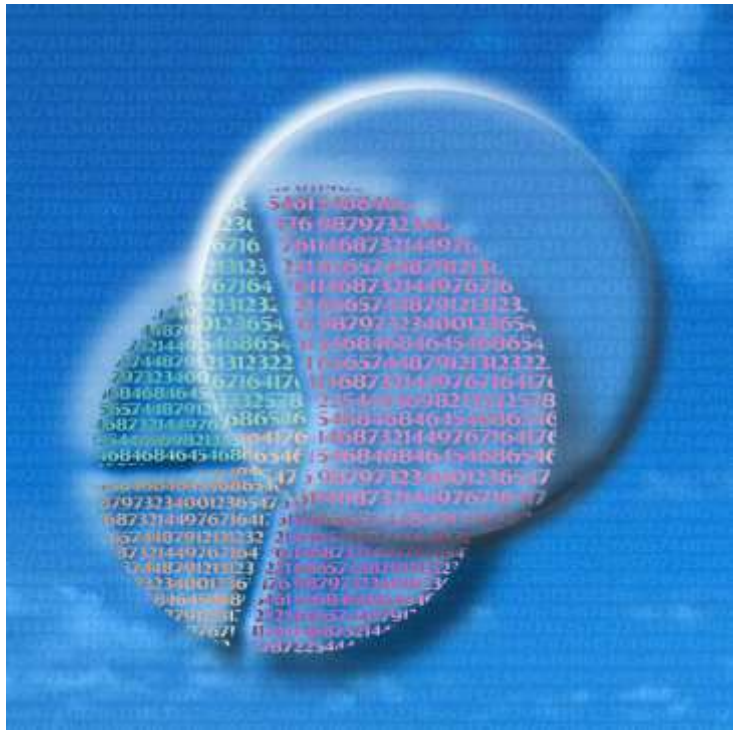


A manifesto for responsible quantification

Andrea Saltelli

A Conference on Corona, Data, Statistics and Decision Making, organized by the Samuel Neaman Institute for National Policy Research, The National Institute for Health Policy Research & Università Vita-Salute San Raffaele,

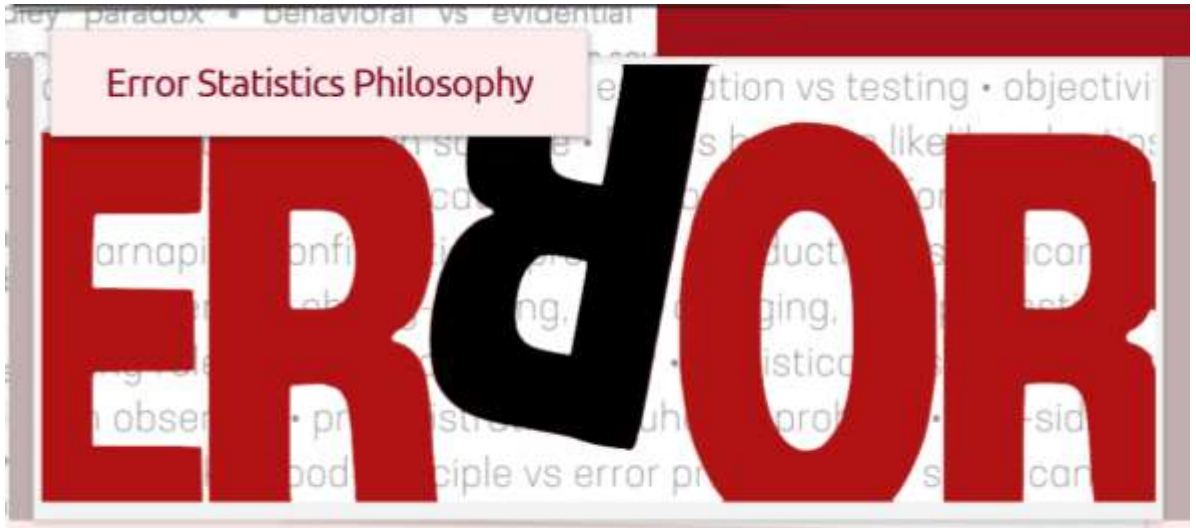
Virtual, May 12, 2022

Are models a way of producing numbers that is poorly explored (*). But for how long?

(*) With respect e.g. to statistics, big data and algorithms … there are statistical wars, not modelling wars

Andrea Saltelli, 2019, A short comment on statistical versus mathematical modelling, Nature Communications, 10, Article number: 3870, https://doi.org/10.1038/s41467-019-11865-8.

Eker, S. et al. (2018) 'Practice and perspectives in the validation of resource management models', Nature Communications, 9(1), p. 5359. doi:10.1038/s41467-018-07811-9.



Statistics in the wake of the reproducibility crisis

Statistical wars on hypothesis testing don't have an equivalent in the modelling many communities

More people died of COVID-19 than were officially registered

Morgue data hint at COVID's true toll in Africa

Around 90% of deceased people tested at a Lusaka facility during coronavirus surges were positive for SARS-CoV-2 infection, suggesting flaws in the idea of an 'African paradox'.

Freda Kreier

nature

NEWS | 23 March 2022

More people died because of COVID-19 than of COVID-19

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.

