

# Ethics of quantification

Andrea Saltelli

MNF990 PhD course on  
Theory of Science and Ethics  
February 9, 2022





www.andreasaltelli.eu

HOME

ABOUT ME

PUBLICATIONS

NEWS & VIDEOS

RESOURCES



### Tweets by @AndreaSaltelli



**andrea saltelli**  
@AndreaSaltelli

Impressive asymmetry of power in the ongoing battle on social and environmental sustainability... 🤔🤔 <https://twitter.com/marpinoir/status/1409405623725400065>



Jun 28, 2021



**andrea saltelli**  
@AndreaSaltelli

Replying to @AndreaSaltelli

Should we come to term with the fact that the internet - at the end of the day - proved to be an instrument of oppression and domination rather than one of freedom and emancipation? 🤔



Jun 27, 2021

[Embed](#)

[View on Twitter](#)

Do we live immersed in  
fantastic numbers?

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

Sept. 17, 2021

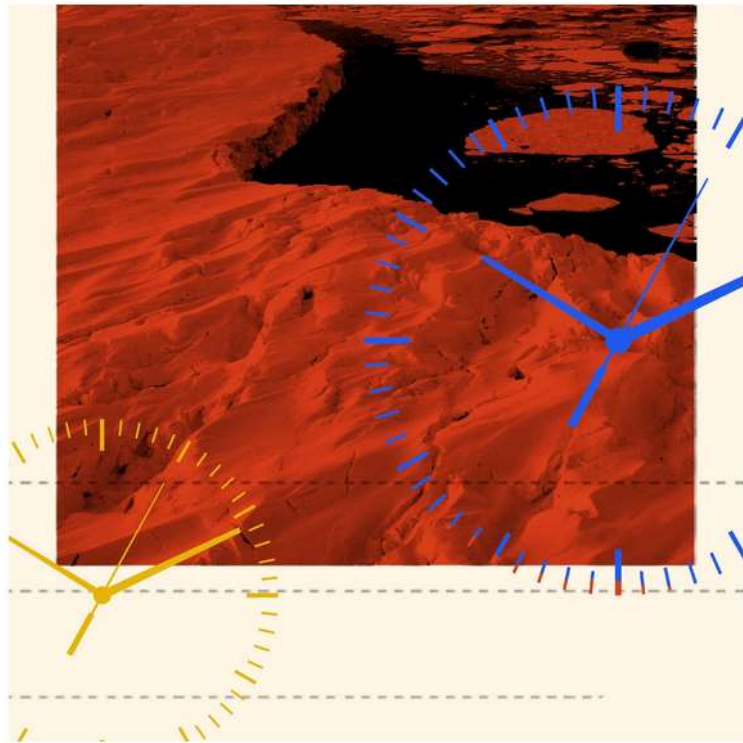


Illustration by Arsh Raziuddin, The New York Times

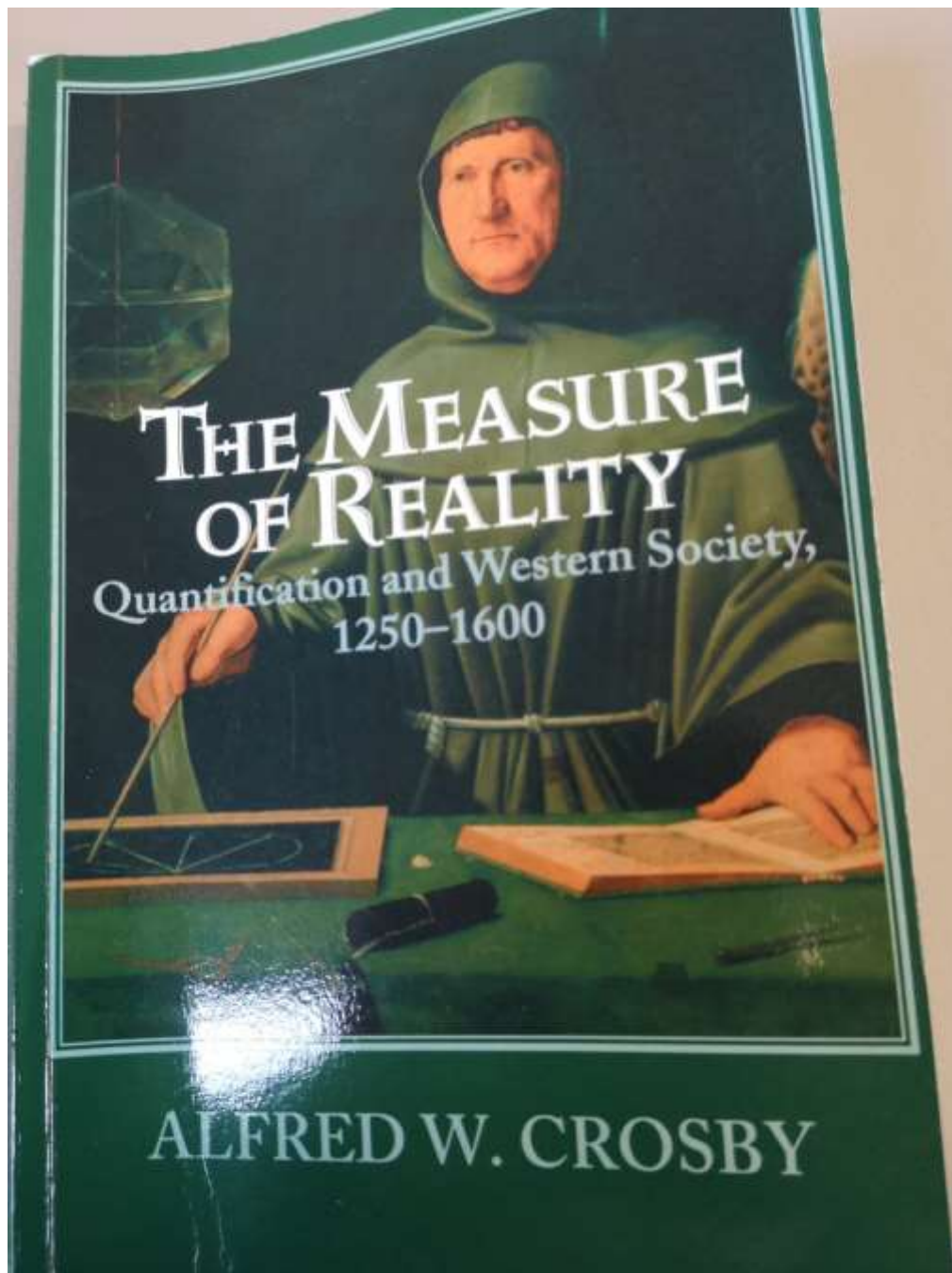
“social cost of carbon:

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

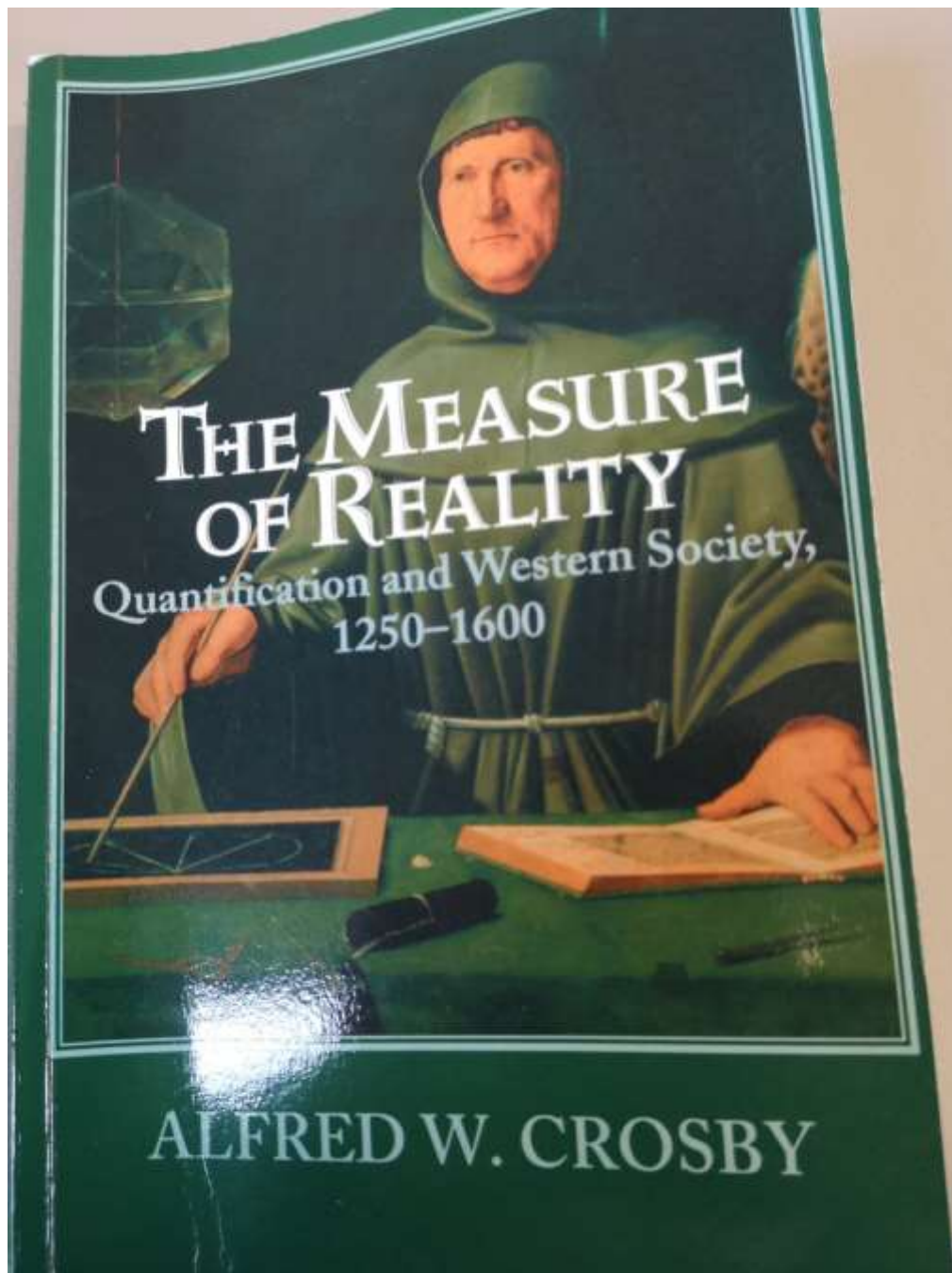
= \$171 a ton on average at a 2 percent discount rate”

**The New York Times**

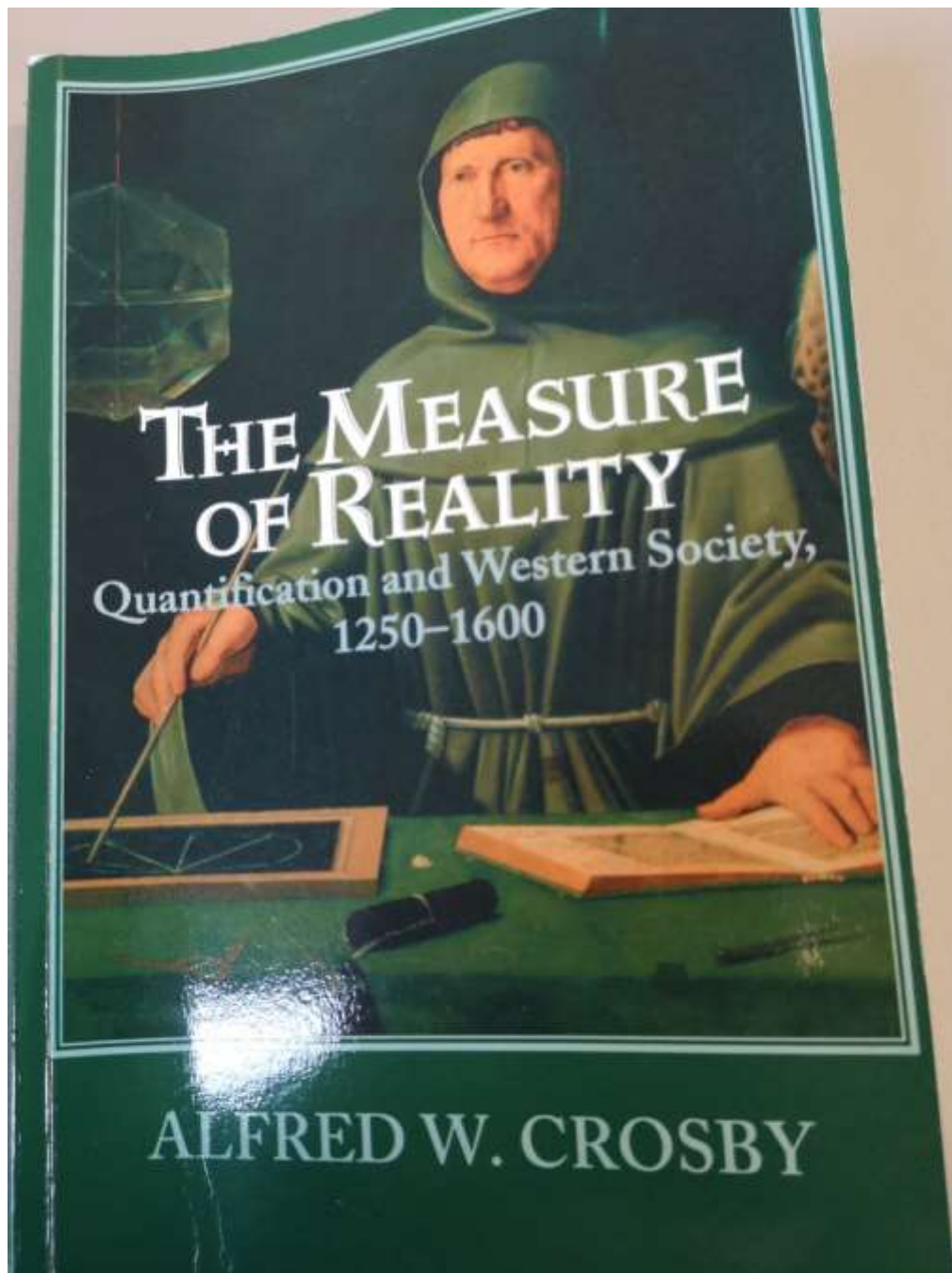
How did we get there?



Were quantification and visualization the engine inside the engine of western success and domination?



Quantification and visualization of space and time gave rise in the XIV century to a true revolution, in music, painting, accounting, cartography, astronomy ...



... a revolution that in the following two centuries XV–XVI ensured the epochal success of the West and its domination over the rest of the world

# Pieter Bruegel the Elder, Temperance, 1560

Measuring, military  
technology (math),  
dispute on a printed  
bible, learning,  
accounting,  
perspective,  
polyphonic music, the  
windmill, the watch ...

