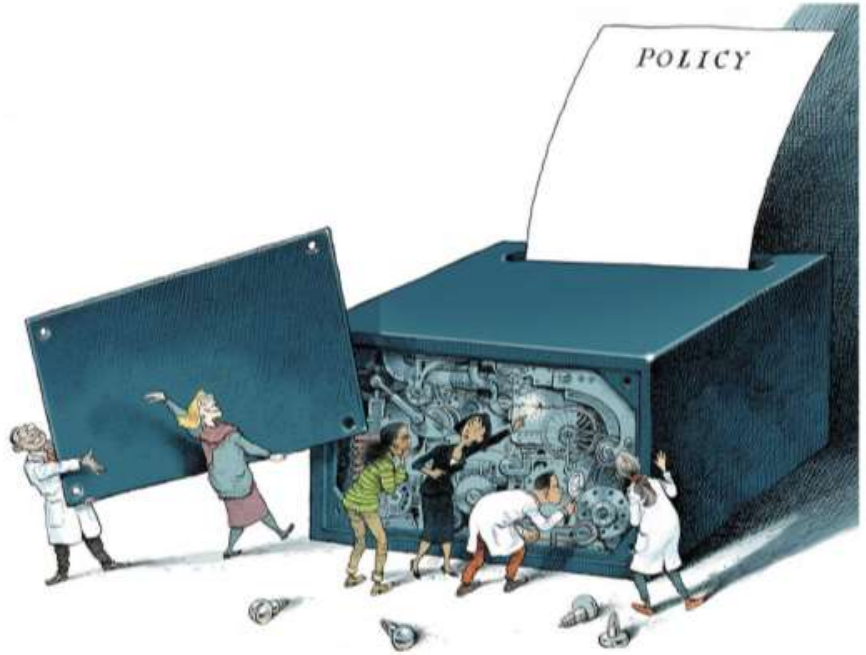
World Health Organization
REGIONAL OFFICE FOR Africa

Mind the assumptions

Assess uncertainty and sensitivity

Mind the hubris

Complexity can be the enemy of relevance



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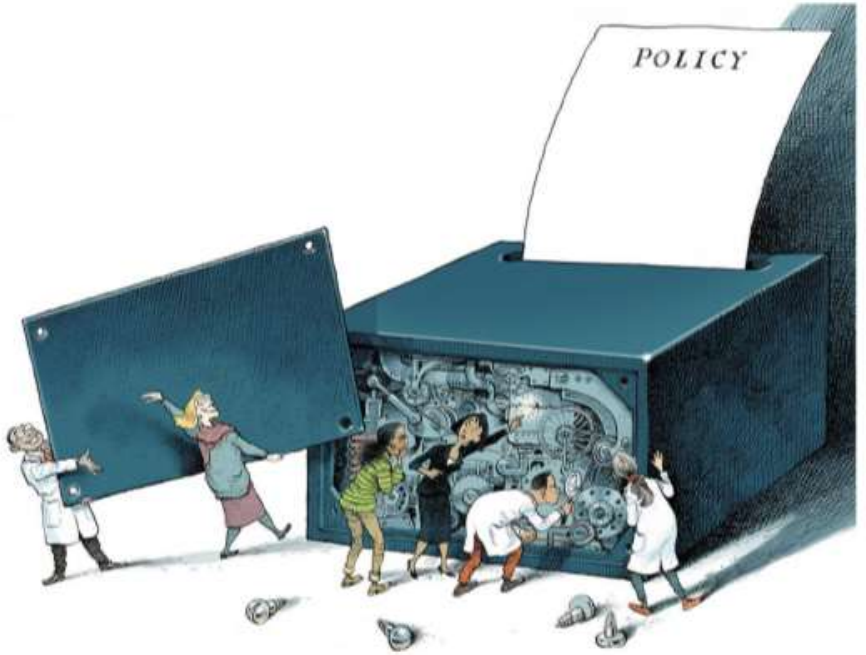

"there is no number-answer to your question"