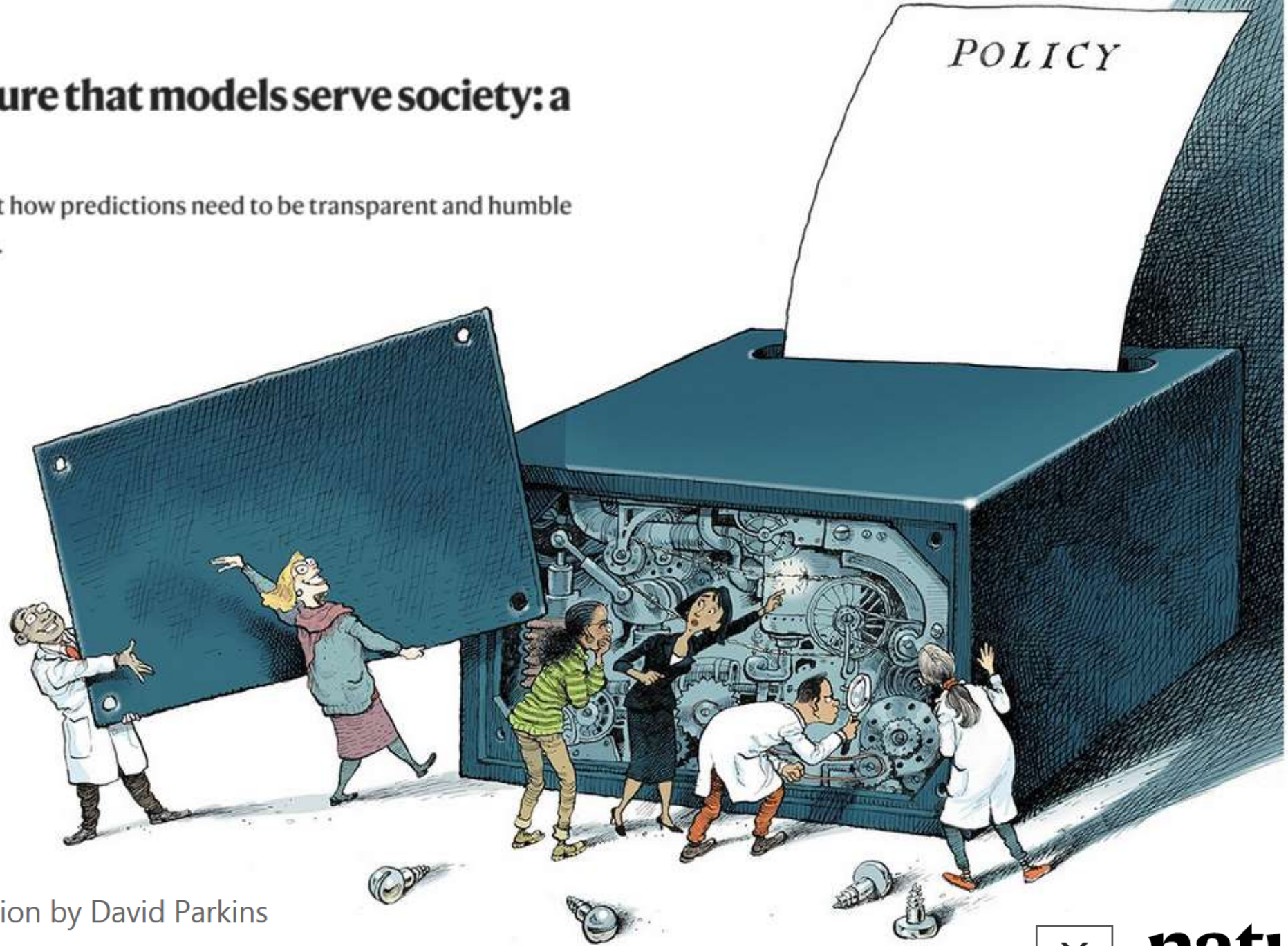


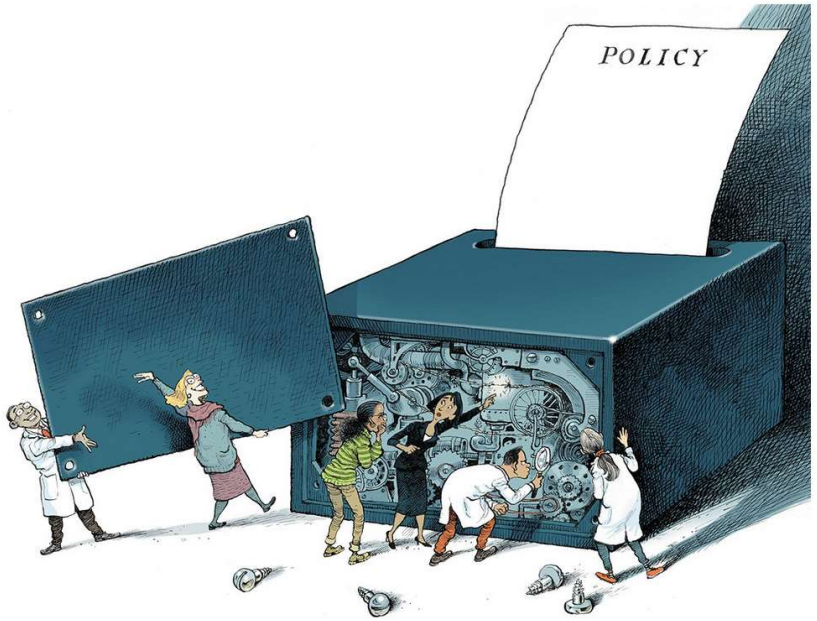
Illustration by David Parkins

nature

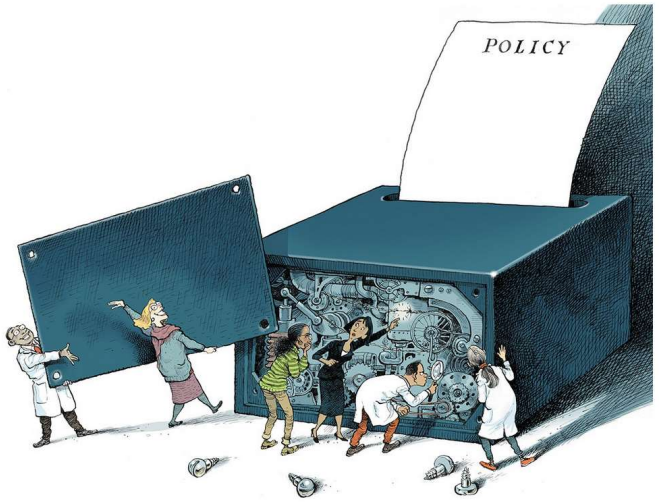
Andrea Saltelli, Gabriele Bammer, Isabelle Bruno, Erica Charters, Monica Di Fiore, Emmanuel Didier, Wendy Nelson Espeland, John Kay, Samuele Lo Piano, Deborah Mayo, Roger Pielke Jr, Tommaso Portaluri, Theodore M. Porter, Arnald Puy, Ismael Rafols, Jerome R. Ravetz, Erik Reinert, Daniel Sarewitz, Philip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

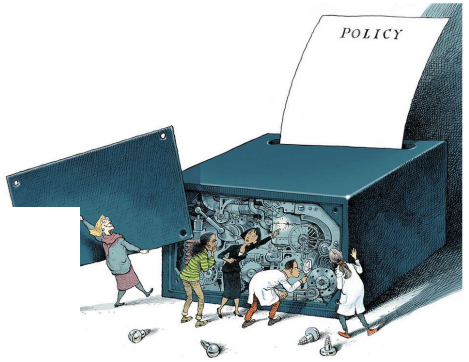


COVID has put mathematical models in the limelight



➔ Power & controversy

Power



The New York Times

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

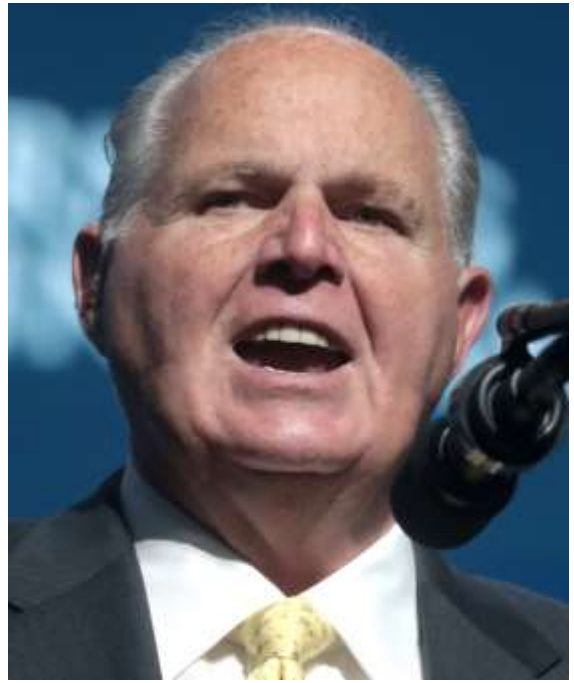
It wasn't so much the numbers themselves, frightening though they were, as who reported them: Imperial College London.

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.

Controversy, 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

Bob Seely slams Imperial College and modelling

UK, a conservative MEP

A **well documented** 15 m tirade against Imperial College's model and its track record from foot and mouse disease to COVID-19

https://www.indigoumbrella.co.uk/bob-seely-slams-imperial-college-and-modelling/

Mind the assumptions

Assess uncertainty and sensitivity

Mind the hubris

Complexity can be the enemy of relevance

Mind the framing

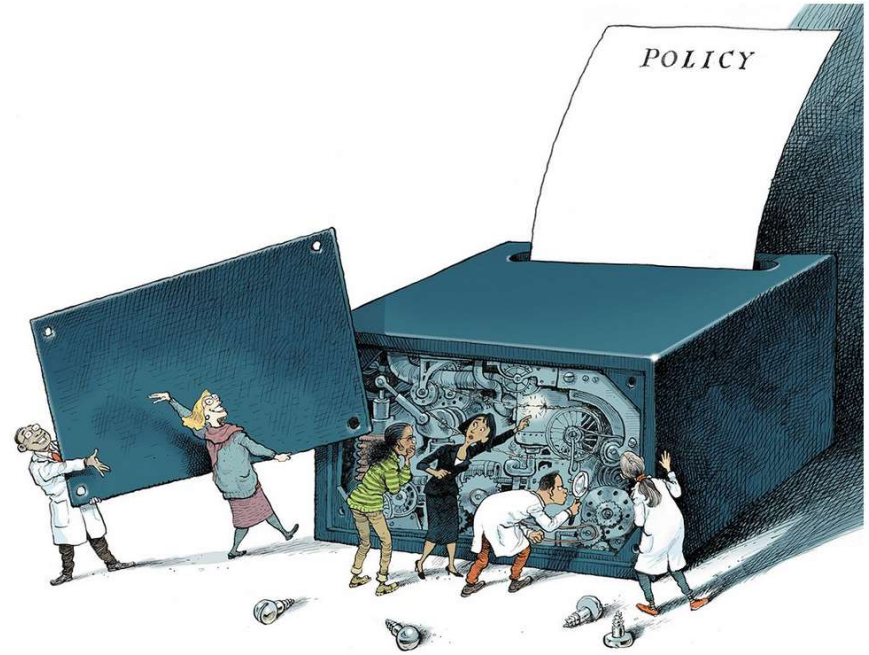
Match purpose and context

Mind the consequences

Quantification can backfire

Mind the unknowns

Acknowledge ignorance



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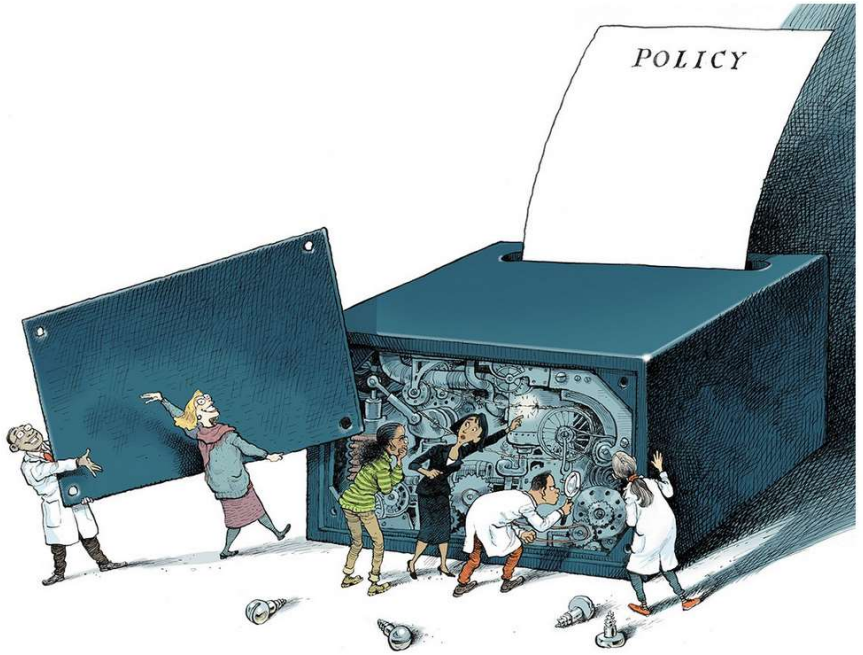