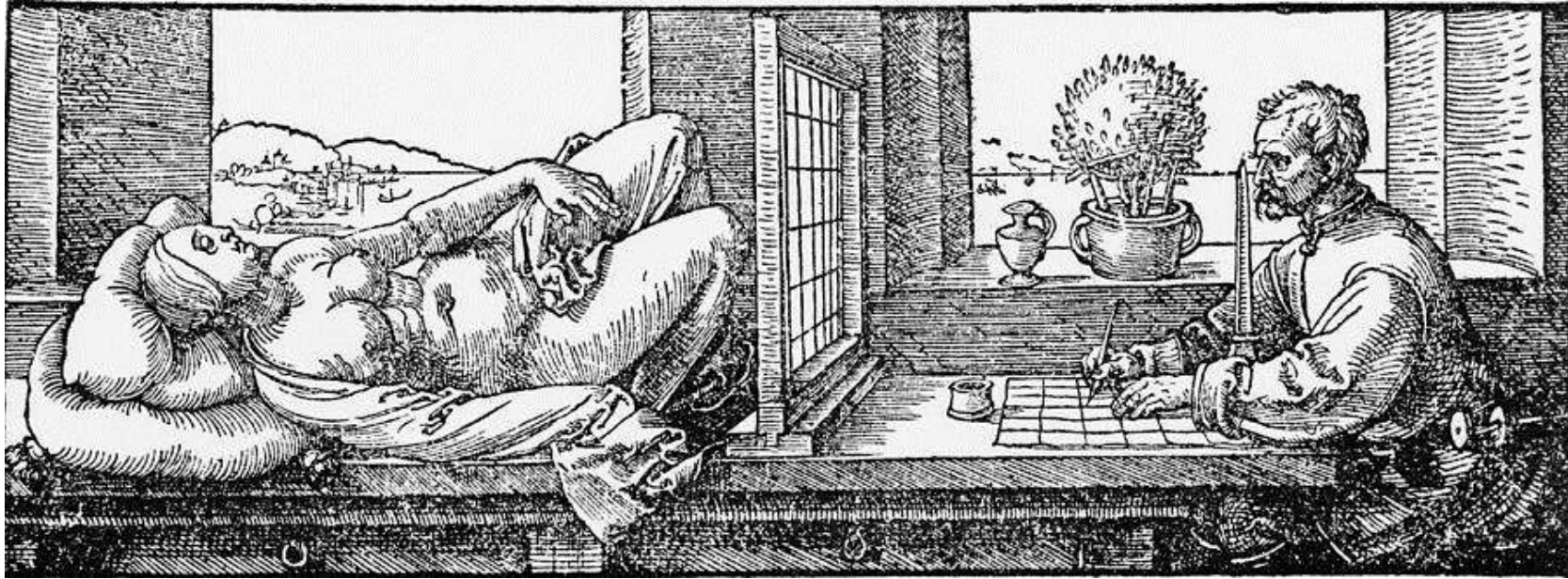




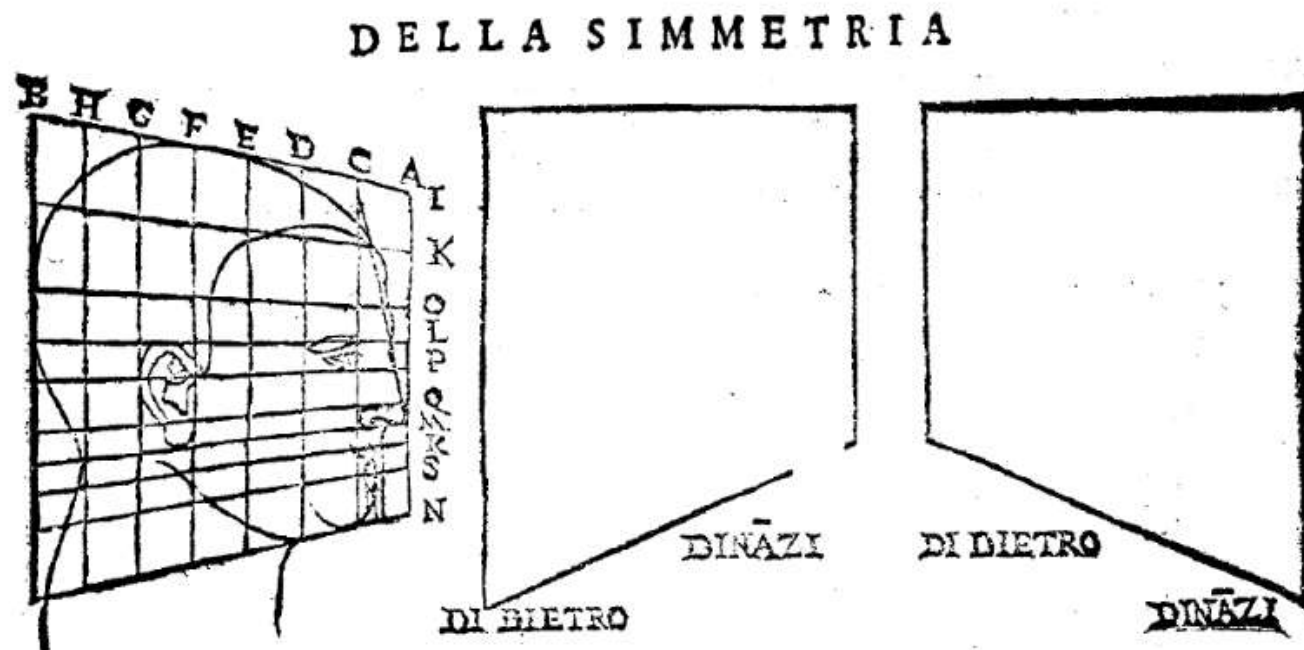
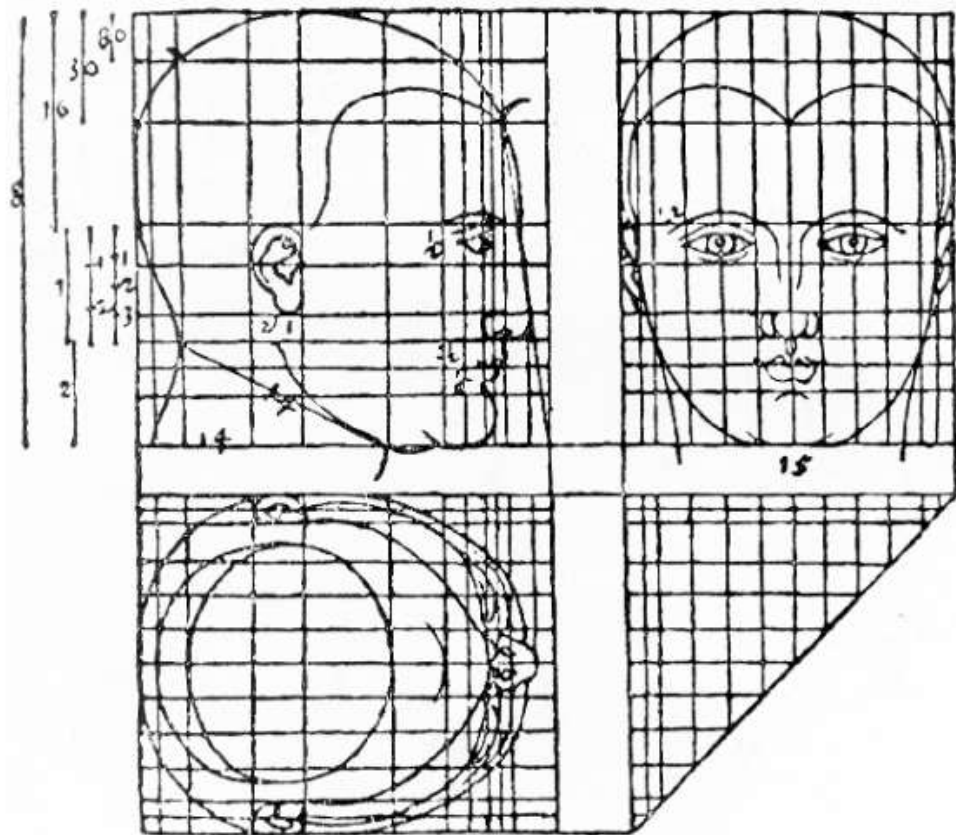
From the abacus  
to Arabic  
numerals



The Annunciation,  
Carlo Crivelli  
(1435, 1495)



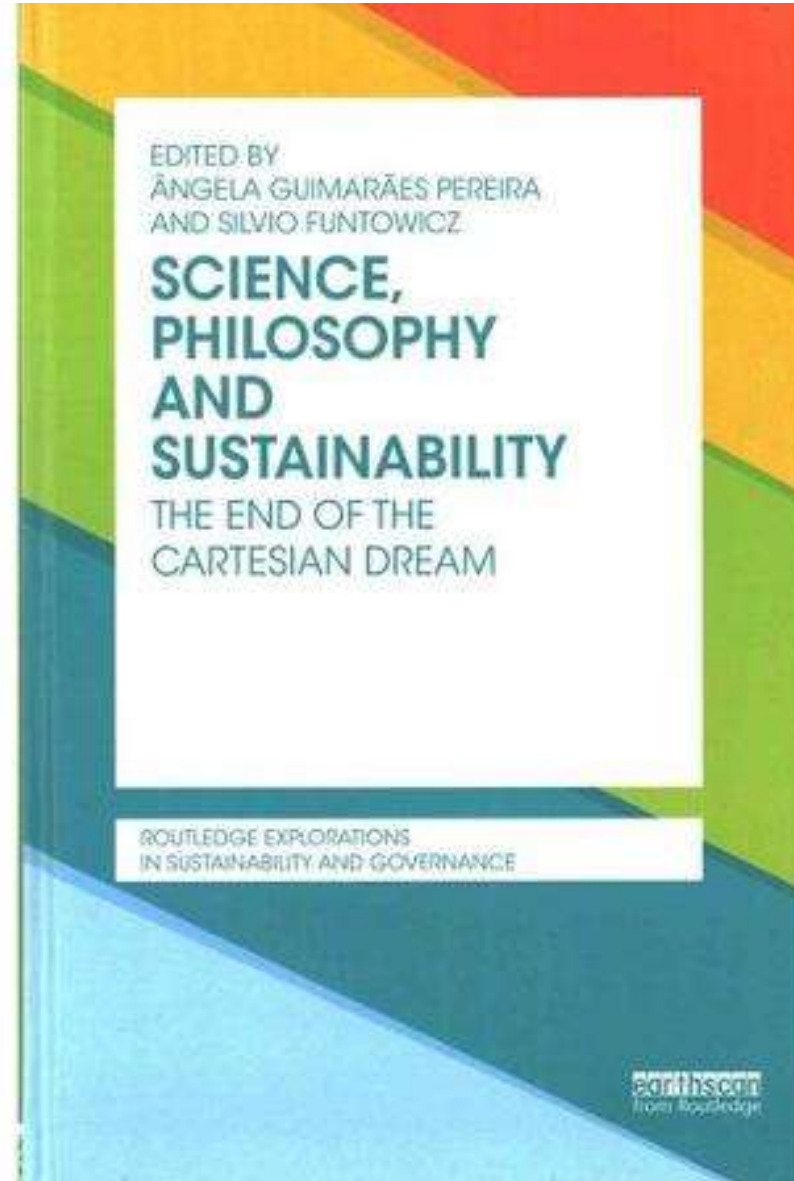
Draftsman Drawing a Reclining Nude  
Albrecht Dürer (1471–1528)



From “De Varietate figurarum”  
Albrecht Dürer (1471–1528)

# Quantification as a key element of the Cartesian Dream

Guimarães Pereira, Â, and Funtowicz, S, Eds, 2015, The end of the Cartesian dream, Routledge.



# Quantifications and the roots of the Cartesian dream

# Separate but related stories

Cartesian dream:  
possess and domination  
of nature



The 'procedural utopia':  
grounding social harmony and  
progress in calculations





Francis Bacon  
(1561–1626)

We call Cartesian dream the idea of man as master and possessor of nature, of prediction and control, of Bacon's wonders of science and of Condorcet's mathématique sociale...



René Descartes  
(1596–1650)



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



Francis Bacon  
(1561–1626)

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

The prolongation of life; The restitution of youth in some degree; The retardation of age; The curing of diseases counted incurable; The mitigation of pain; More easy and less loathsome purgings; The increasing of strength and activity; The increasing of ability to suffer torture or pain; The altering of complexions, and fatness and leanness; The altering of statures; The altering of features; The increasing and exalting of the intellectual parts; Versions of bodies into other bodies; Making of new species; Transplanting of one species into another; Instruments of destruction, as of war and poison; Exhilaration of the spirits, and putting them in good disposition; Force of the imagination, either upon another body, or upon the body itself; Acceleration of time in maturations; Acceleration of time in clarifications; Acceleration of putrefaction; Acceleration of decoction; Acceleration of germination; Making rich composts for the earth; Impressions of the air, and raising of tempests; Great alteration; as in induration, emollition, &c; Turning crude and watery substances into oily and unctuous substances; Drawing of new foods out of substances not now in use; Making new threads for apparel ; and new stuffs, such as paper, glass, &c; Natural divinations; Deceptions of the senses; Greater pleasures of the senses; Artificial minerals and cements.



Francis Bacon  
(1561–1626)

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

The prolongation of life; The restitution  
of youth in some degree; The retardation  
of age; The curing of diseases counted  
incurable; The mitigation of pain; More  
easy and less loathsome purgings;  
...

Natural divinations; Deceptions of the  
senses; Greater pleasures of the senses;  
Artificial minerals and cements.



Francis Bacon  
(1561–1626)

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

The prolongation of life; The restitution of youth in some degree; The retardation of age; The curing of diseases counted incurable; The mitigation of pain; More easy and less loathsome surgeries; The increasing of strength and activity; The increasing of ability to suffer torture or pain; The altering of complexions, and fashions of dresses; The altering of statures; The altering of features; The exalting of the intellectual parts; Versions of species; Transplantation of members; Making of new instruments of husbandry, and putting them to new uses; The hastening of maturation; The retarding of putrefaction; The hastening of germination; Making rich soils; Alterations of the air, and raising of tempests; Great alteration of humors, emollition, &c; Turning crude and watery substances into soft and unctuous substances; Drawing of new foods out of substances not now in use; Making new threads for apparel; and new stuffs, such as paper, glass, &c; Natural divinations; Deceptions of the senses; Greater pleasures of the senses; Artificial minerals and cements.

**MISSION:  
ACCOMPLISHED**

The study of letters leading to “doubts and errors”;

Comparing “disquisitions of the ancient moralists to very towering and magnificent palaces with no better foundation than sand and mud”;

Condemnation of humanities and exaltation of mathematics.



René  
Descartes  
(1596–1650)

Discourse on  
Method (1637)

“I perceived it to be possible to arrive  
at knowledge highly useful in life; and  
in room of the Speculative Philosophy  
[...]



René  
Descartes  
(1596–1650)

Discourse on  
Method (1637)

“to discover a Practical, by means of which, knowing the force and action of fire, water, air, the stars, the heavens, and all the other bodies that surround us, [...]we might also apply them [...]

and thus render ourselves the lords and possessors of nature.”



René  
Descartes  
(1596–1650)

Discourse on  
Method (1637)

In the formulation of Condorcet: “All the errors in politics and in morals are founded upon philosophical mistakes, which, themselves, are connected with physical errors” (Ninth Epoch)



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

‘Sketch for a Historical Picture of  
the Progress of the Human Spirit’

Overpopulation? War due to scarcity of resources? Will not happen because technical progress and ethical progress will go hand in hand. Man will understand that his duty “will consist not in the question of giving existence to a greater number of beings, but happiness.” (Tenth Epoch)



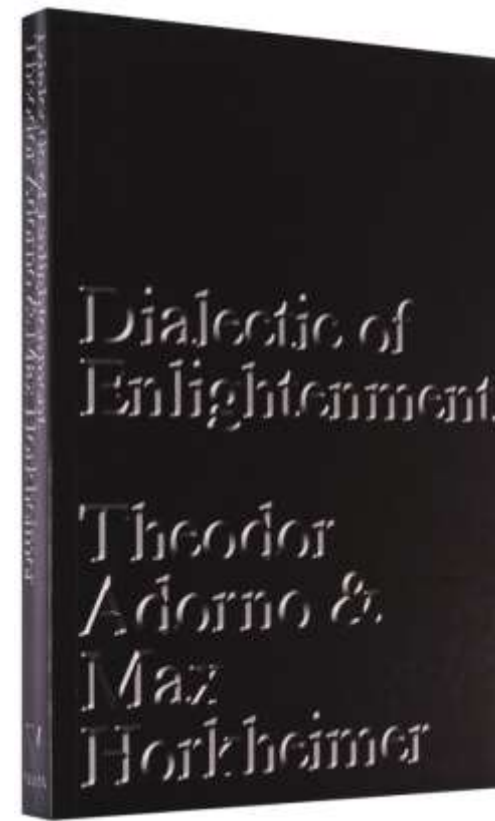
Nicolas de Caritat, marquis de Condorcet  
(1743– 1794)

‘Sketch for a Historical Picture of the  
Progress of the Human Spirit’

“Technical progress  
and ethical progress  
will go hand in hand”



Marquis de Condorcet



= progressive view of  
enlightenment attacked by  
the Frankfurt school

‘Mathématique sociale’: We still use today terms such as ‘Condorcet method’, ‘Condorcet winner’, ‘Condorcet–ranking procedure’



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

Feldman, J., 2005, Condorcet et la mathématique sociale: enthousiasmes et bemols, Mathematics and Social Sciences, 172(4), 7–41, <http://www.ehess.fr/revue-msh/pdf/N172R955.pdf>

Munda G. (2007) – Social multi-criteria evaluation, Springer-Verlag, Heidelberg, New York, Economics Series



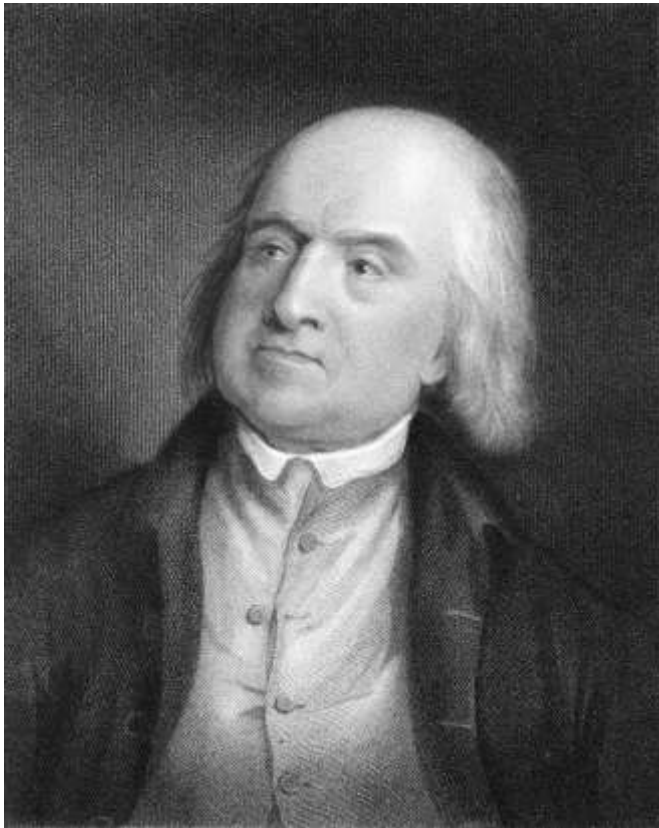
Condorcet's  
algorithms and  
Descartes'  
Geometry: the  
dream always had a  
quantification  
agenda



Condorcet's *Mathématique sociale*  
had its continuation in Jeremy  
Bentham's utilitarianism



Marquis de  
Condorcet  
(1743– 1794)



Felicific calculus: 'The greatest  
good for the greatest number'  
(utility or hedonistic calculus)

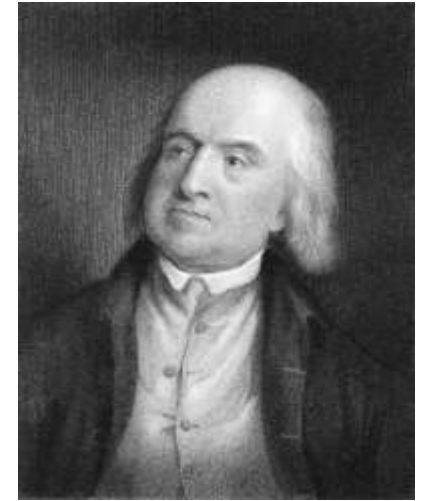
Jeremy Bentham  
(1748–1832)

- Intensity: How strong is the pleasure?
- Duration: How long will the pleasure last?
- Certainty or uncertainty: How likely or unlikely is it that the pleasure will occur?
- Propinquity or remoteness: How soon will the pleasure occur?
- Fecundity: The probability that the action will be followed by sensations of the same kind.
- Purity: The probability that it will not be followed by sensations of the opposite kind.
- Extent: How many people will be affected?