Anthony Fauci

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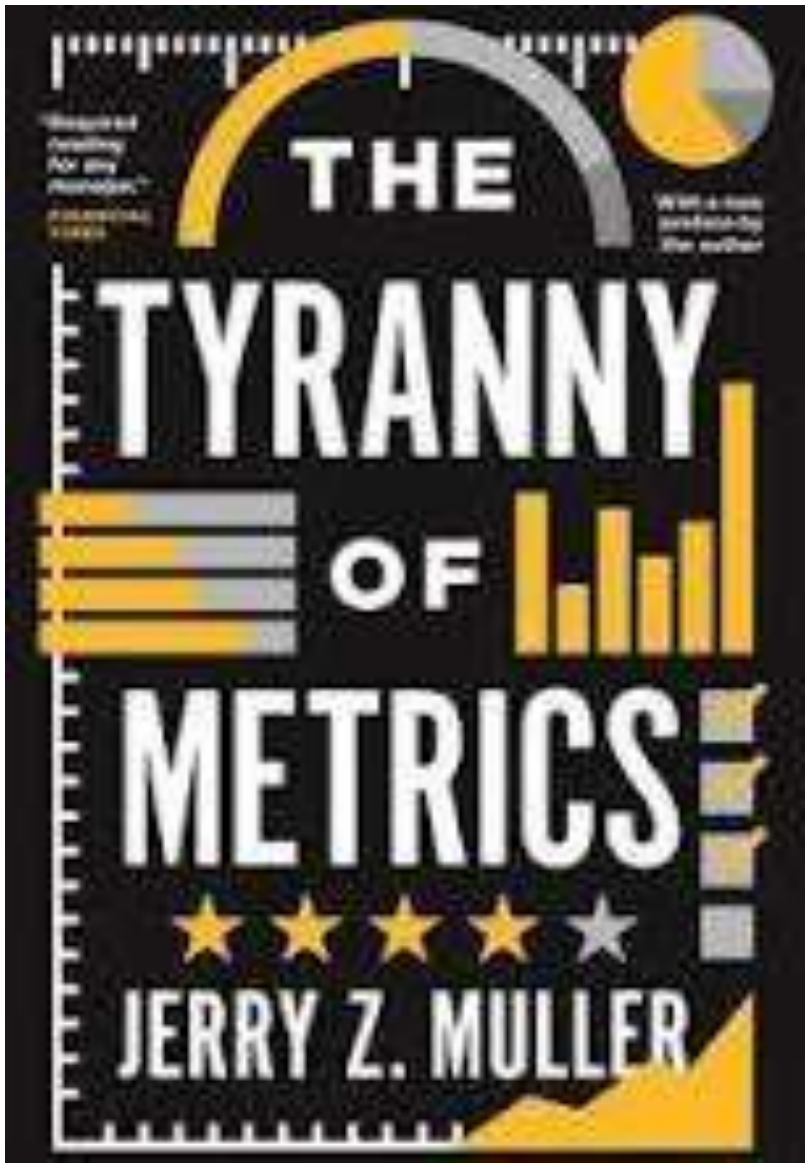
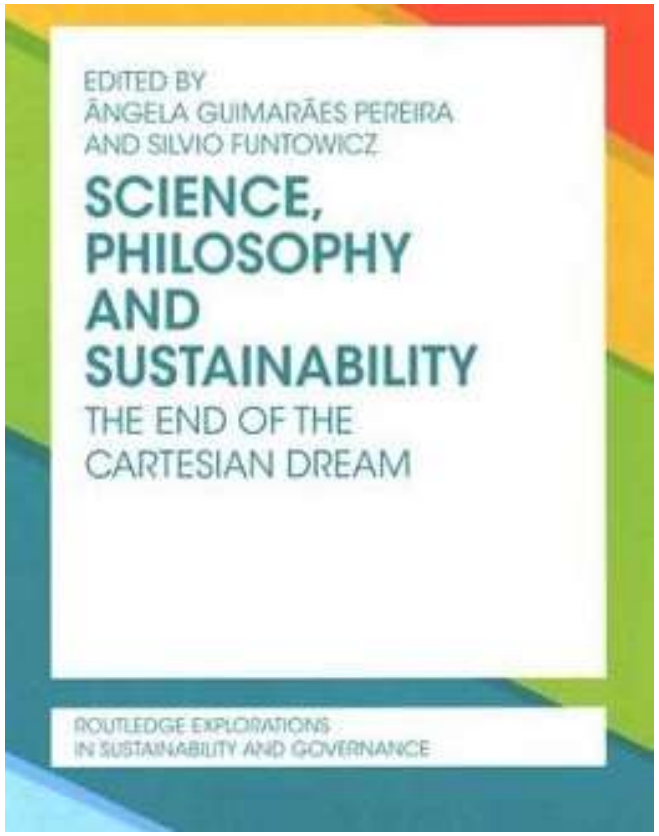


"keep in mind at every step that the best use of metrics may be not to use it at all"



Jerry Ravetz

Ravetz, J, R, 2015, Descartes and the rediscovery of ignorance, in Guimarães Pereira, Â, and Funtowicz, S, Eds, 2015, The end of the Cartesian dream, Routledge.