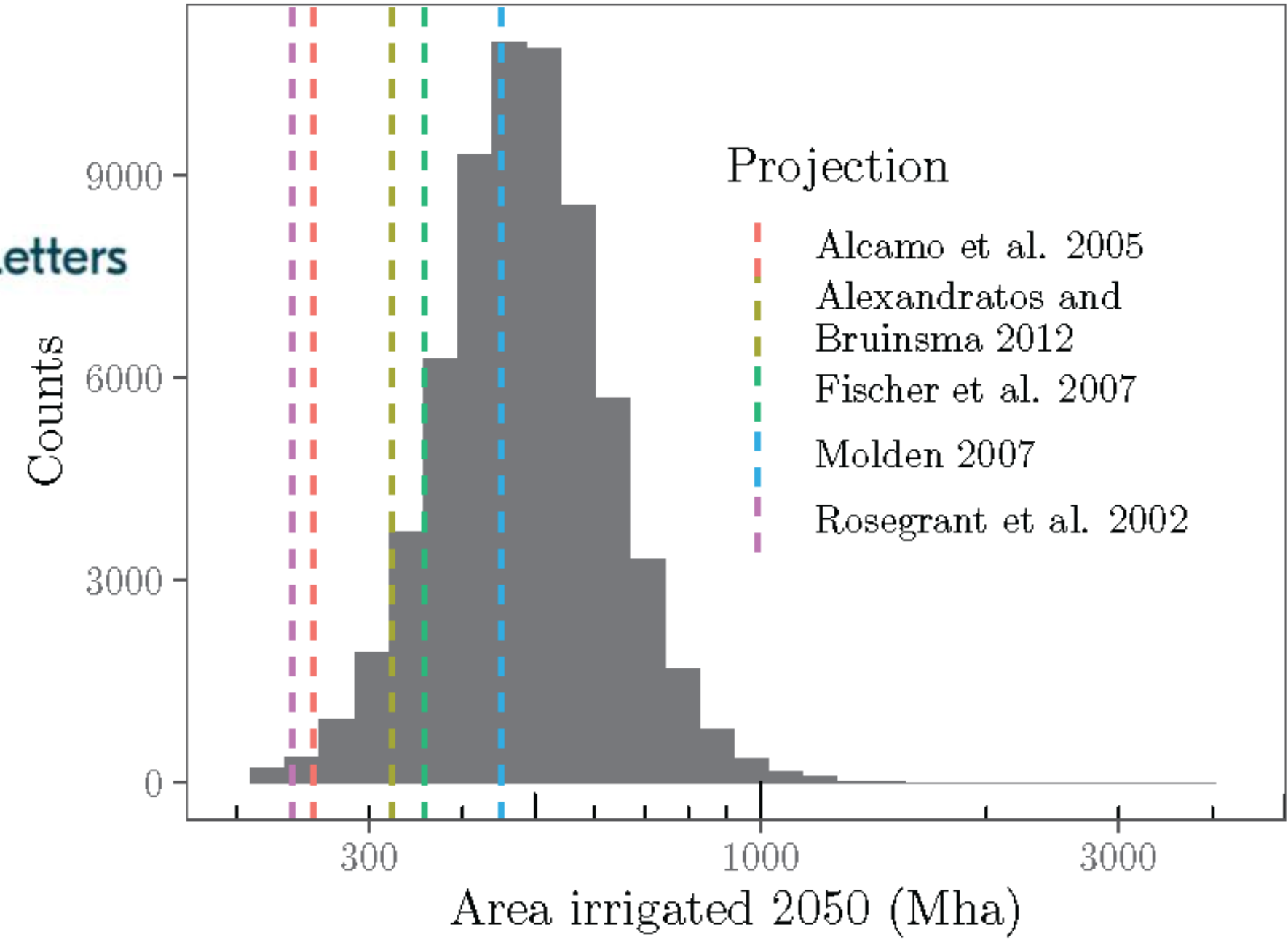
… may lead to interesting discoveries …

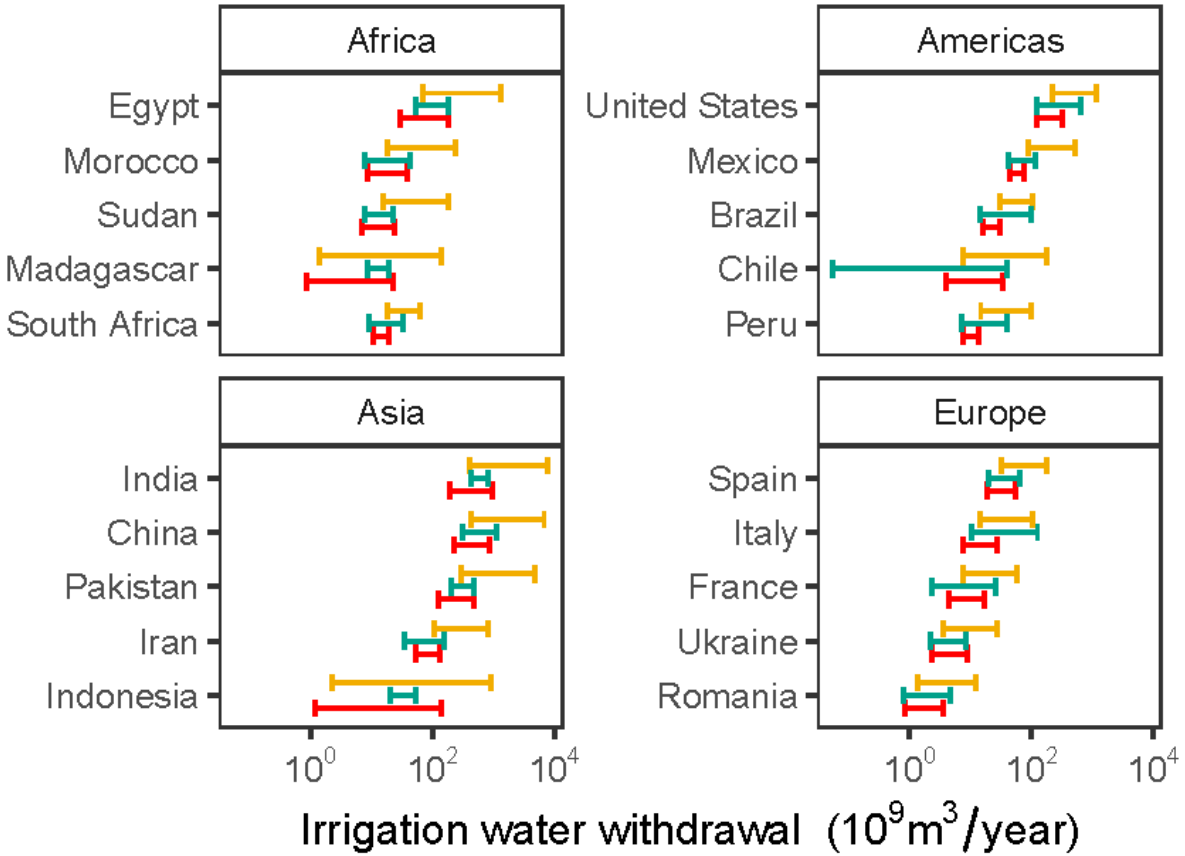
Current Models Underestimate Future Irrigated Areas

Geophysical Research Letters

A. Puy ✉, S. Lo Piano, A. Saltelli

Citation:
Puy, A., Lo Piano, S., & Saltelli, A. (2020). Current models underestimate future irrigated areas. *Geophysical Research Letters*, *47*, e2020GL087360. https://doi.org/10.1029/2020GL087360





IOP Publishing Environ. Res. Lett. 0 (2022) xxxxxx https://doi.org/10.1088/174

ENVIRONMENTAL RESEARCH
LETTERS

LETTER

OPEN ACCESS

RECEIVED
18 November 2021

Large variations in global irrigation withdrawals caused by uncertain irrigation efficiencies