Jeremy  
Bentham

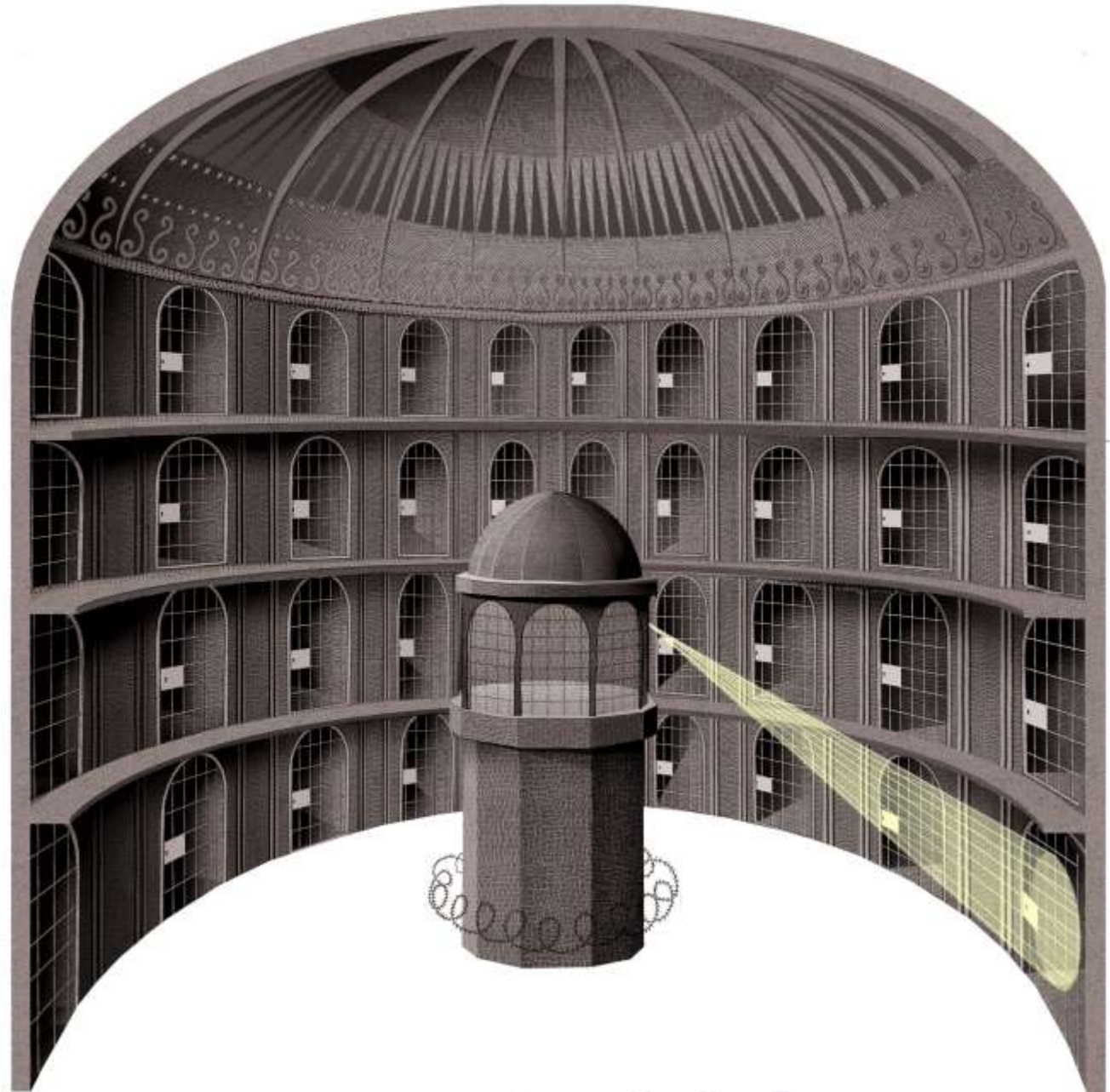


- Intensity: How strong is the pleasure?
- Duration: How long will the pleasure last?
- Certainty or uncertainty: How likely or unlikely is it that the pleasure will occur?
- Propinquity or remoteness: How soon will the pleasure occur?
- Fecundity: The probability that the action will be followed by sensations of the same kind.
- Purity: The probability that it will not be followed by sensations of the opposite kind.
- Extent: How many people will be affected?



“The utilitarian ethic, of ‘the greatest good for the greatest number’, was an implicit quantification of ethics, needed for the post-theological age” (Jerome R. Ravetz)

# Bentham's Panopticon

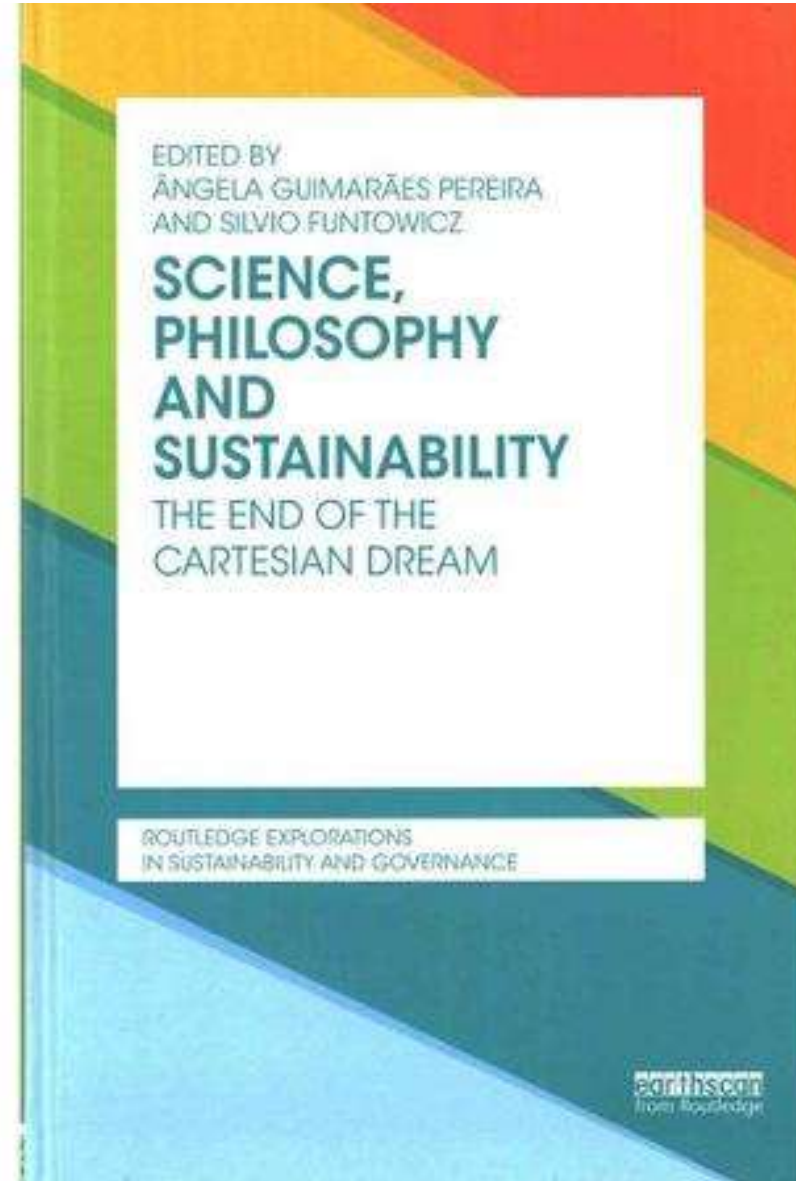


Artwork: Adam Simpson, New York Times

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.



The success of  
the Cartesian  
dream



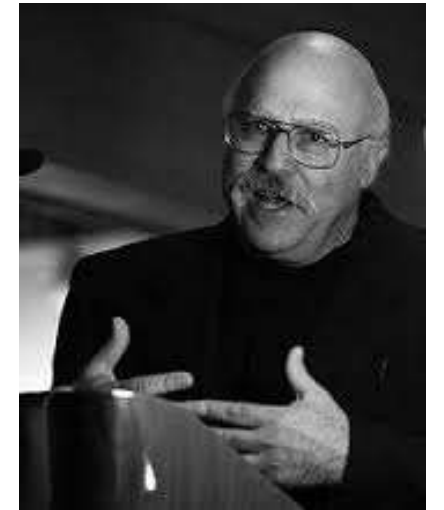
February 18, 2021, Landing of Perseverance on Mars

If you are a natural scientists you were nourished and trained in the Cartesian dream, (S. Toulmin: ‘The hidden agenda of modernity’)



Stephen Toulmin

The dream was spectacularly successful, in all fields of endeavor, leading to what Steven Shapin calls ‘invisible science’



Steven Shapin

Steven Shapin, 2016, Invisible Science, The Hedgehog Review: Vol. 18 No. 3 (Fall 2016).

Many voices of  
alarm as to misuse  
of quantification

Numbers, visible and invisible...

Blurring lines:

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

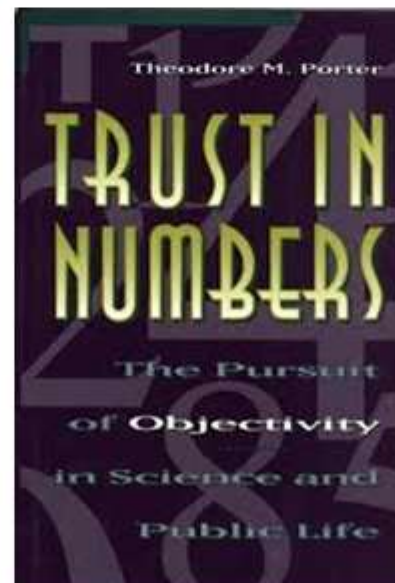
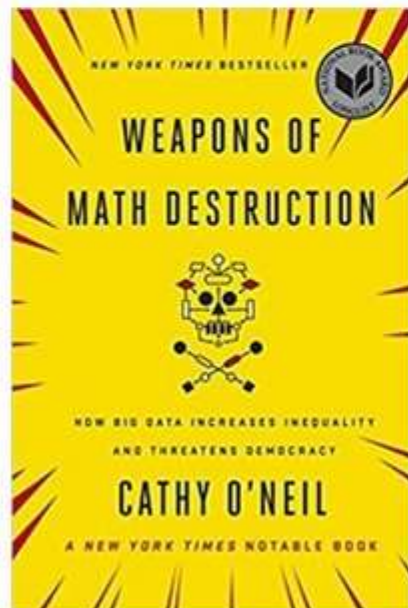
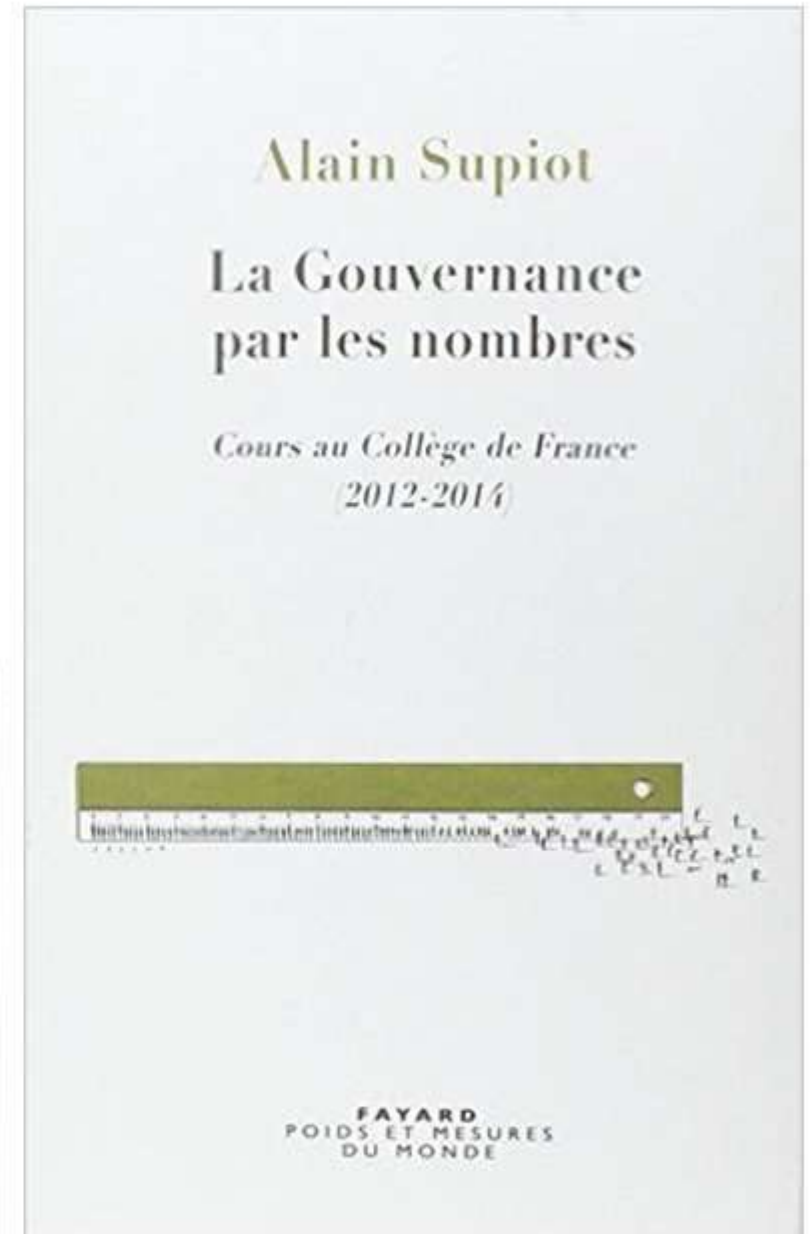
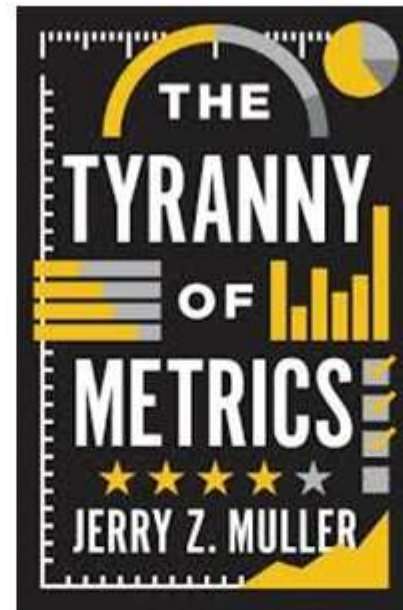
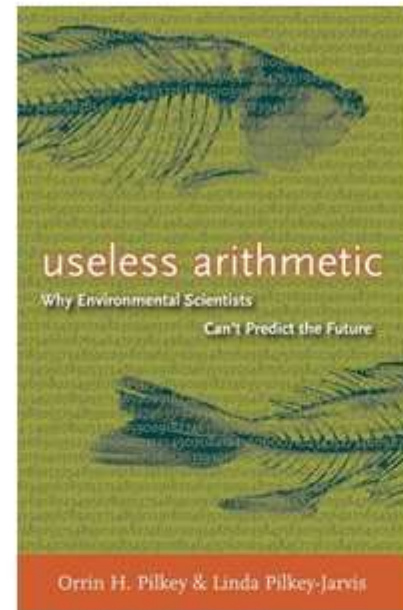
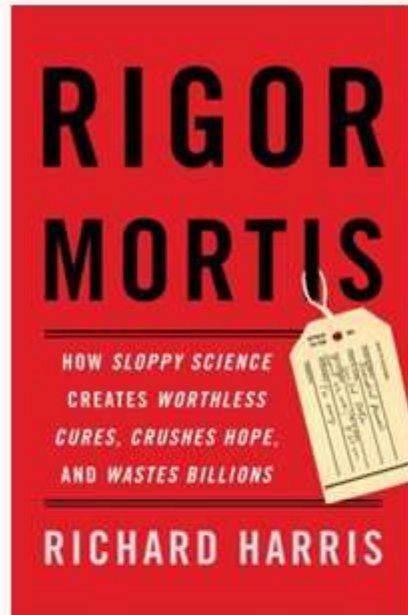


Elizabeth  
Popp Berman

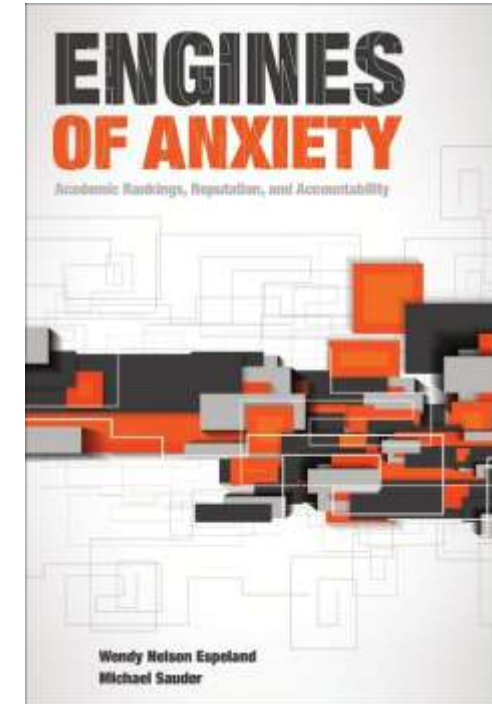
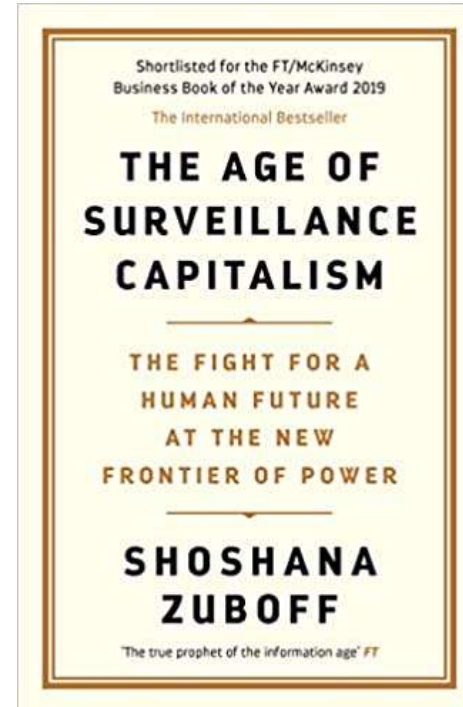
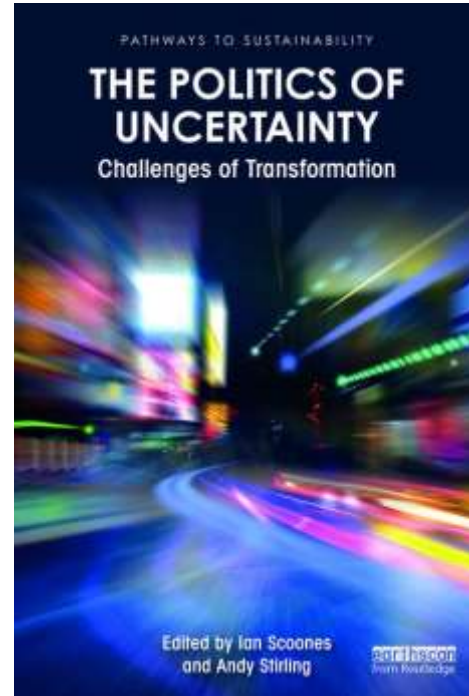
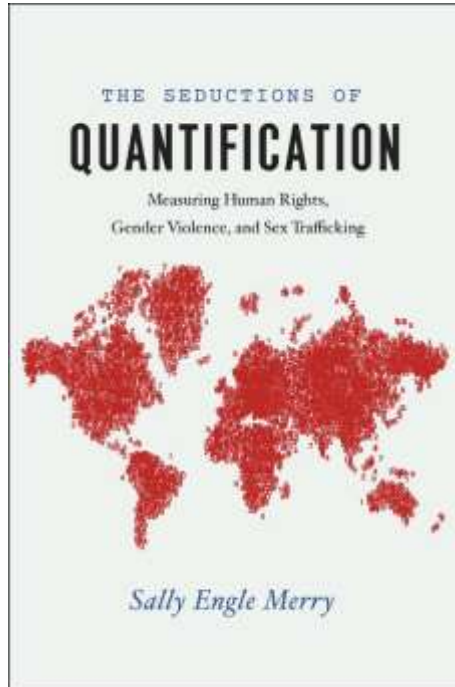
E. Popp Berman and D. Hirschman, *The Sociology of Quantification: Where Are We Now?*, *Contemp. Sociol.*, vol. in press, 2017.