Ravetz, J., R., 1987, Usable Knowledge, Usable Ignorance, Incomplete Science with Policy Implications, Knowledge: Creation, Diffusion, Utilization, 9(1), 87-116.

ELSEVIER

Futures

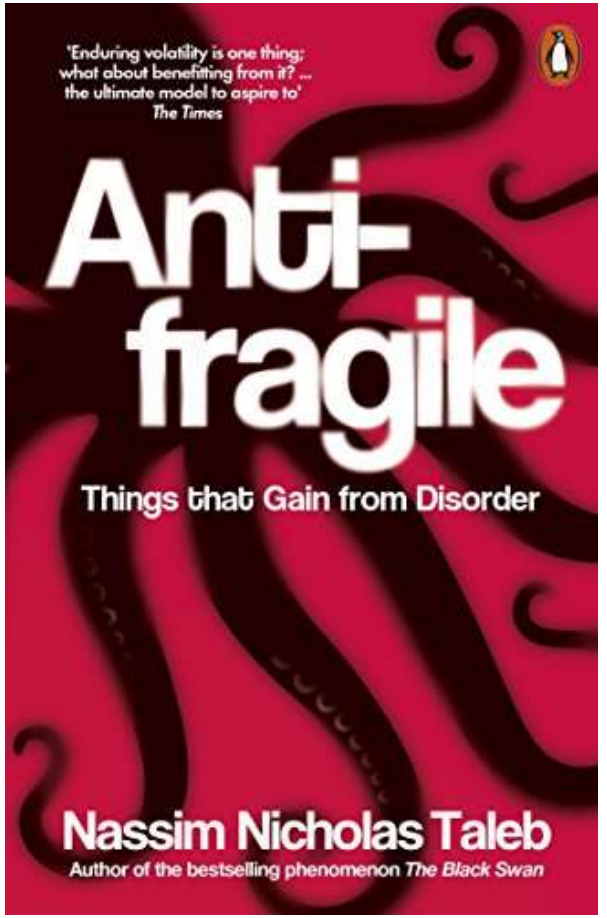
Volume 91, August 2017, Pages 62-71

Original research article

What is wrong with evidence based policy, and how can it be improved?

Andrea Saltelli [a, b, c] ✉, Mario Giampietro [a, c, d]

Responsible use of quantitative information; try via negativa (N. Taleb); instead of proving policy options try to falsify them



ELSEVIER

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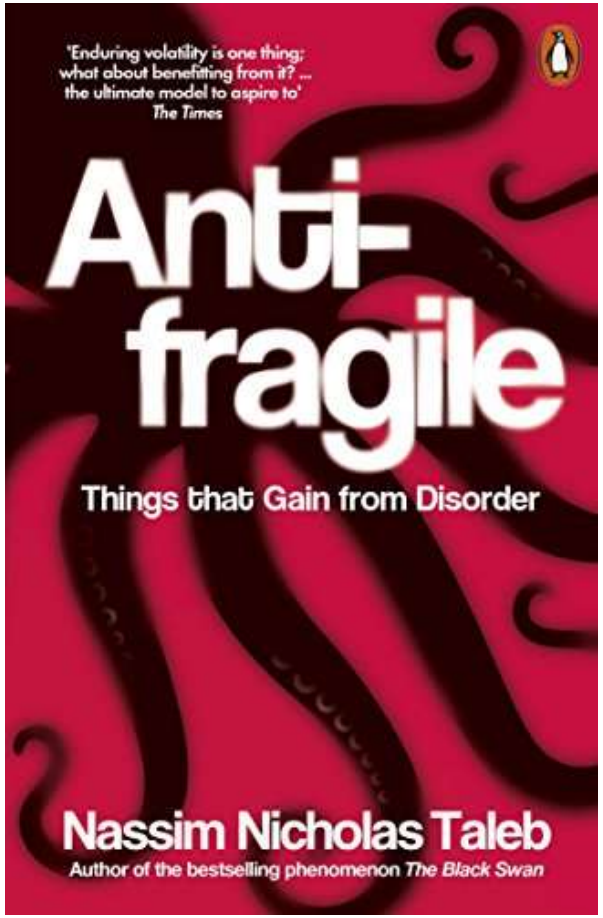
"…we know what is wrong with more clarity than what is right, and that knowledge grows by subtraction