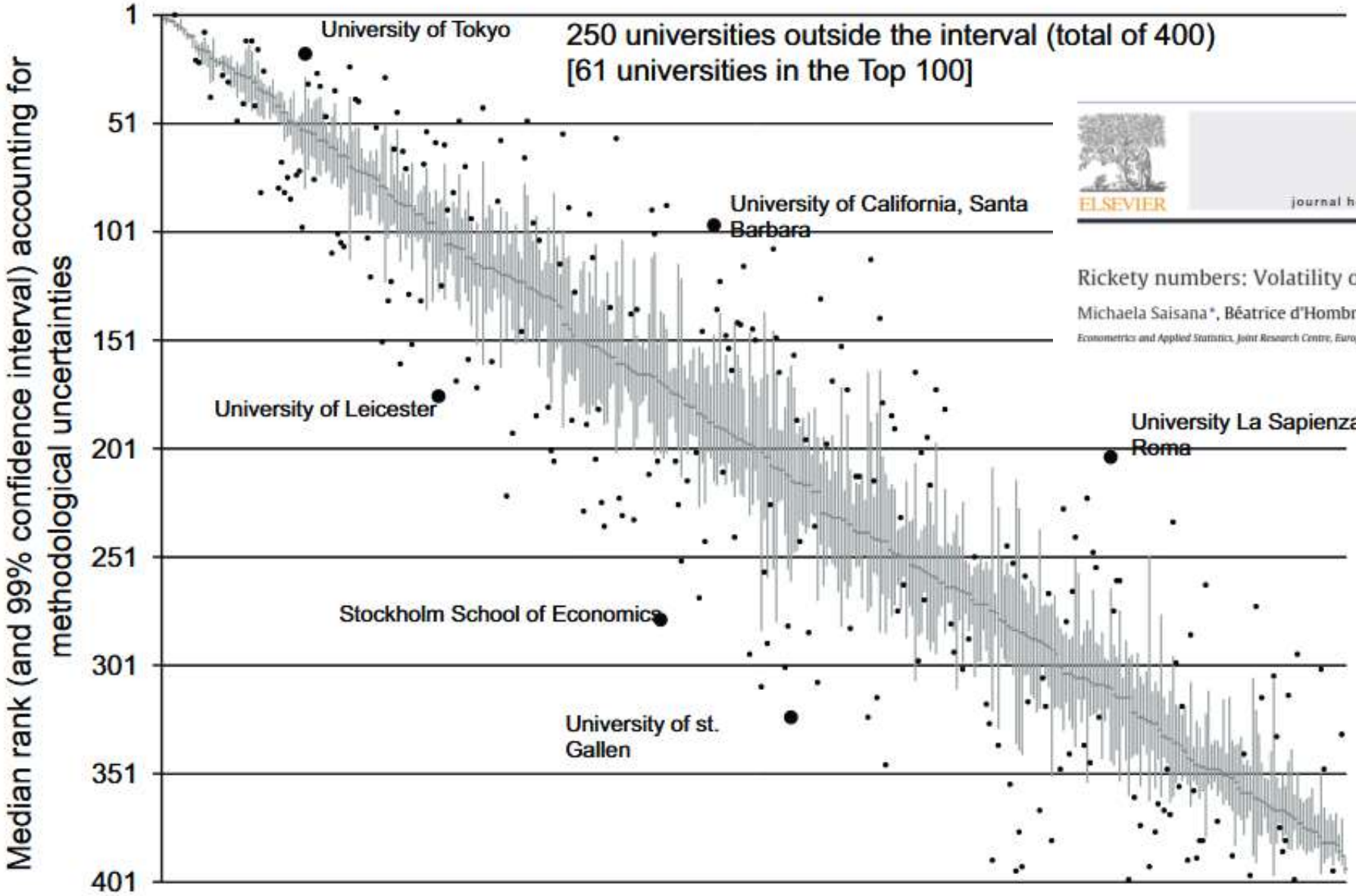
Arnald Puy, Bruce Lankford, Jonas Meier, Saskia van der Kooij and Andrea Saltelli

GMs

- GMs
- GMs + uncertainty in climate change
- GMs + uncertainty in irrigation efficiency

"a largely overlooked source of uncertainty (irrigation efficiency) impact irrigation water withdrawal more than climate change uncertainties, which are much sexier" (A. Puy)

Volatility of ranks of universities as measured by THES (2008)



Research Policy 40 (2011) 165–177

Contents lists available at ScienceDirect

Research Policy

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

Rickety numbers: Volatility of university rankings and policy implications

Michaela Saisana*, Béatrice d'Hombres, Andrea Saltelli

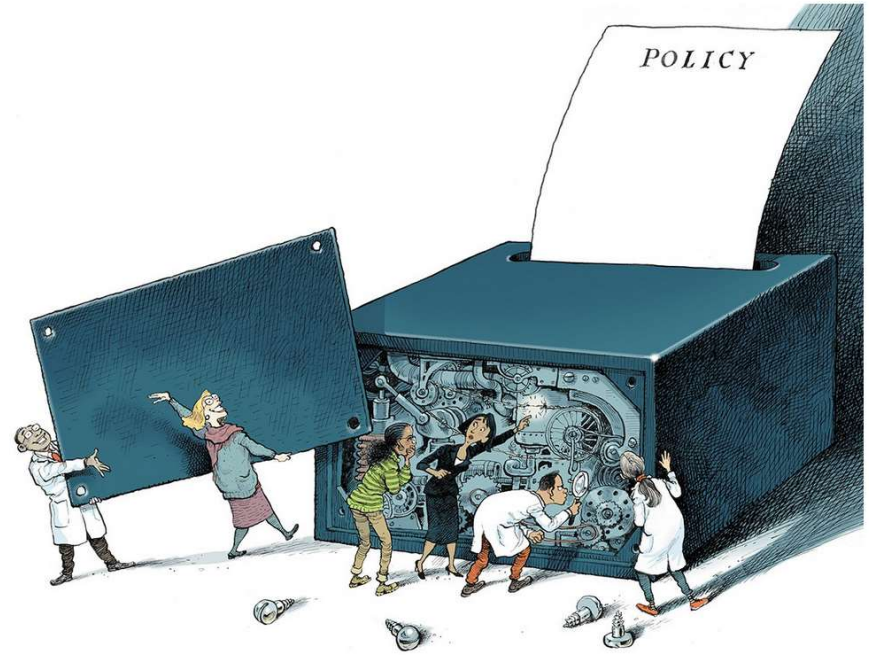
Econometrics and Applied Statistics, Joint Research Centre, European Commission, Enrico Fermi 2749, 21027 Ispra, Italy