And an explosion of works, from  
within and without, from many  
disciplines

# Algorithms, models, metrics, statistics...



# Algorithms, models, metrics, statistics...



Numbers and their ‘reactivity’  
(Espeland and Sauder, 2016)

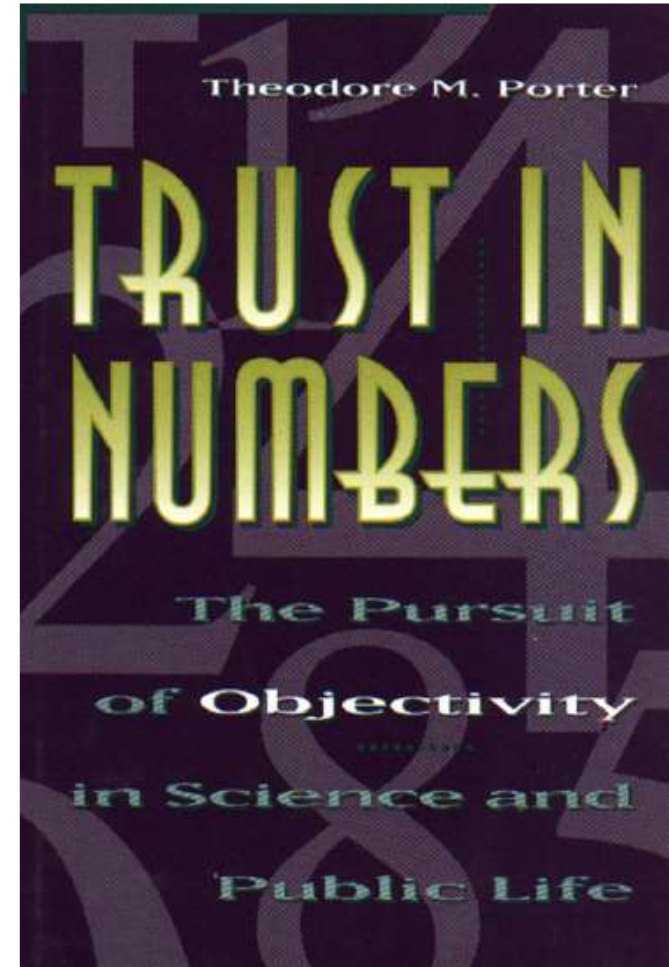
Incumbent numbers affect what society will  
measure in the future (Merry 2016)

Numbers “create the environment that  
justifies their assumptions”  
(O’Neil, 2016)

# Numbers and trust



Theodor  
M. Porter



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

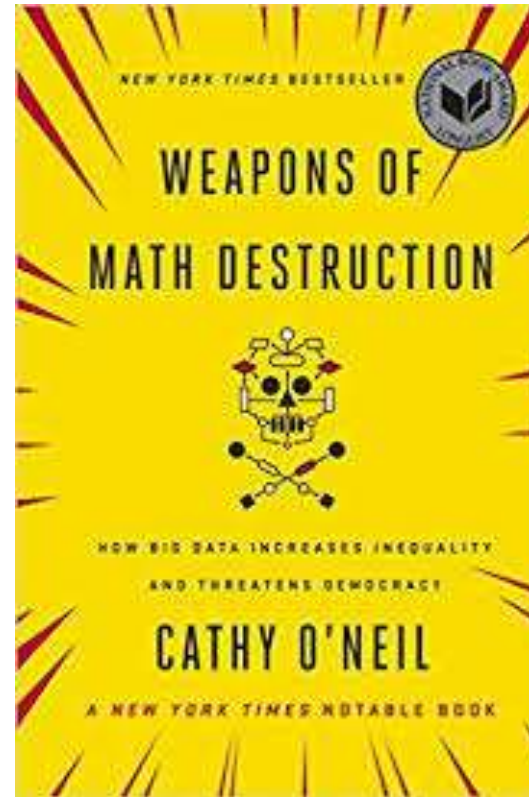
Porter's story: Quantification needs judgment which in turn needs trust ...without trust quantification becomes mechanical, a system, and 'systems can be played'.



# Alarm for Weapons of Math Destruction



Cathy O'Neil

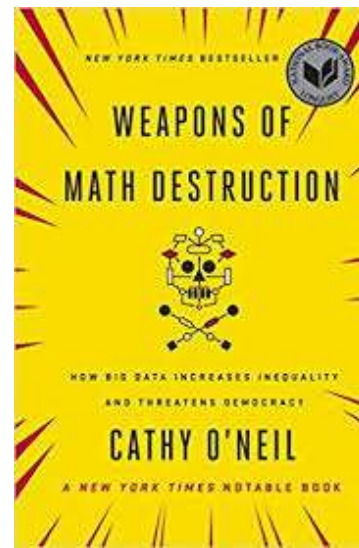


O'Neil, C. (2016). Weapons of math destruction : how big data increases inequality and threatens democracy. Random House Publishing Group.

Opacity (also because of trade secrecy) of algorithms used to decide on recruiting, carriers (including of researchers), prison sentencing, paroling, custody of minors, political campaigns...

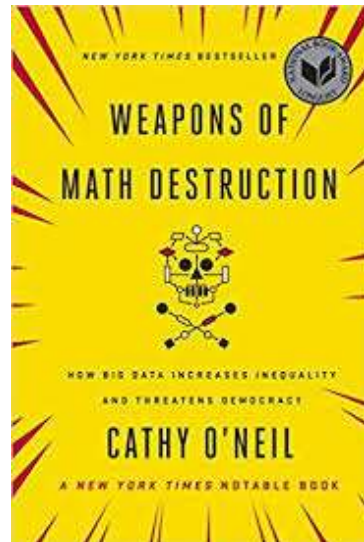
O'Neil, C. (2016). Weapons of math destruction : how big data increases inequality and threatens democracy. Random House Publishing Group.

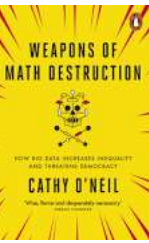
Brauneis, R., & Goodman, E. P. (2018). Algorithmic Transparency for the Smart City. Yale Journal of Law & Technology, 20, 103–176. Retrieved from [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3012499](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3012499)



Opacity coupled with opportunity for scale and damage and with non-appealability make them an instrument of oppression & inequality

Cathy O'Neil Google talk <https://www.youtube.com/watch?v=TQHs8SA1qpk>





NETFLIX

UNLIMITED TV SHOWS & MOVIES

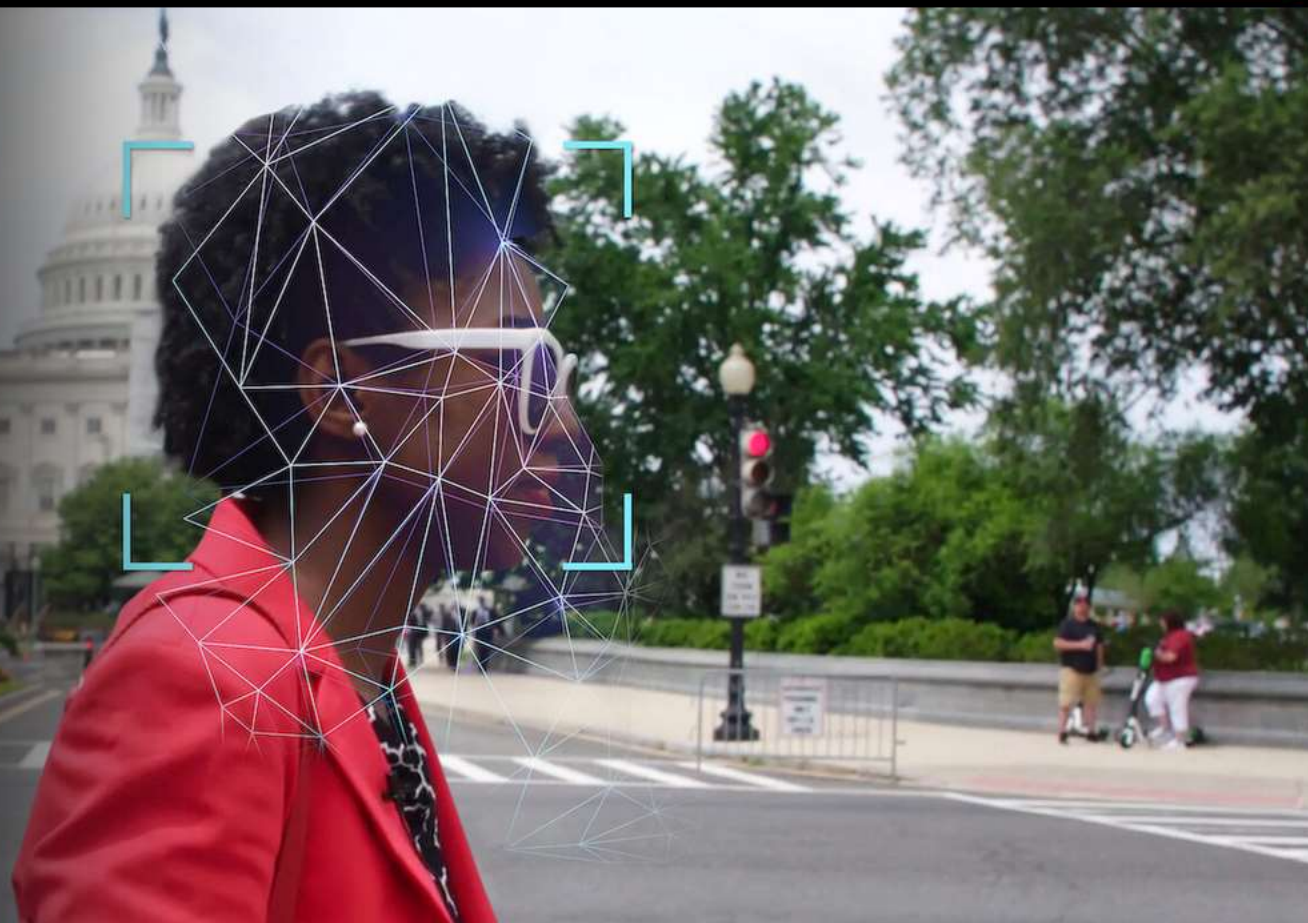
JOIN NOW

# C O D E D B I A S

## Coded Bias

2020 | 12+ | 1h 25m | Science & Nature Docs

This documentary investigates the bias in algorithms after M.I.T. Media Lab researcher Joy Buolamwini uncovered flaws in facial recognition technology.





Algorithmic Justice  
League

<https://www.ajl.org/>

The New York Times

Bloomberg  
Business

Forbes

TIME

FORTUNE

TED

WIRED

The Telegraph

Quantification  
blues,  
continued



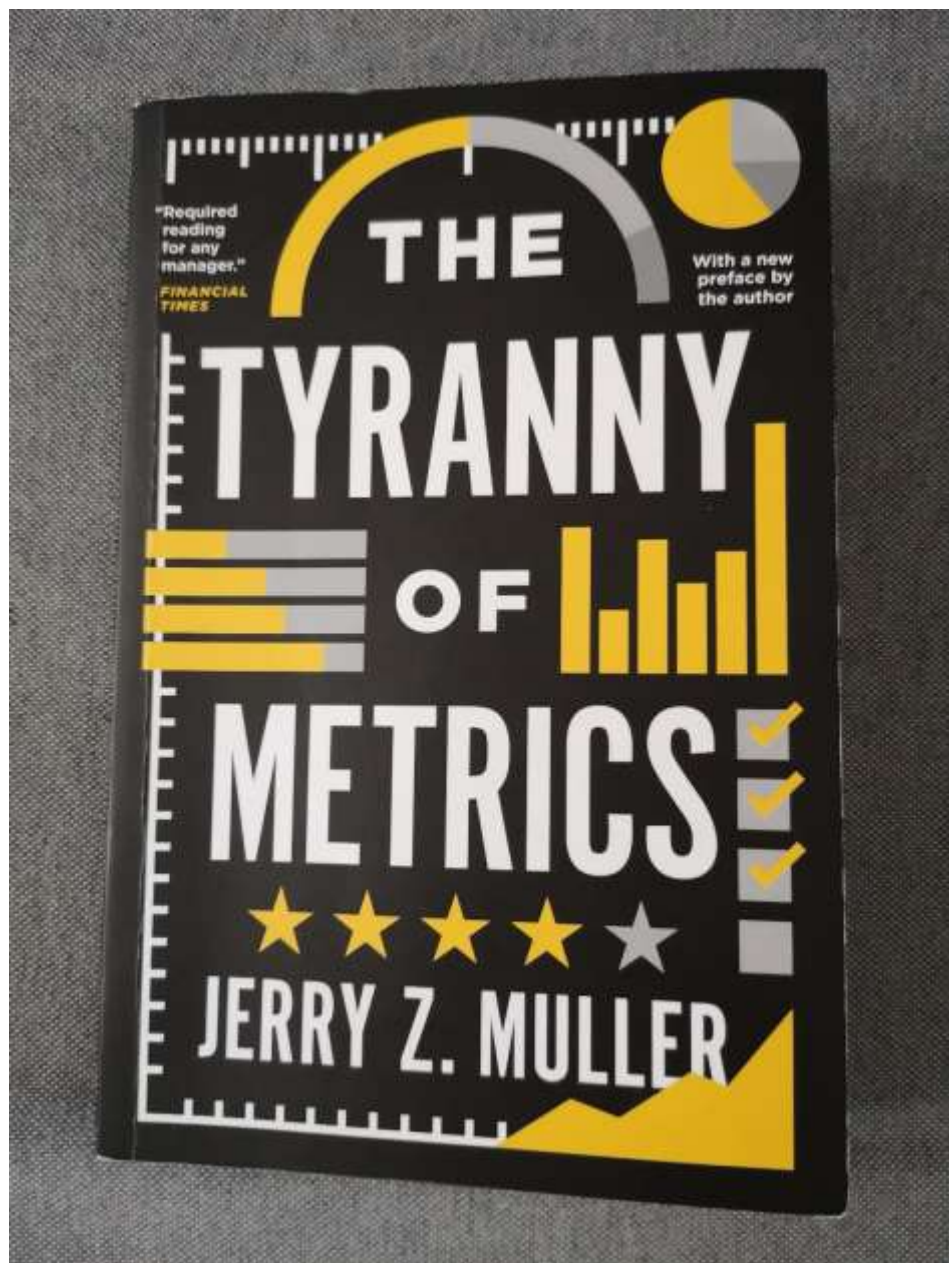
Charles Goodhart

p. 44 “Any ... measures necessarily involve a loss of information ... [and distorts behavior]” (Porter, 1995)

This is what we normally call Goodhart's law, from Charles Goodhart. "When a measure becomes a target, it ceases to be a good measure."