… easier to know that something is wrong than to find the fix …

Actions that remove are more robust than those that add because addition may have unseen, complicated feedback loops"



Falsification of the available options based on:

- Feasibility (compatibility with external constraints),
- Viability (compatibility with internal constraints), and
- Desirability (compatibility with normative values adopted in the given society)

nature

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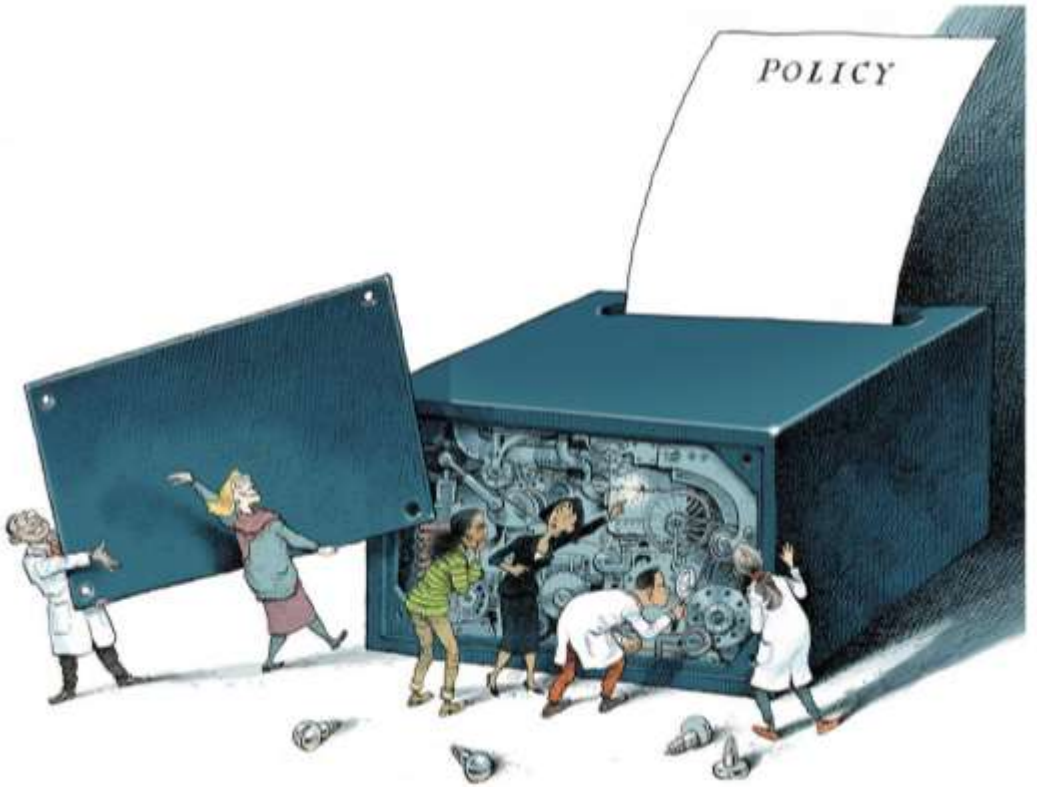
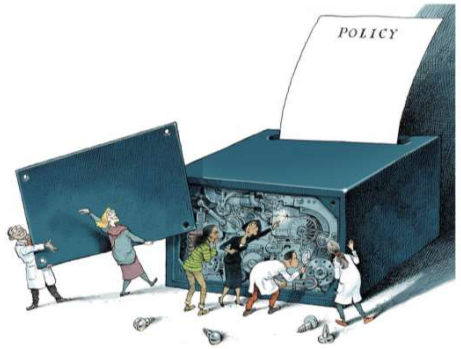
nature › comment › article

COMMENT | 24 June 2020

Five ways to ensure that models serve society: a manifesto



➔ Responsible modelling; reciprocal domestication between models and society



“Modellers must not be permitted to project more certainty than their models deserve;

and politicians must not be allowed to offload accountability to models of their choosing”

The End

@andreasaltelli