Mind the assumptions

Assess uncertainty and sensitivity

Mind the hubris

Complexity can be the enemy of relevance



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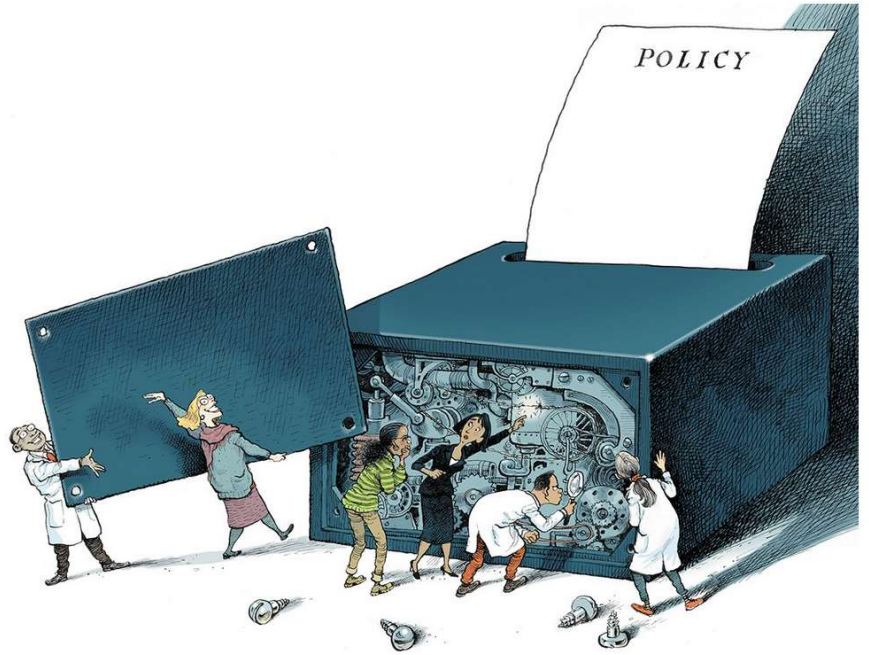
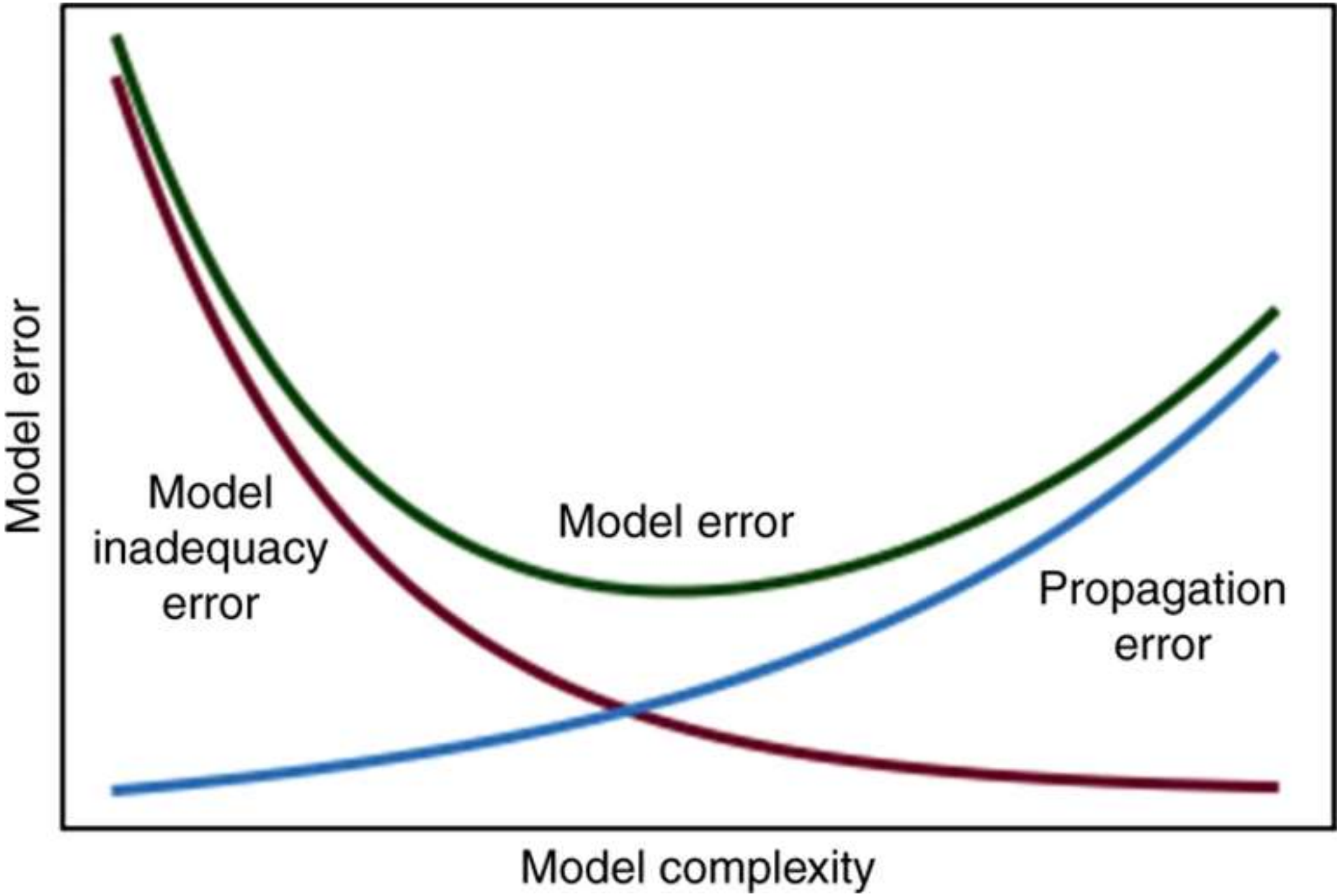
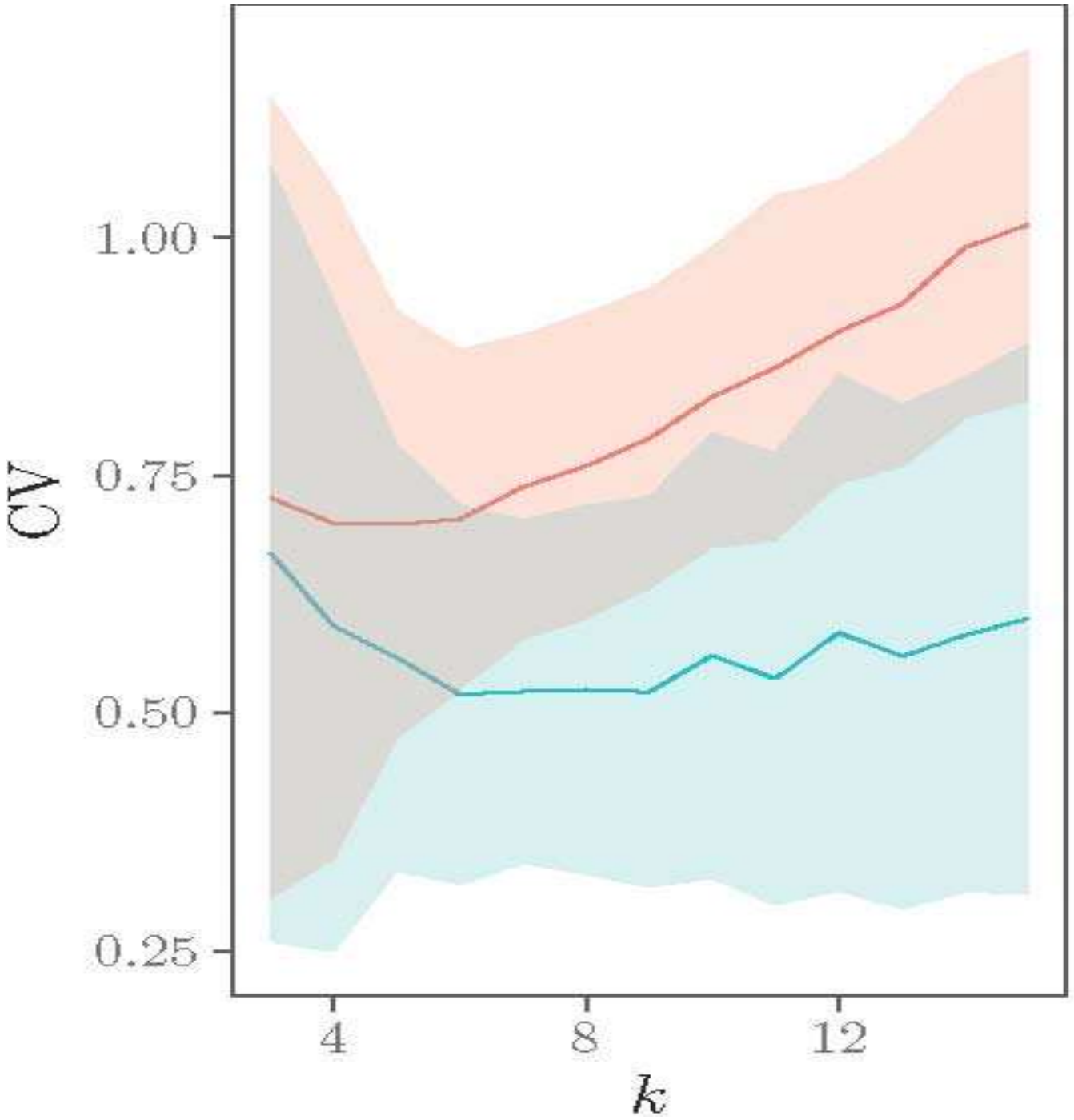


… many are seduced by the idea of adding complexity in an attempt to capture reality more accurately, but…

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**

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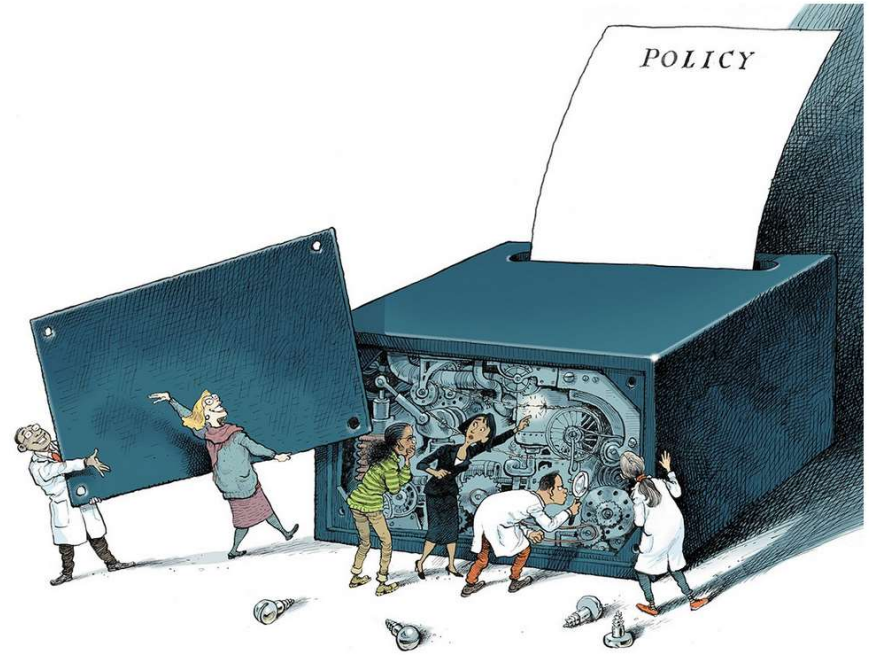

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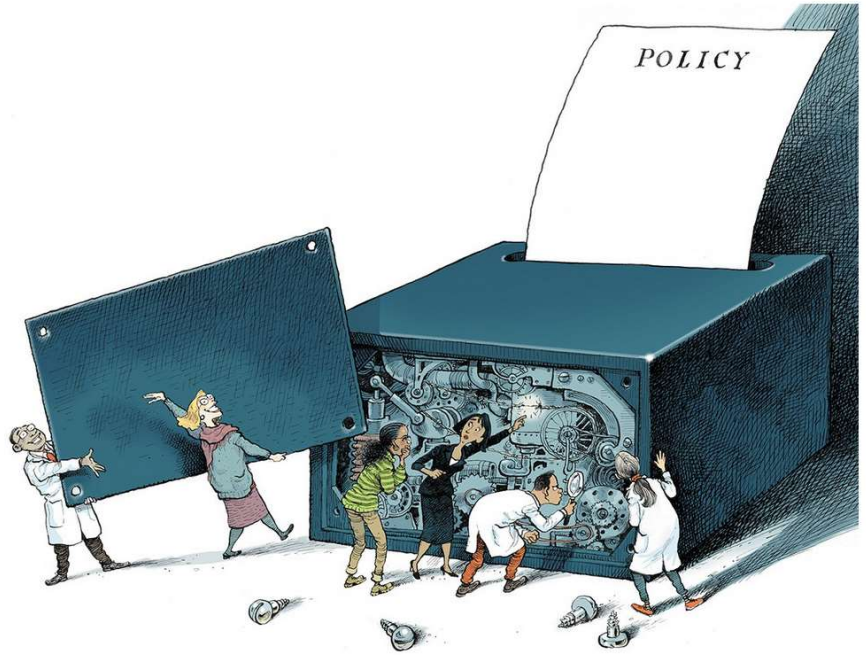