Also known as Campbell's law (1976);

[https://en.wikipedia.org/wiki/Goodhart%27s\\_law](https://en.wikipedia.org/wiki/Goodhart%27s_law)

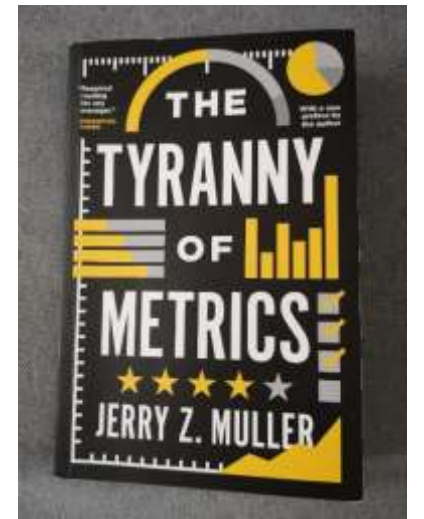


J. Z. Muller, The tyranny of metrics. Princeton University Press , 2018.

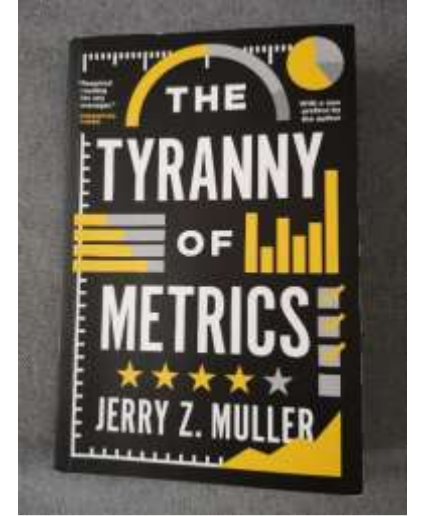
Metric fixation, or the irresistible pressure to measure performance

Gaming of metrics (recall Goodhart law)

A wealth of case studies from education to war to medicine to foreign aid..



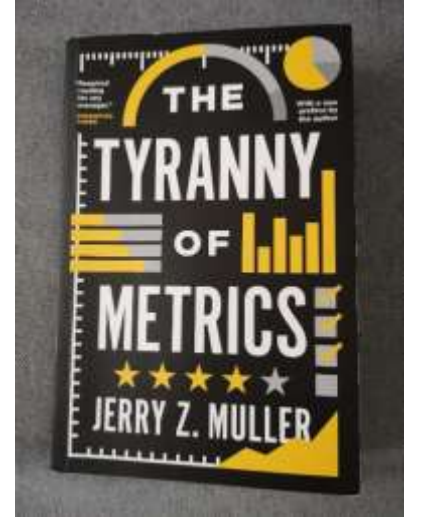
# Unintended consequences



- Goal displacement
- Short termism
- Diminishing utility
- Rule cascade
- Discouraging risk taking
- Discouraging innovation
- Rewarding luck
- Discouraging cooperation and common purpose
- Degrading work
- Time waste
- Loss of productivity

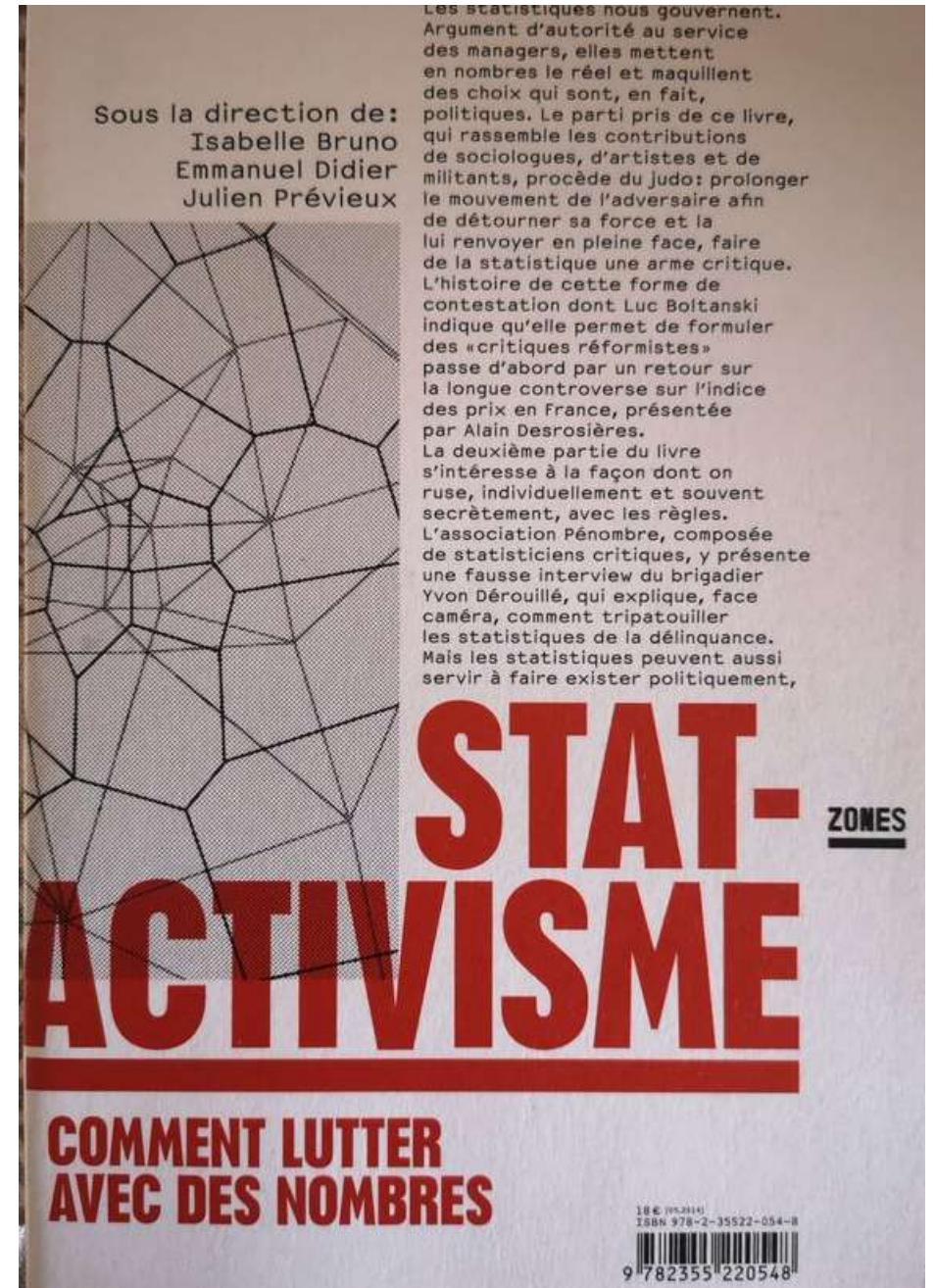
A concluding remark of Muller

Considering all of the above keep in mind at every step that “the best use of metrics may be not to use it at all”



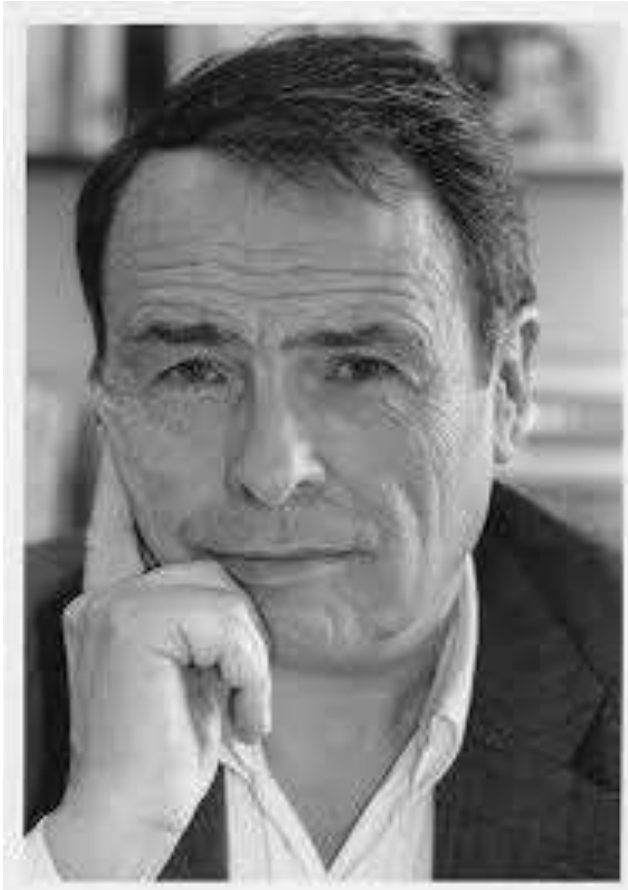
# Do we need a movement of resistance?

I. Bruno, E. Didier, and J. Prévieux, Stat-activisme. Comment lutter avec des nombres. Paris: Zones, La Découverte, 2014



# How to be a "statactiviste"?

1. Deconstruct existing metrics, including using irony (Pierre Bourdieu, *Les héritiers*).



La sociologie,  
ça doit être  
rigolo

(Sociology must be fun)



# How to be a "statactiviste"?

2. Gaming metrics (statistical judo) – use Goodhart's law to your advantage – or make the ruse public.

- Police statistics in NY



# How to be a "statactiviste"?

3. Bring to the surface what is hidden / unsaid/ excluded – new social classes, marginalization, minorities:

- ‘Creative class’ or ‘precarious intellectuals’?



# How to be a "statactiviste"?

## 4. Measure something different.

- Suicides at France Telecom;
- BIP 40, a new French measure of poverty/inequality



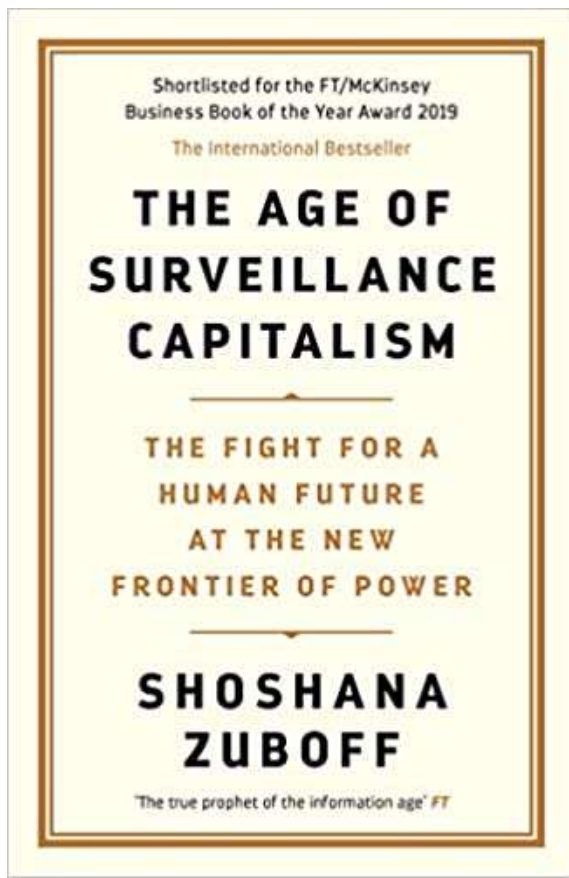
# Important:

“Quantification should not be abandoned to the advantage of exalting qualities, singularities, and the incommensurable. Such an abandon would be a tactical error”

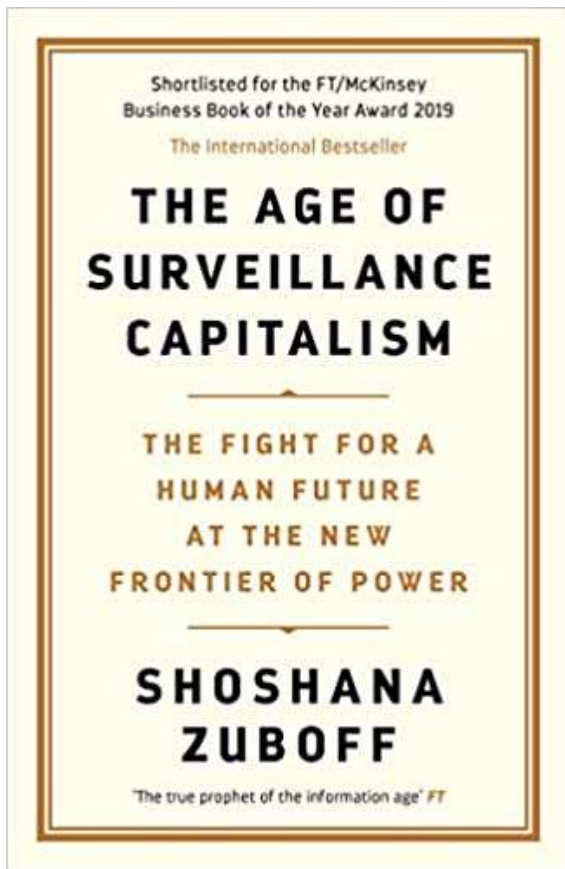




A project of domination of consumers and voters is made possible by artificial intelligence, big data & cognitive psychology



Inequality, power asymmetries and the world of surveillance capitalism



Chapters 11 & 12

Instrumentarian  
power



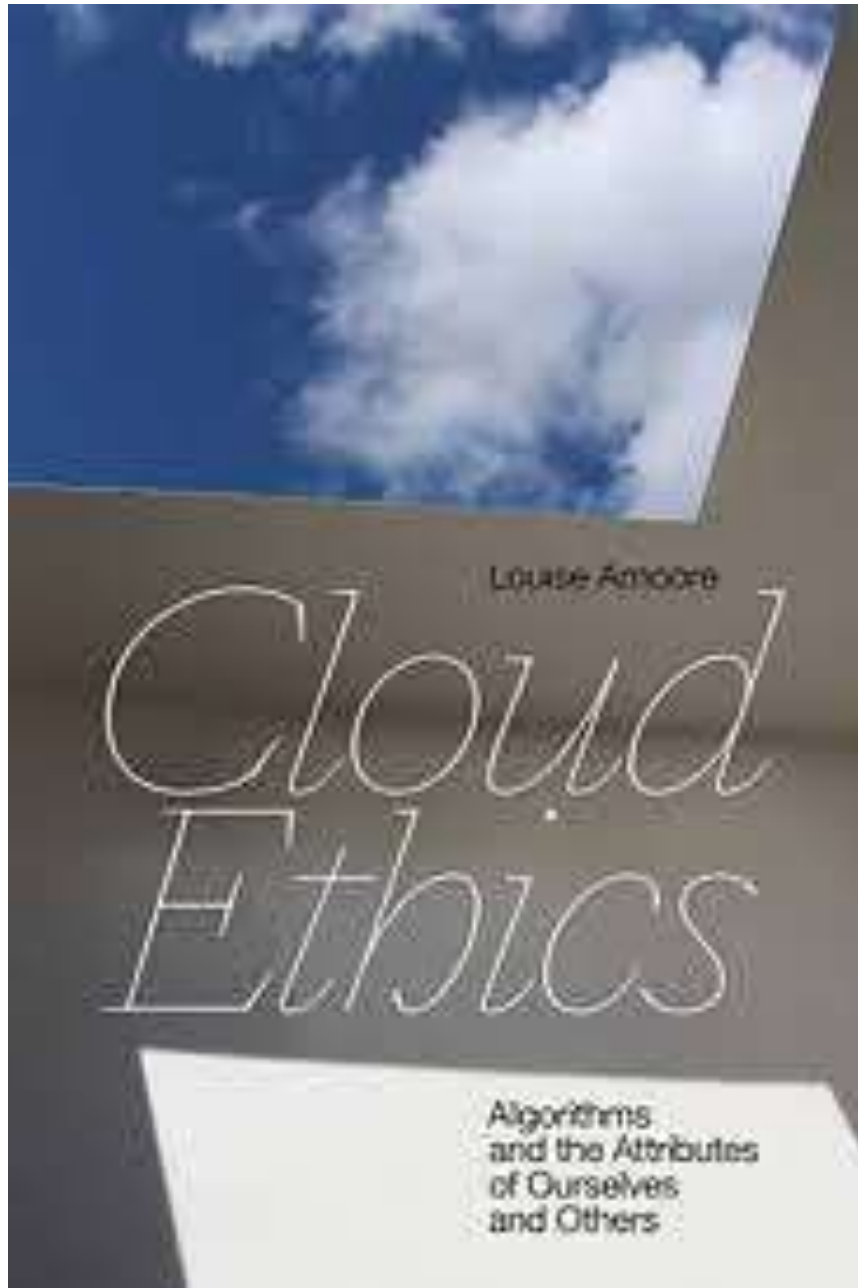
Chapter 10

*Néorationalism d'importation*

*La trollisation de l'espace  
public*

Cognitive psychology  
and evolutionary  
psychology

A project of domination?



Making algorithms  
'good' or 'transparent'  
is beyond the point.  
Algorithms create new  
norms of good or bad.

Algorithm =  
ethicopolitical  
arrangement of  
values, assumptions,  
and propositions about  
the world



Louise Amoore



THE LONDON SCHOOL  
OF ECONOMICS AND  
POLITICAL SCIENCE ■

# LSE Research Online

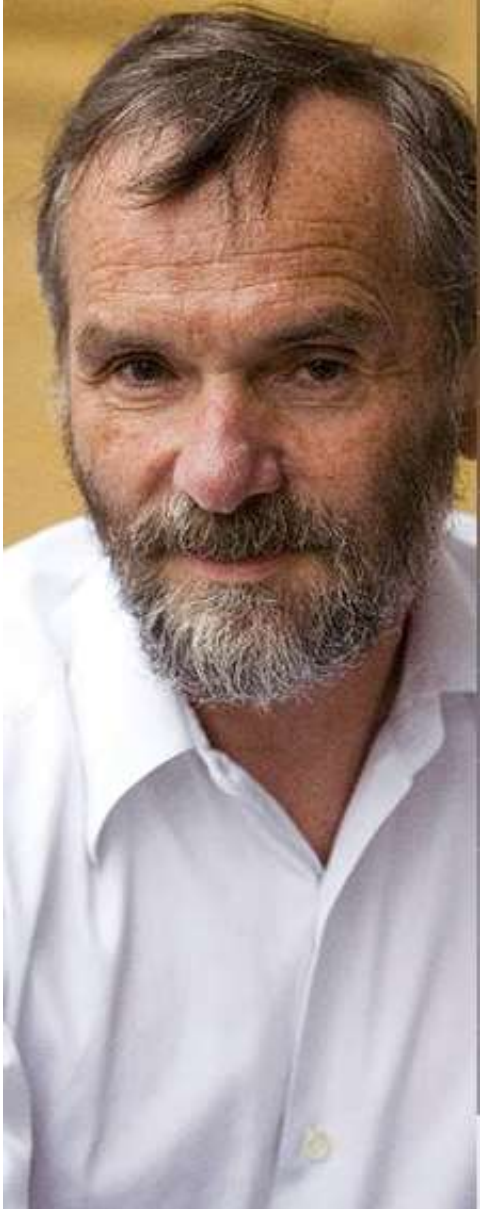
[Nick Couldry](#) and Ulises Mejias

## Data colonialism: rethinking big data's relation to the contemporary subject

Couldry, Nick and Mejias, Ulises (2018) Data colonialism: rethinking big data's relation to the contemporary subject. *Television and New Media*, vol. 20, 4: pp. 336-349.