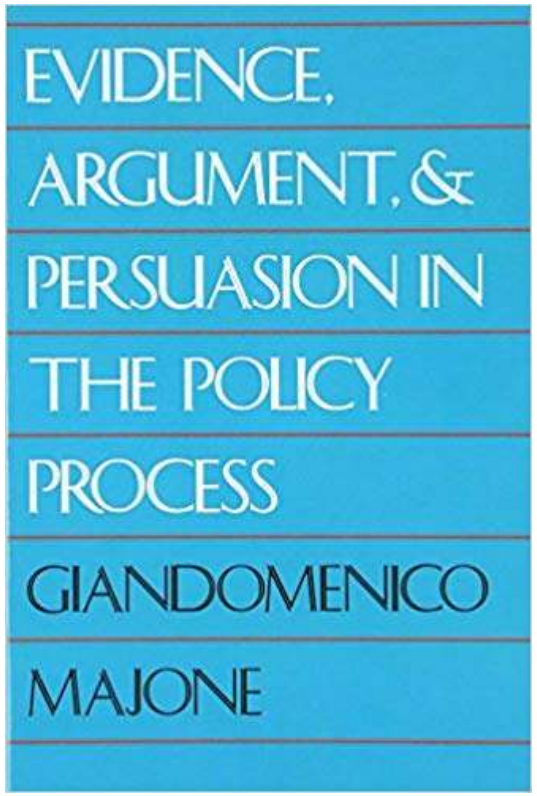
… models will reflect the interests, disciplinary orientations and biases of the developers…

SUPPLEMENTARY INFORMATION

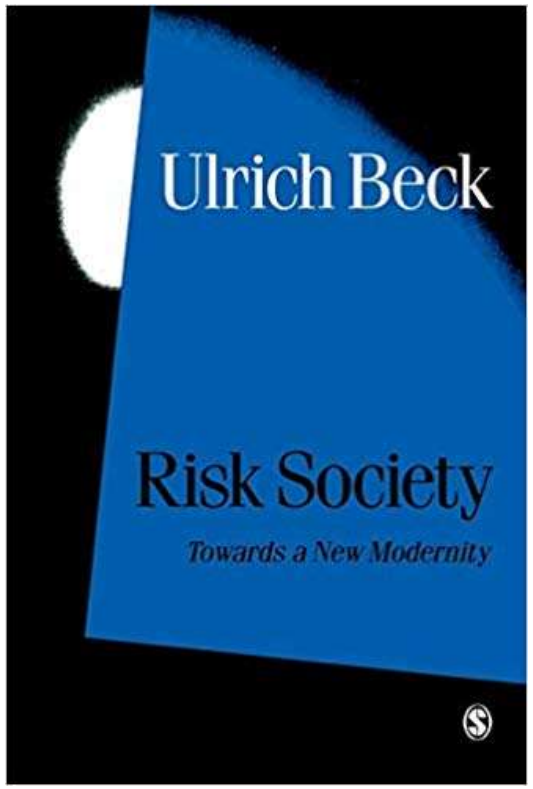
1. Additional information and references >260 references

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

Ulrich Beck
(1944 –2015)



1989



1992 (1986)

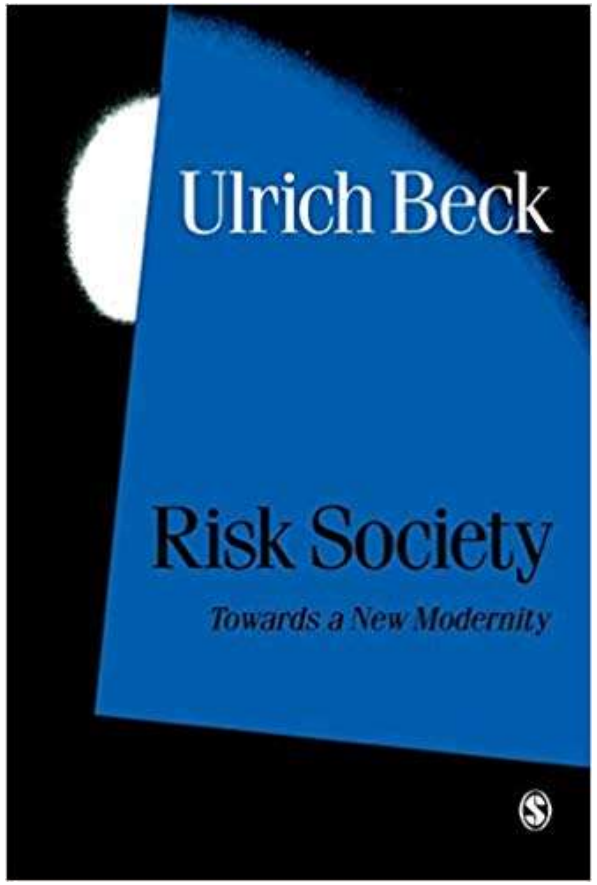
ELSEVIER

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.”



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

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

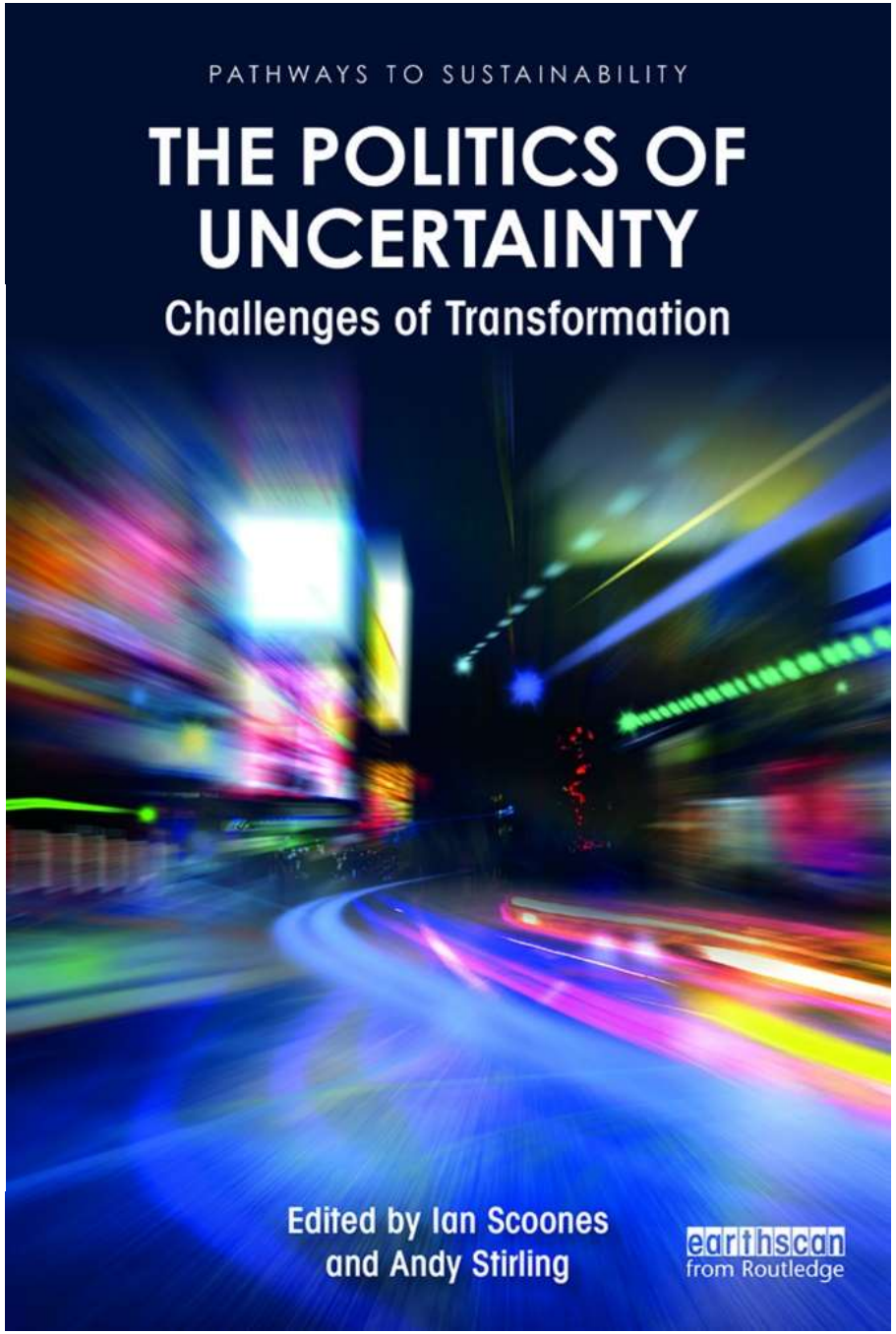
On reductionism

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".

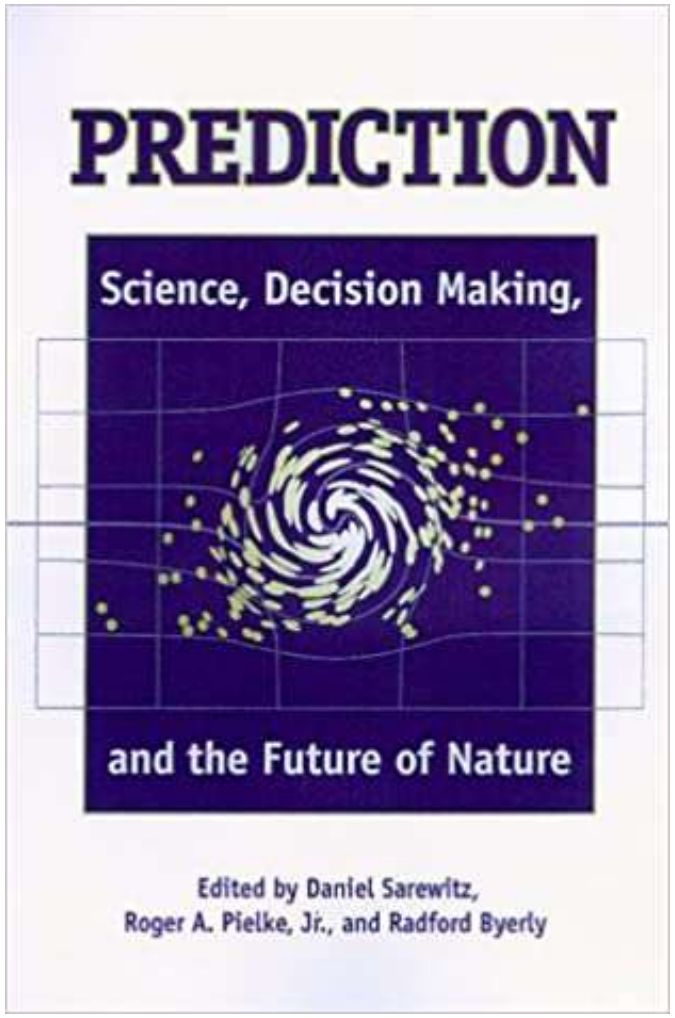
Denial, Dismissal, Diversion, Displacement

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.



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).

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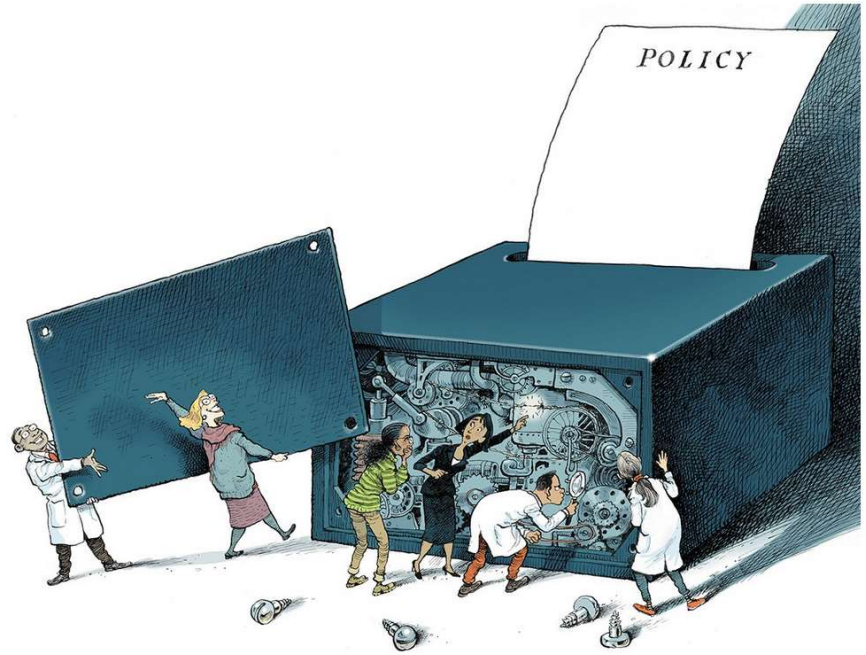

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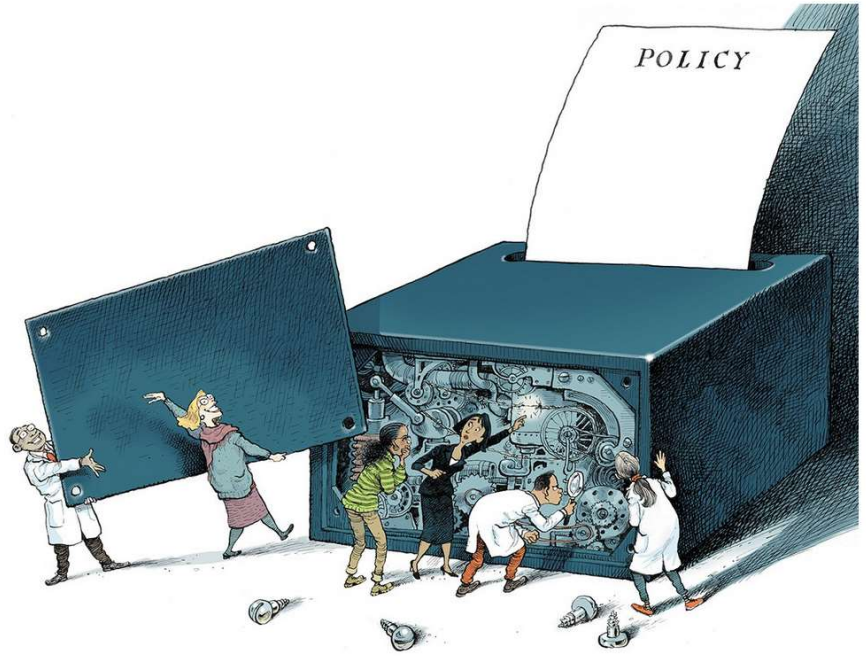
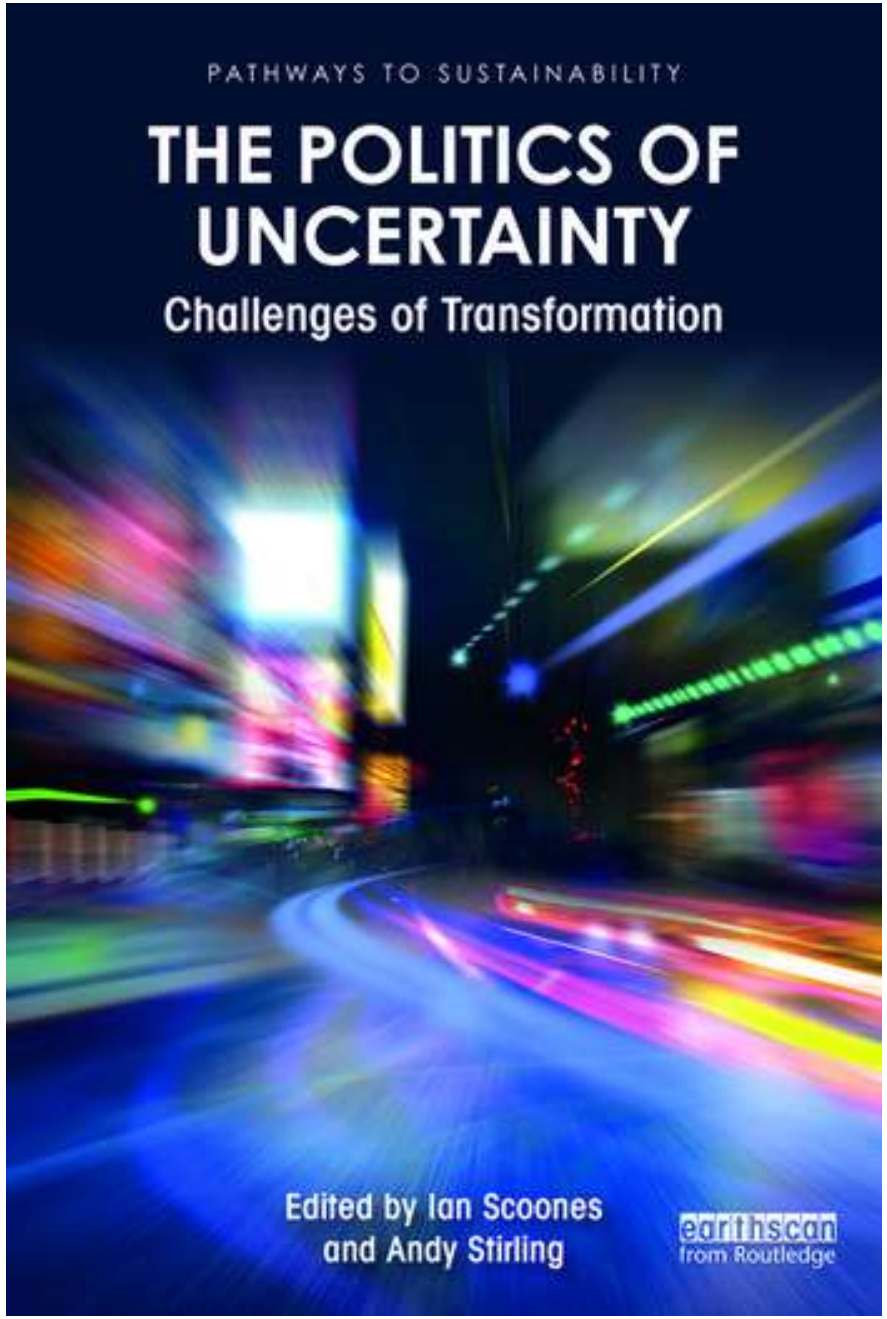


From the risk of financial products to the management of costal zones to the models for disaster insurance bad modelling may lead to wrong decisions

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

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

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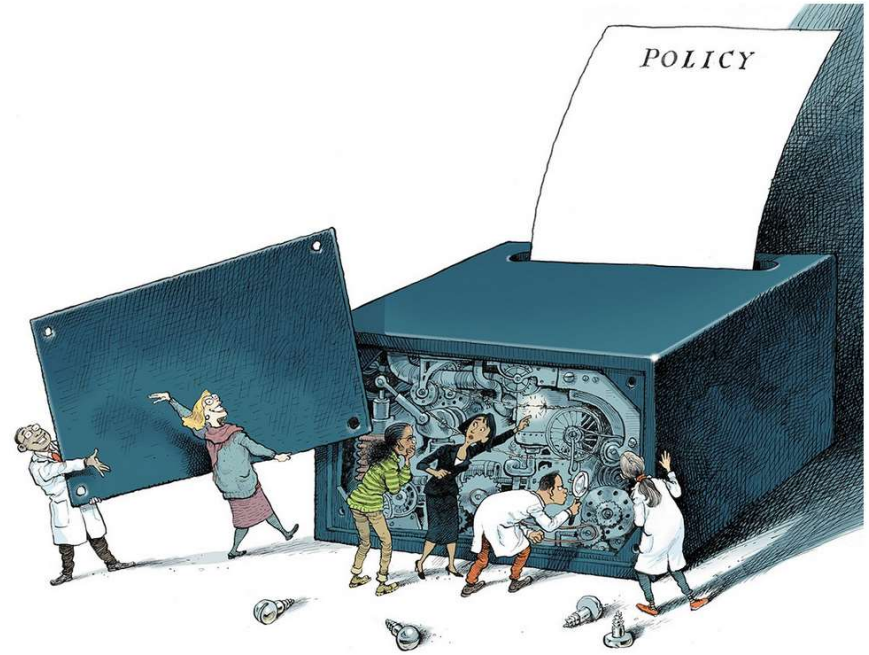