# Quantification blues, continued (II)

# Alain Supiot

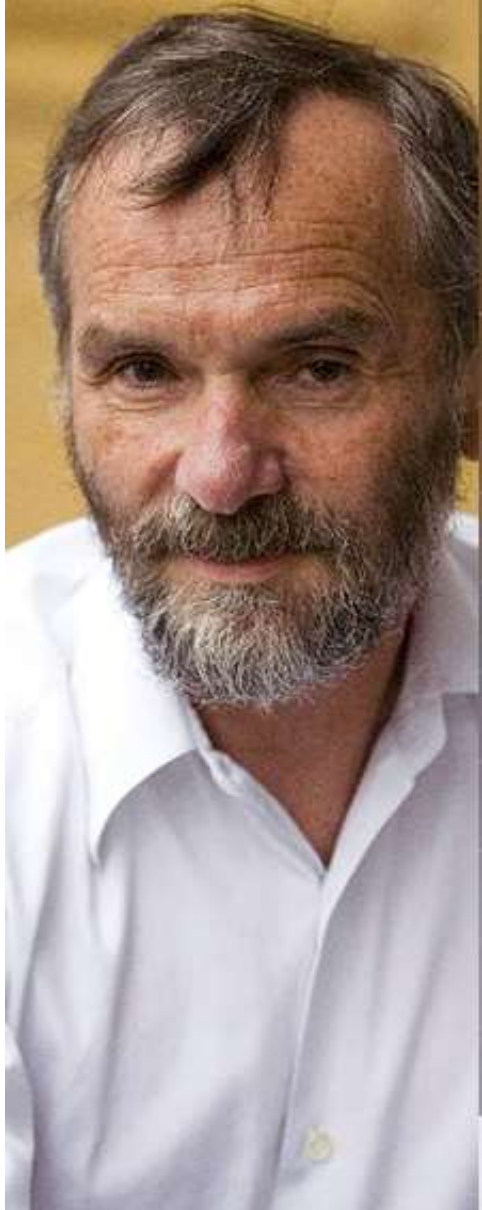


An indictment of the  
Total Market and the  
normative uses of  
economic quantification

<https://www.college-de-france.fr/site/en-alain-supiot/Governance-by-Numbers-Introduction.htm>



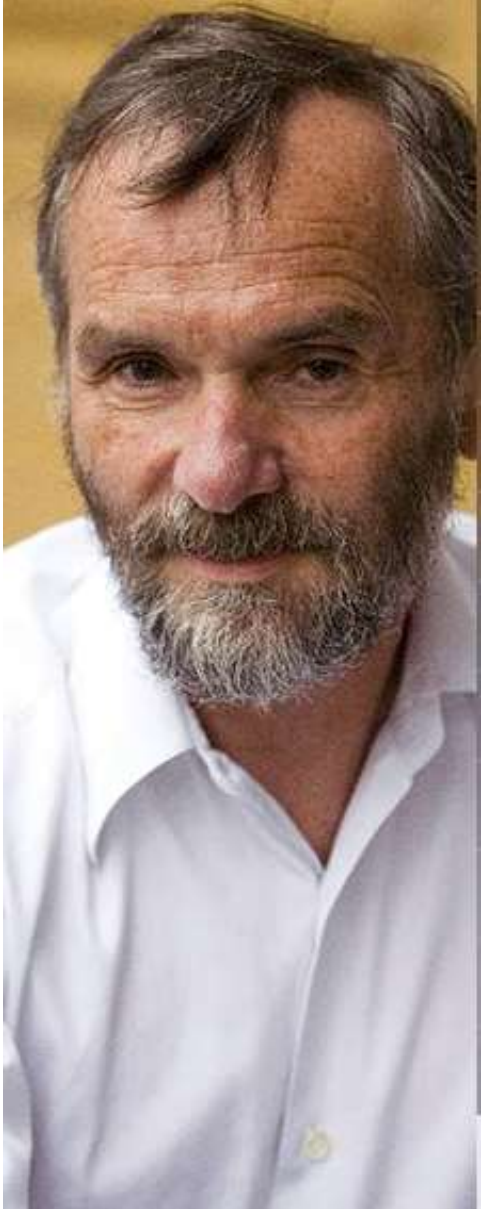
# Alain Supiot



...we have entered the era of the cybernetic imaginary, which revives the West's age-old dream of grounding social harmony in calculations.

Repudiating the goal of governing by just laws, this new discourse advocates in its stead the attainment of measurable objectives efficiently

# Alain Supiot



... This leaves no option open to populations or countries than to ride roughshod over social legislation, and pledge allegiance to those stronger than they are

# 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.



UCL Institute for  
Innovation and  
Public Purpose



WORKING PAPER  
WP 2021/07

# 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**

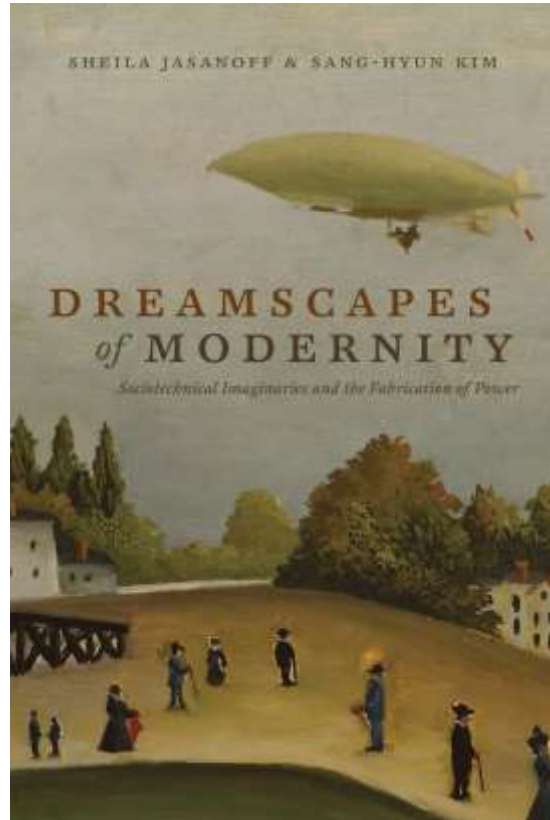
Open Evidence Research, Universitat Oberta de Catalunya (UOC)

**Jerome R. Ravetz**

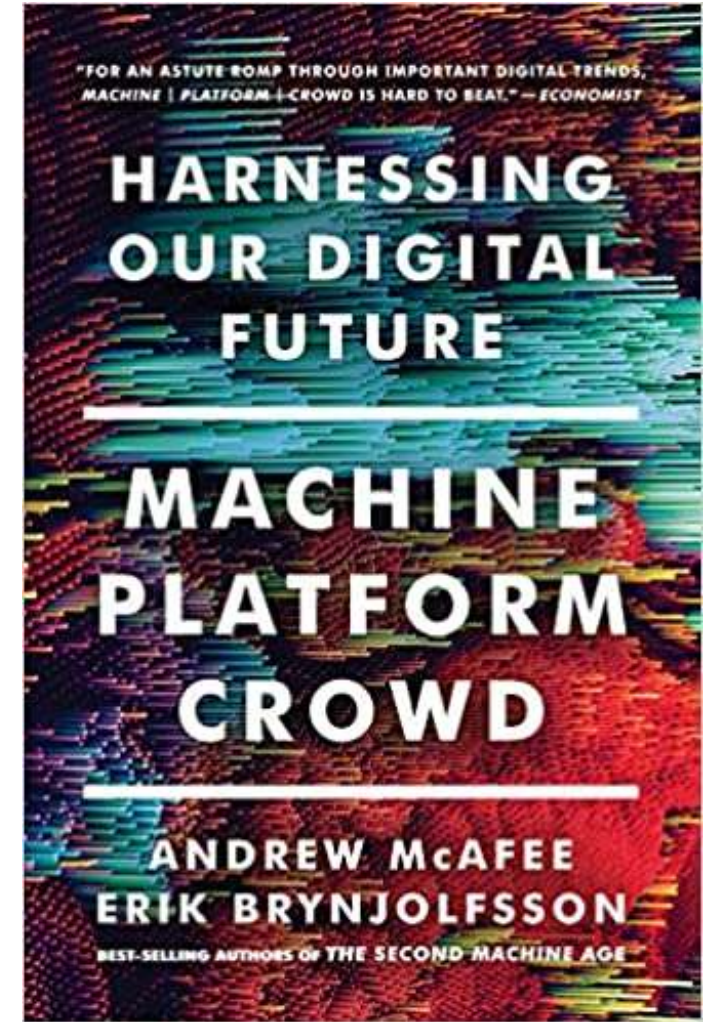
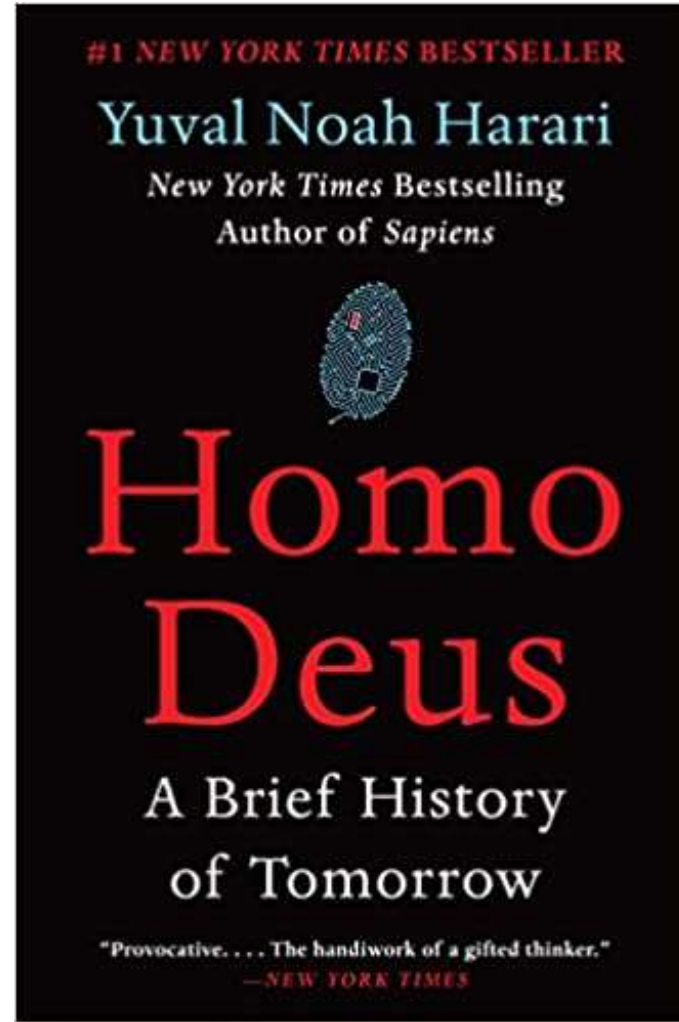
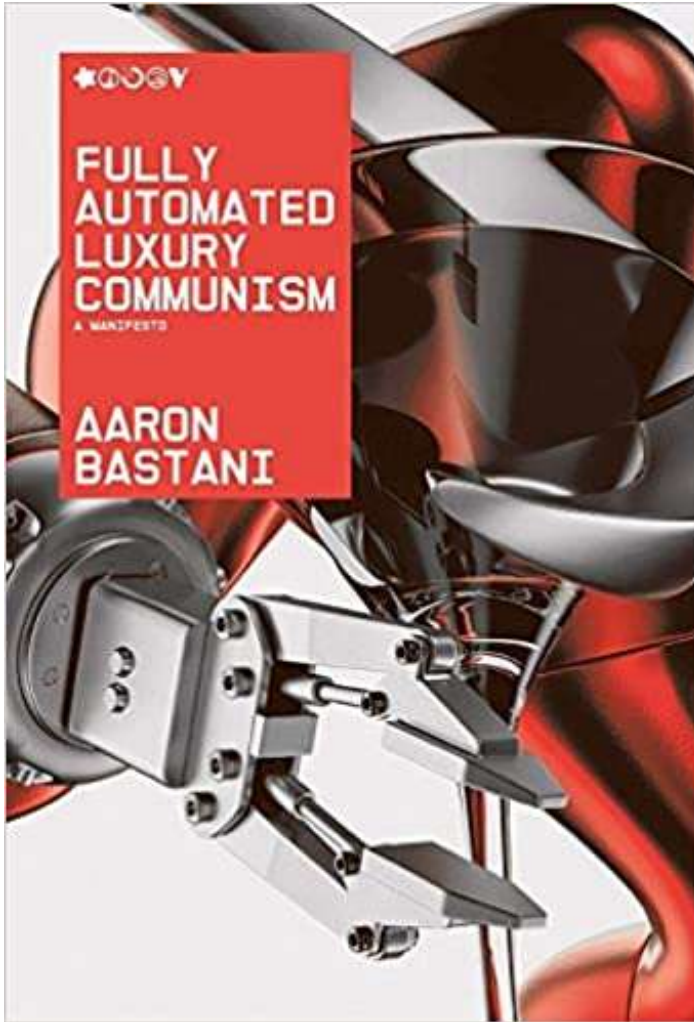
Institute for Science, Innovation and Society, University of Oxford

And yet ...which is the  
prevailing sociotechnical  
imaginary ?

Sociotechnical imaginary: How visions of scientific and technological progress carry with them implicit ideas about public purposes, collective futures, and the common good



Sheila Jasanoff



Good news!

Which is the prevailing  
sociotechnical imaginary for  
quantification?

‘Decisionism’ is mainstream

“Often, immersion in the facts often makes value disagreements feel much less relevant” (C. Sunstein)

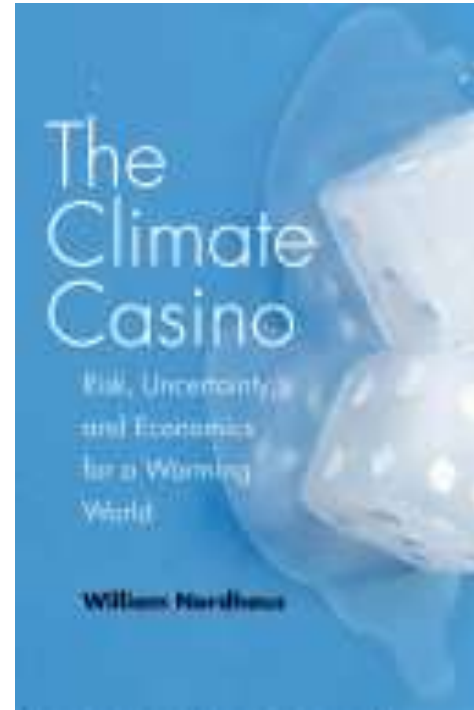


Cass Sunstein, winner of  
the 2018 Holberg Prize

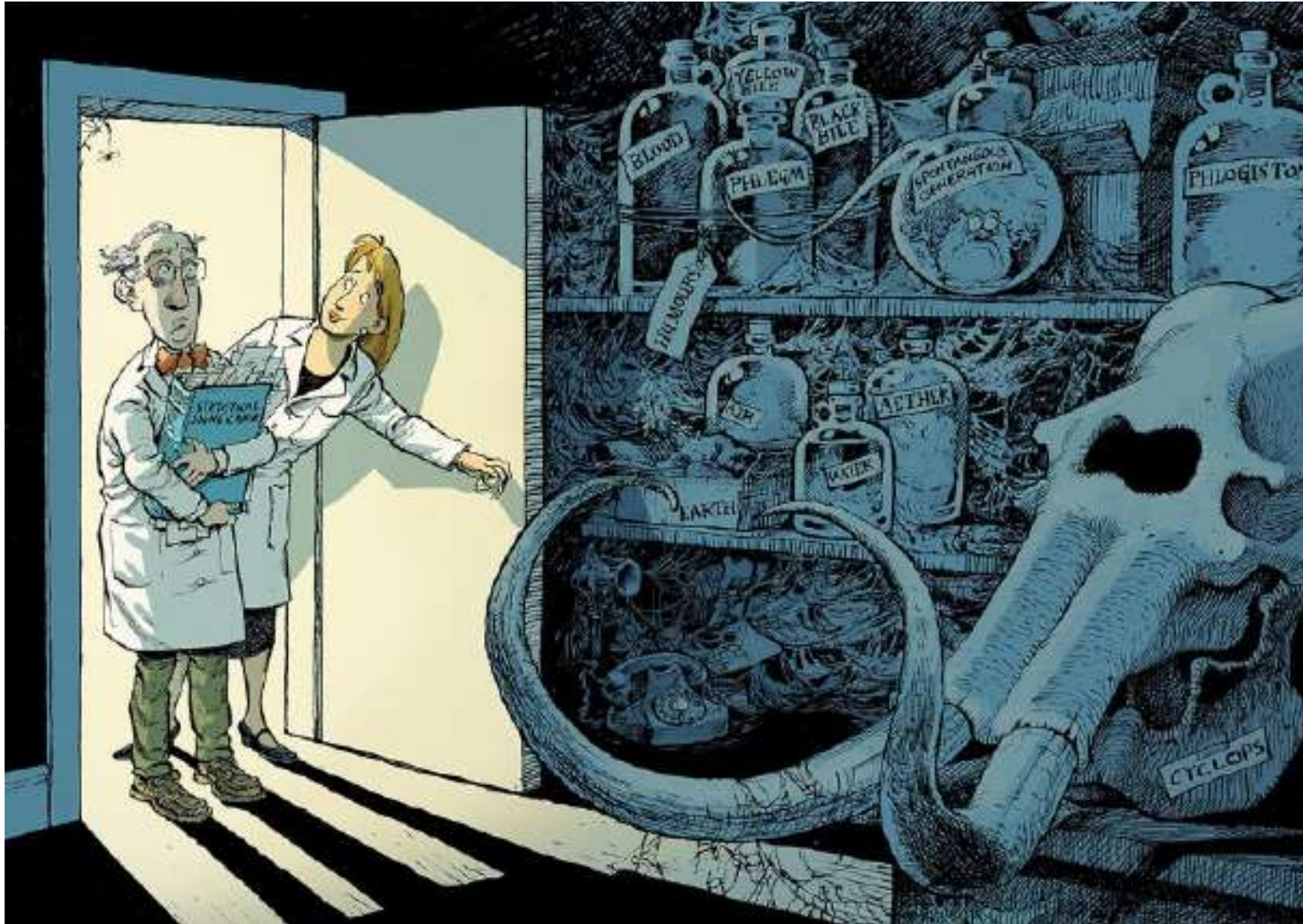


One of the winner of Nobel prize for economics 2018 was Willem Nordhaus, for his work on the economics of climate change.

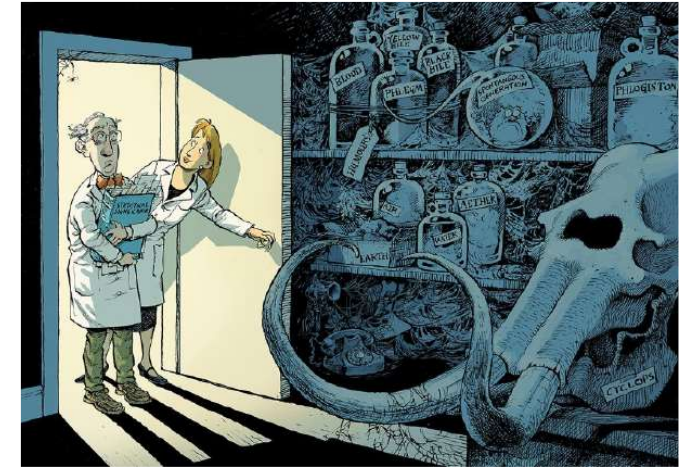
Cost benefit analysis to the year 2100?



# Statistical and mathematical modelling



Throw away  
the concept of  
statistical  
significance?



COMMENT • 20 MARCH 2019

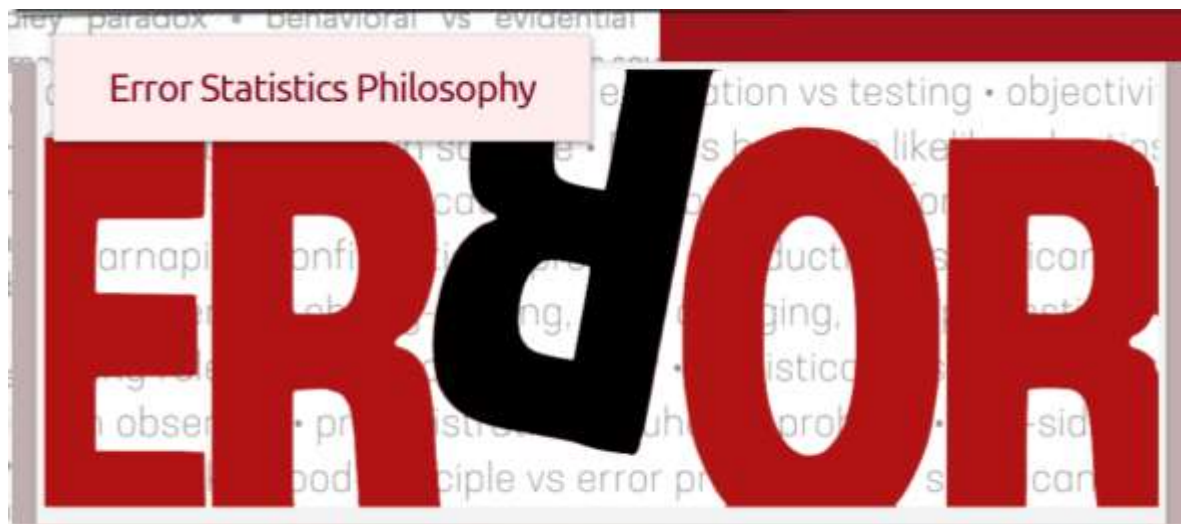
# Scientists rise up against statistical significance

Valentin Amrhein, Sander Greenland, Blake McShane and more than 800 signatories call for an end to hyped claims and the dismissal of possibly crucial effects.

---

Valentin Amrhein , Sander Greenland & Blake McShane

See the discussion on the blog of Andrew Gelman <https://statmodeling.stat.columbia.edu/>





### A. Saltelli (Guest post): What can we learn from the debate on statistical significance?

Posted on November 22, 2019 by Mayo



**Professor Andrea Saltelli**  
Centre for the Study of the Sciences and the Humanities (SVT), University of Bergen (UIB, Norway),  
&  
Open Evidence Research, Universitat Oberta de Catalunya (UOC), Barcelona

*What can we learn from the debate on statistical significance?*

Recent Comments:



## Cargo-cult statistics and scientific crisis

Written by Philip B. Stark and Andrea Saltelli on 05 July 2018. Posted in [Science](#)



Statistics in the  
wake of the  
reproducibility  
crisis

# Statistical wars?

# Mathematical models

# 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.

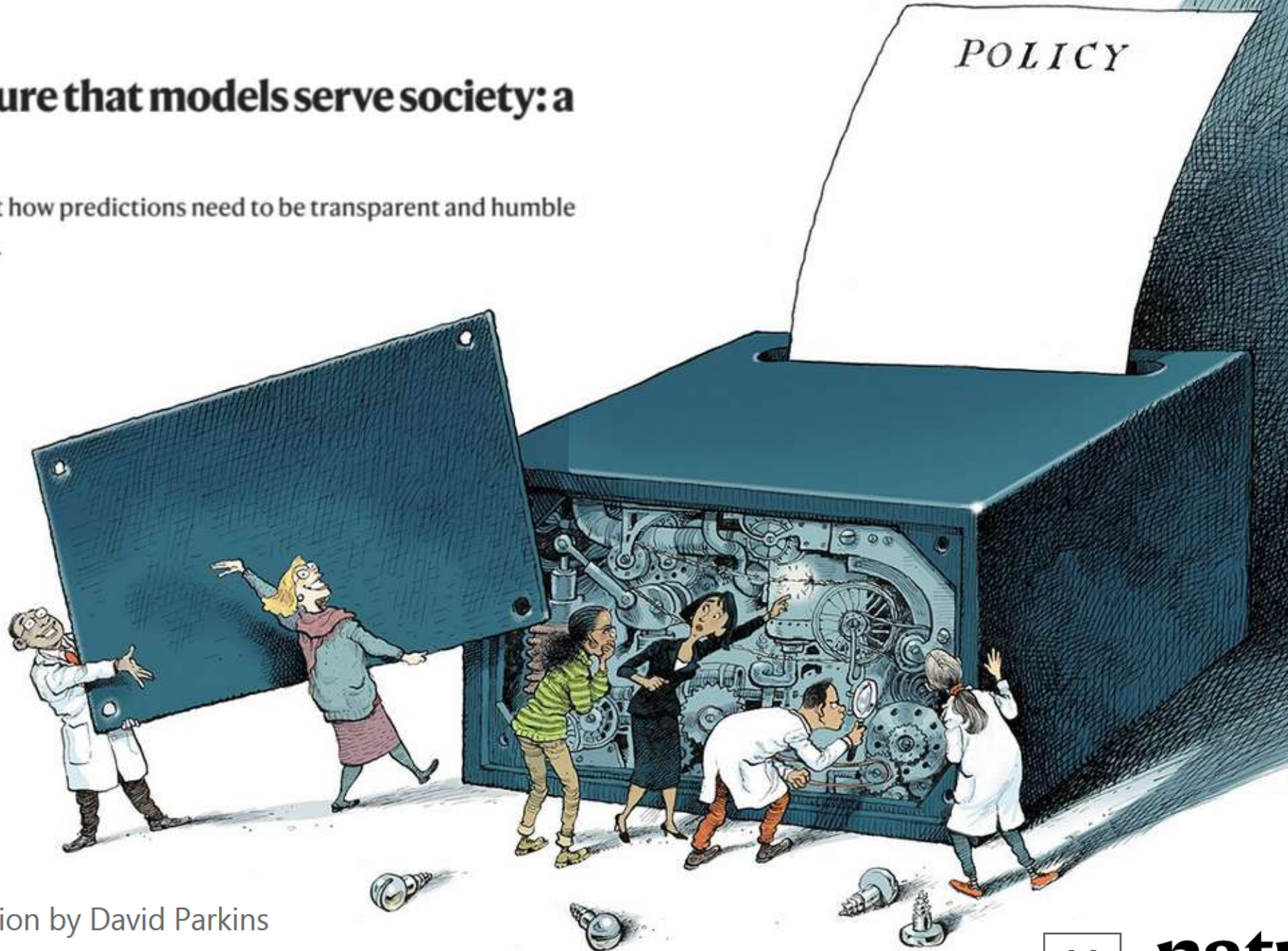


Illustration by David Parkins



**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

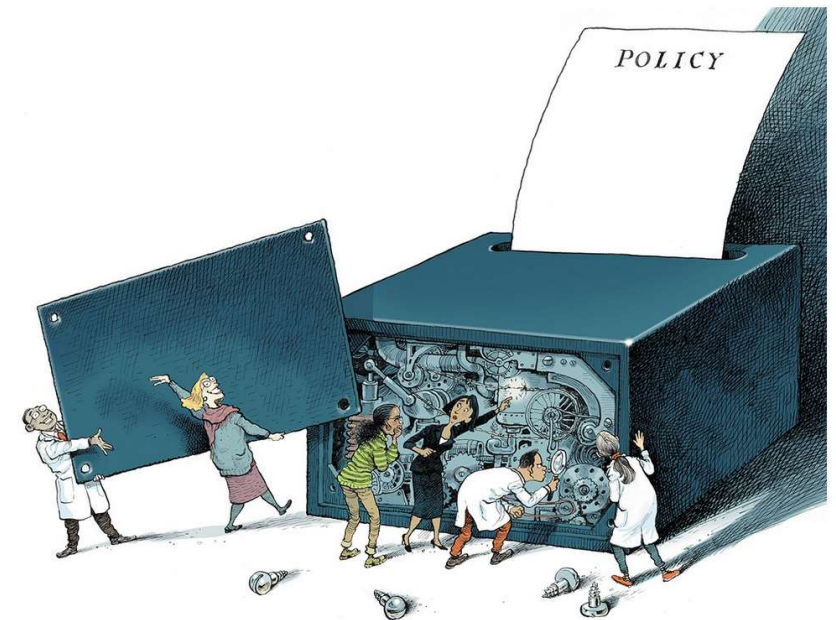
**3 STS scholars** Bammer, Sarewitz, Stirling

**1 philosopher** Ravetz

**1 historian** Charters

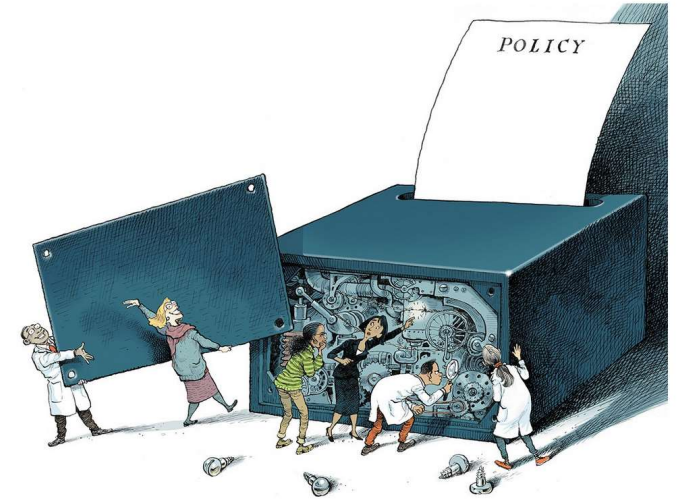
**1 political scientists** Di Fiore

**1 expert RRI - Open Science** Rafols



COVID has put mathematical models in the limelight

➔ Power & controversy



# Power

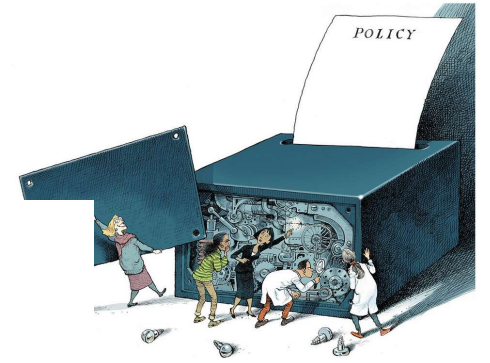
The New York Times

## *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

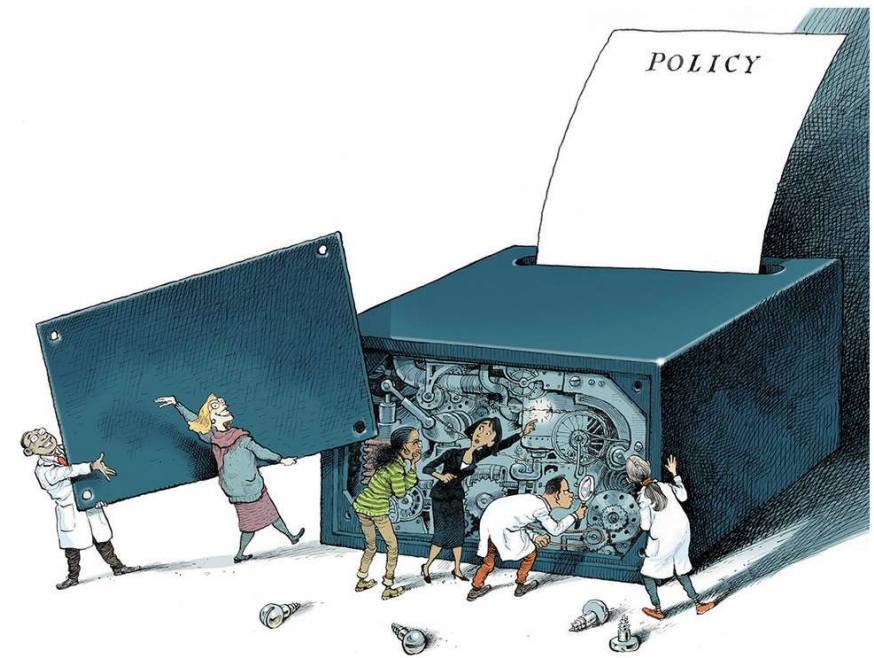
Match purpose and context

## Mind the consequences

Quantification can backfire.

## Mind the unknowns

Acknowledge ignorance



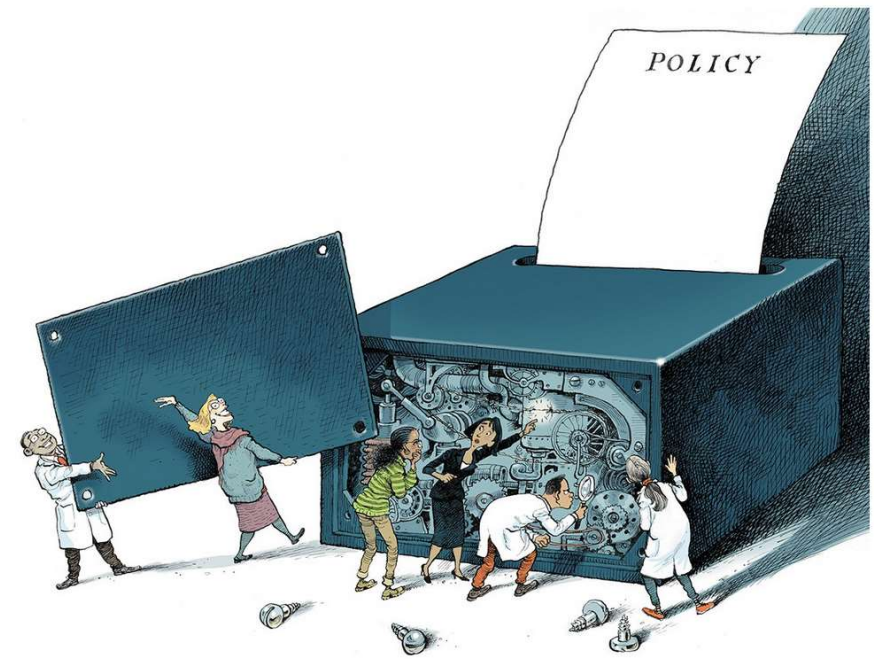
# Mind the assumptions

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 ...