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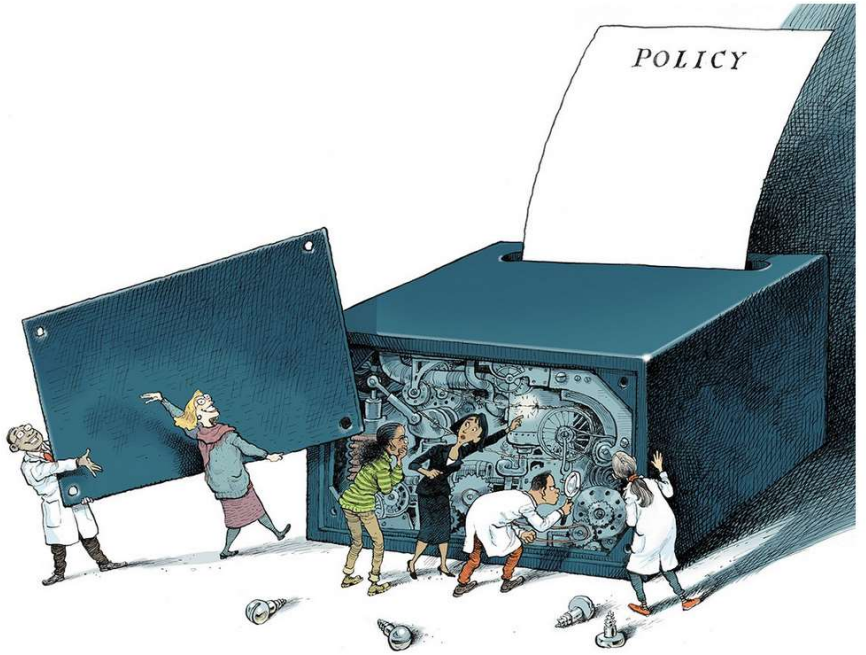


"there is no number-answer to your question"

Anthony Fauci

SUPPLEMENTARY INFORMATION

1. Additional information and references

>260 references

Are policies predicated on the use of fantastic numbers?

OPINION

PETER COY

‘The Most Important Number You’ve Never Heard Of’

Sept. 17, 2021

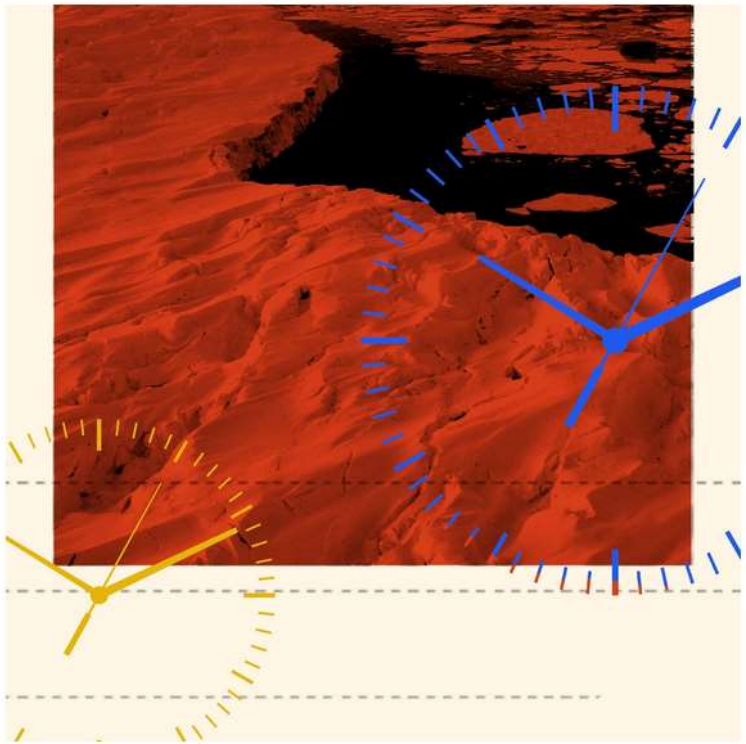


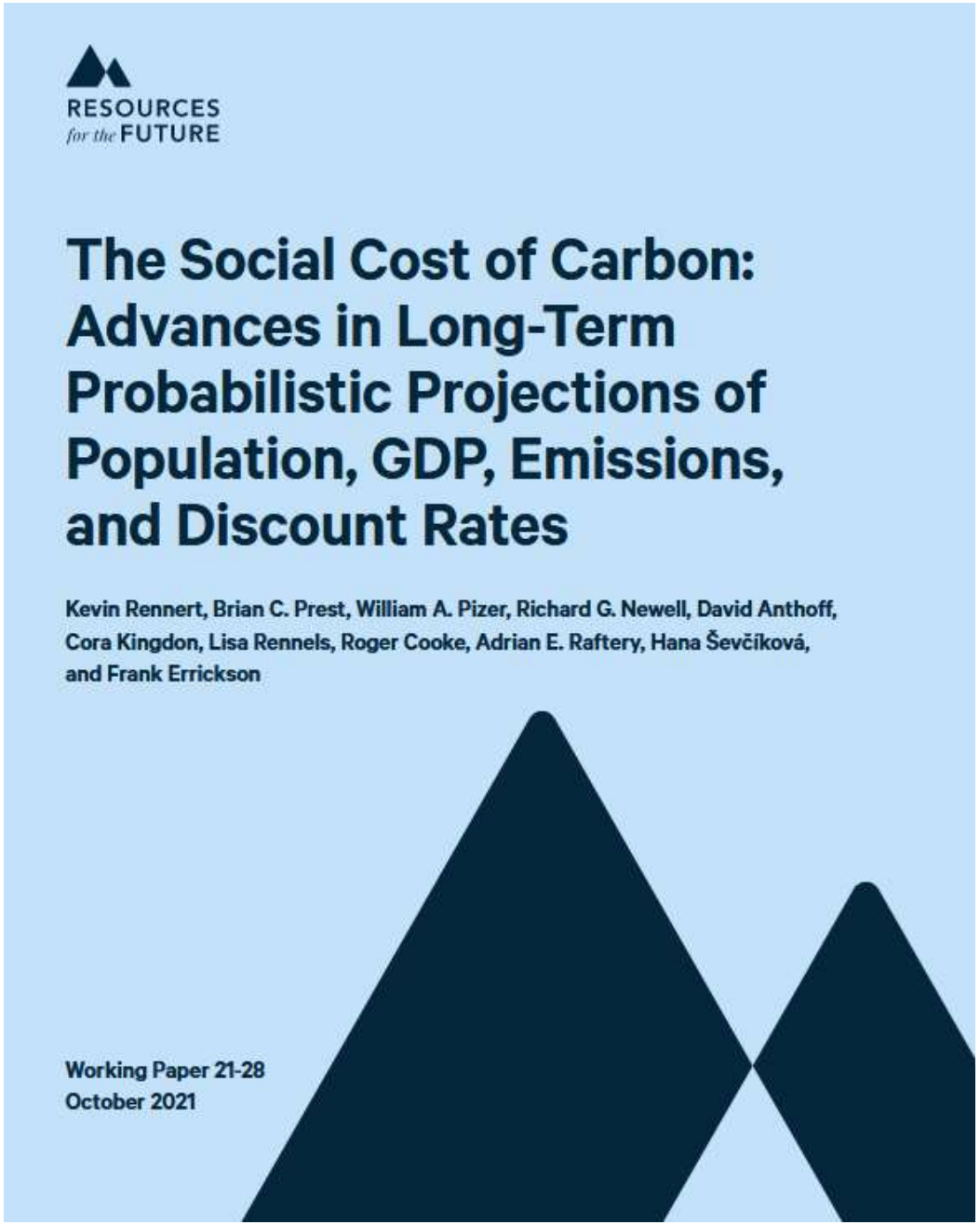
Illustration by Arsh Raziuddin, The New York Times

“social cost of carbon:

=$56 a ton on average at a 3 percent discount rate

=$171 a ton on average at a 2 percent discount rate”

The New York Times



Averaged till year 2300

Feeds into policy design

We have perhaps reached a complex epistemic state, where on the one hand ‘everybody knows’ that some numbers are pseudo-precise and that numbers can be gamed, while the game works only because most people don’t know about it

Jerome R. Ravetz

Should one have more eyes looking at the production of numbers? Creating new observatories?

Source: Tor Freeman, http://tormalore.blogspot.com/

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

[Ethics of quantification, Video curated by the Open University of Catalonia, September 2021.]

http://materials.cv.uoc.edu/cdocent/PID_00284929/

The End

@andreasaltelli