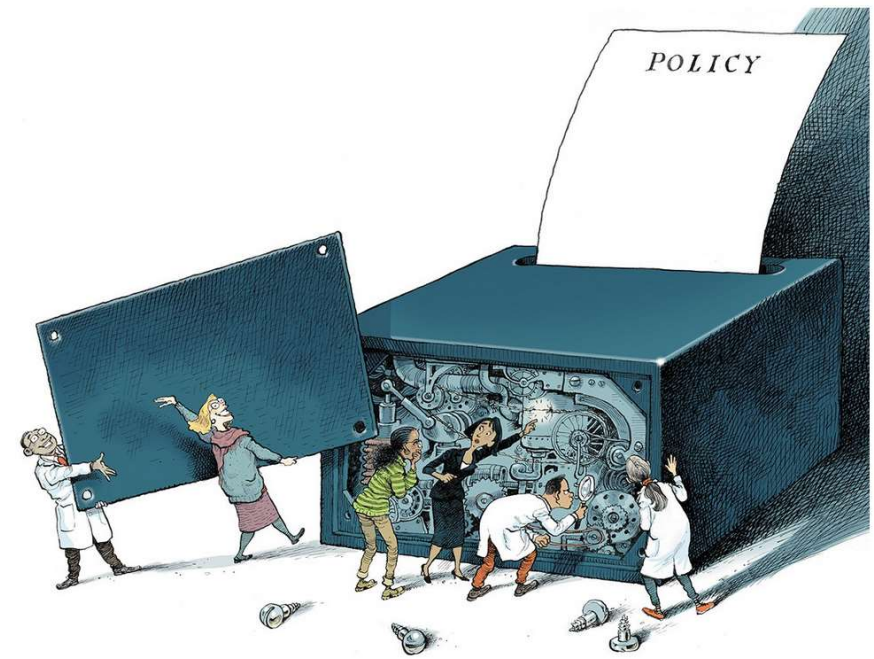


# Mind the assumptions

Assess uncertainty and sensitivity



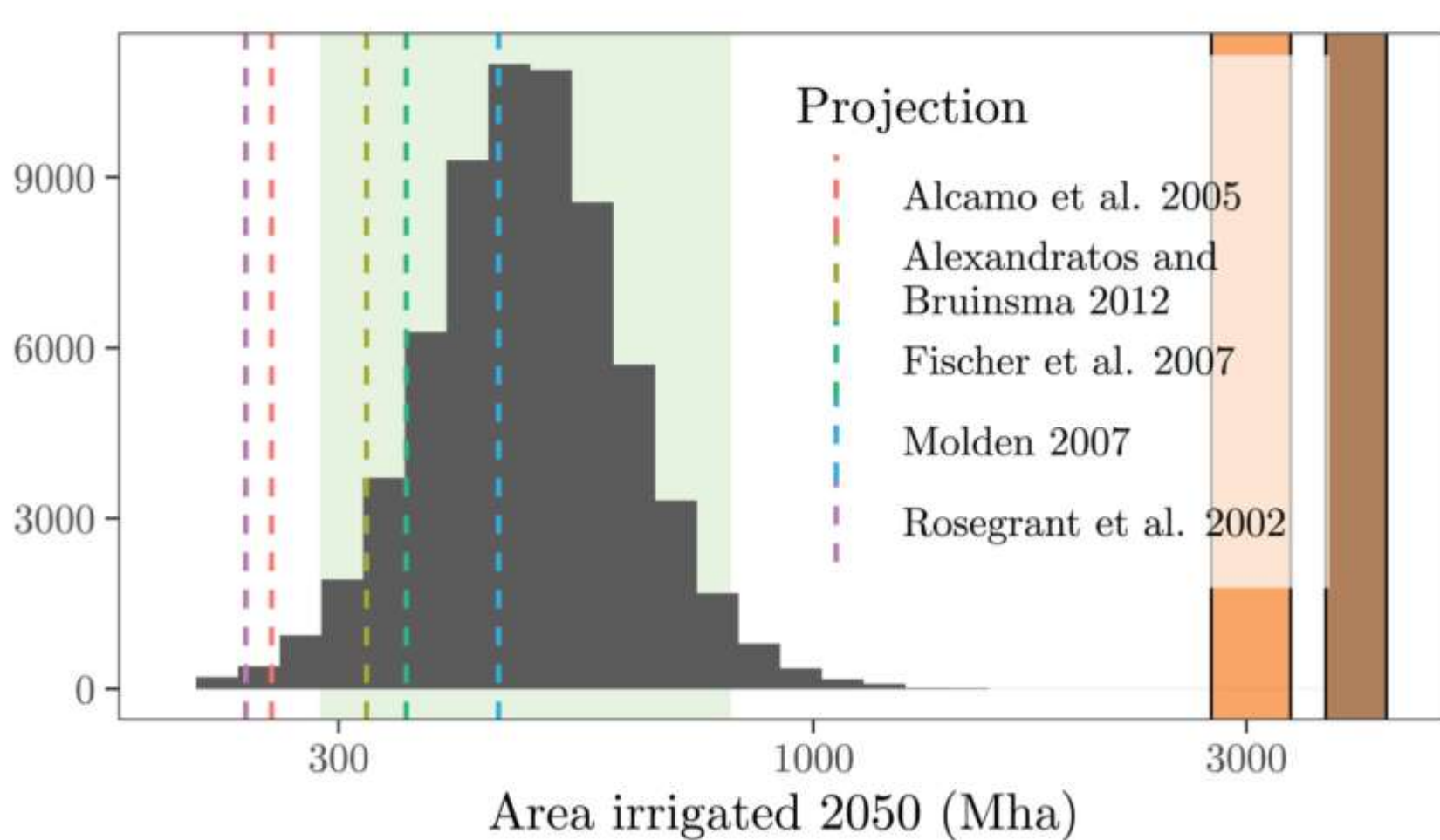
... this may lead to interesting discoveries ...



# 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](https://www.ifs.org.uk/docs/john_kay_feb2012.pdf)

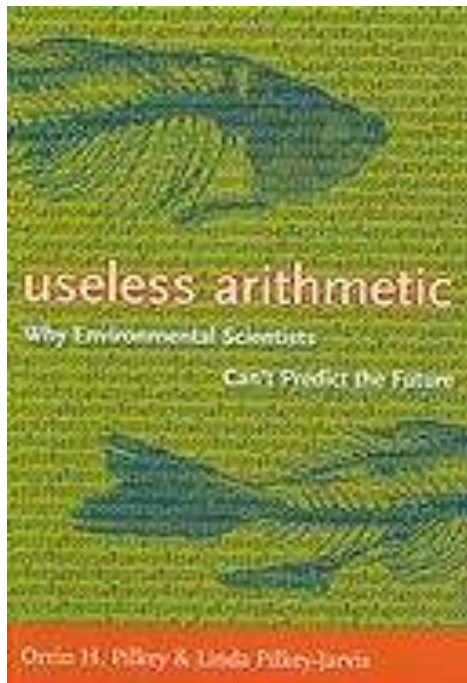


## WebTAG: Annual Percentage Change in Car Occupancy (% pa) up to 2036

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



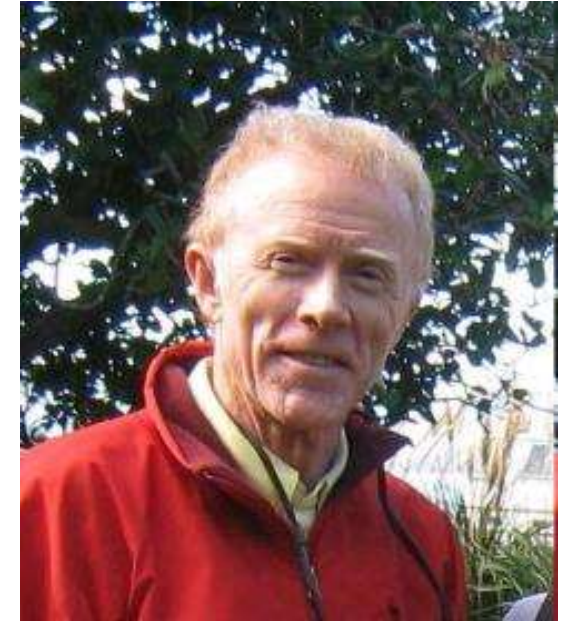
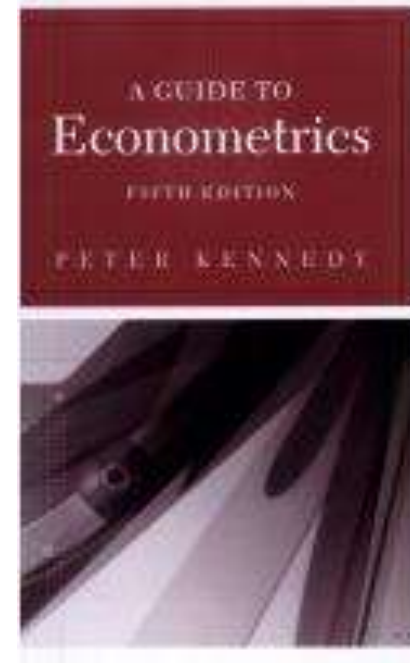
Orrin H. Pilkey



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

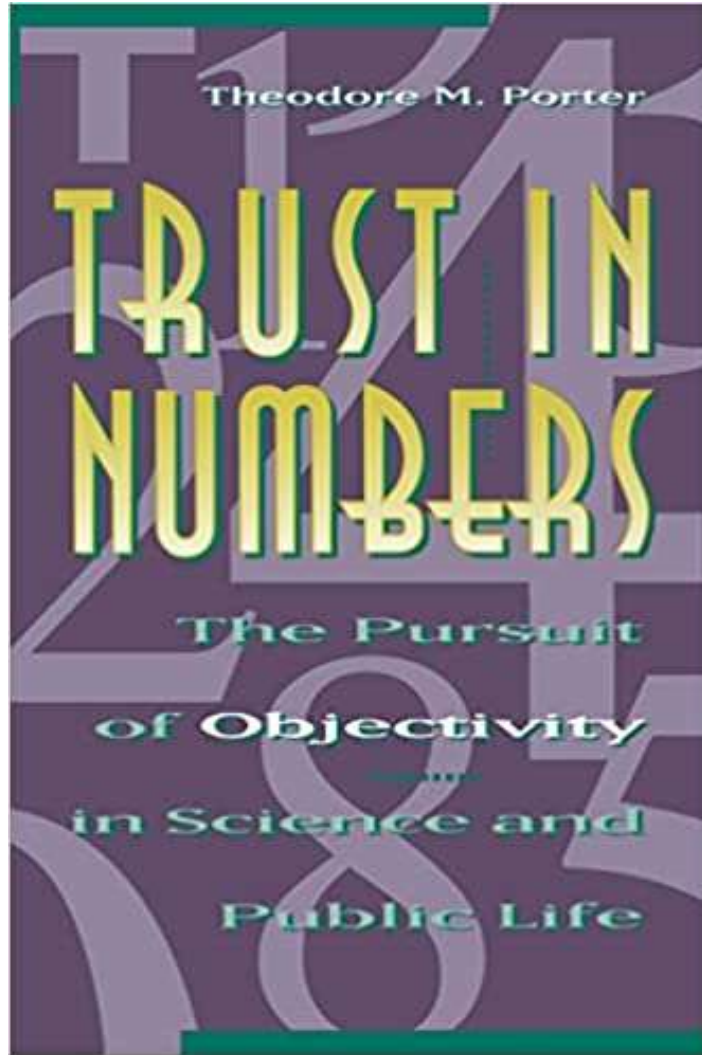
“Thou shall confess in the presence of sensitivity.  
Corollary: Thou shall anticipate criticism “



“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

## Mind the framing

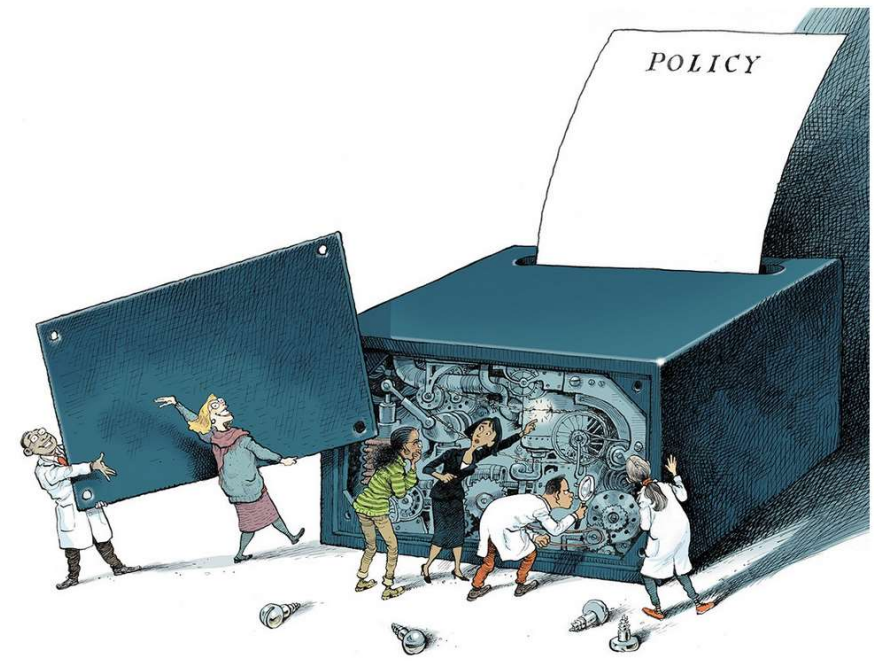
Match purpose and context

## Mind the consequences

Quantification can backfire.

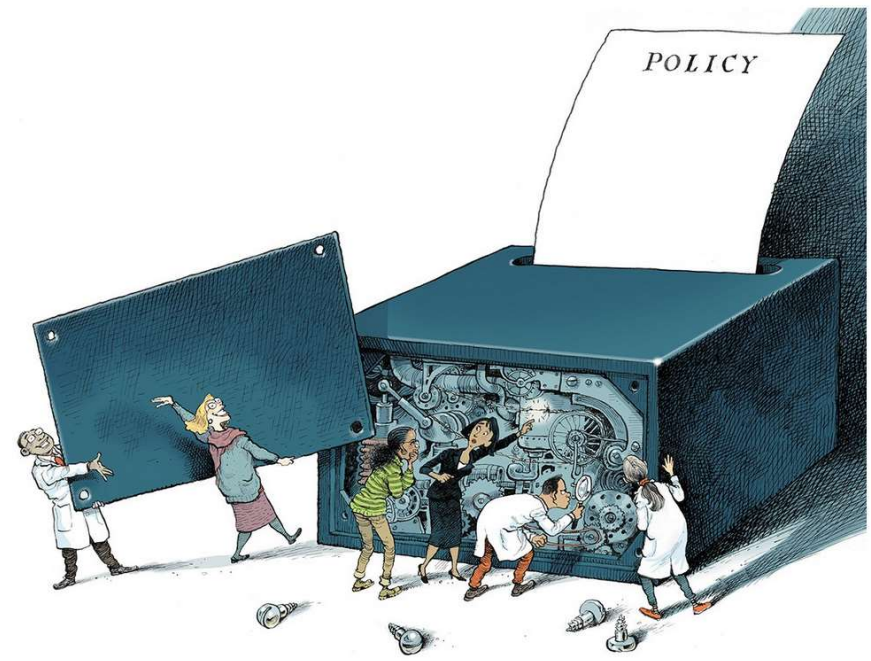
## Mind the unknowns

Acknowledge ignorance



# Mind the hubris

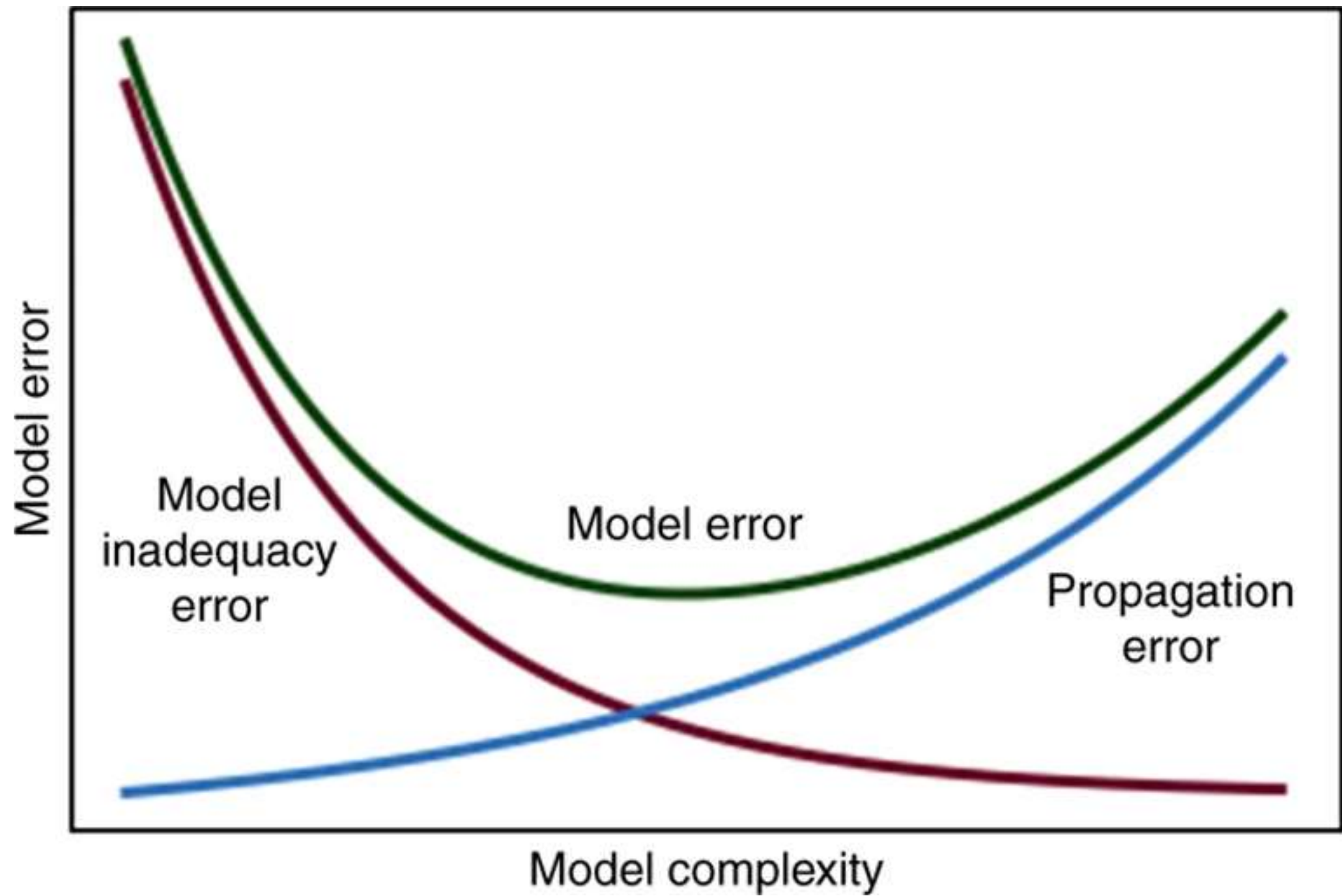
Complexity can be the enemy of relevance



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

## SUPPLEMENTARY INFORMATION

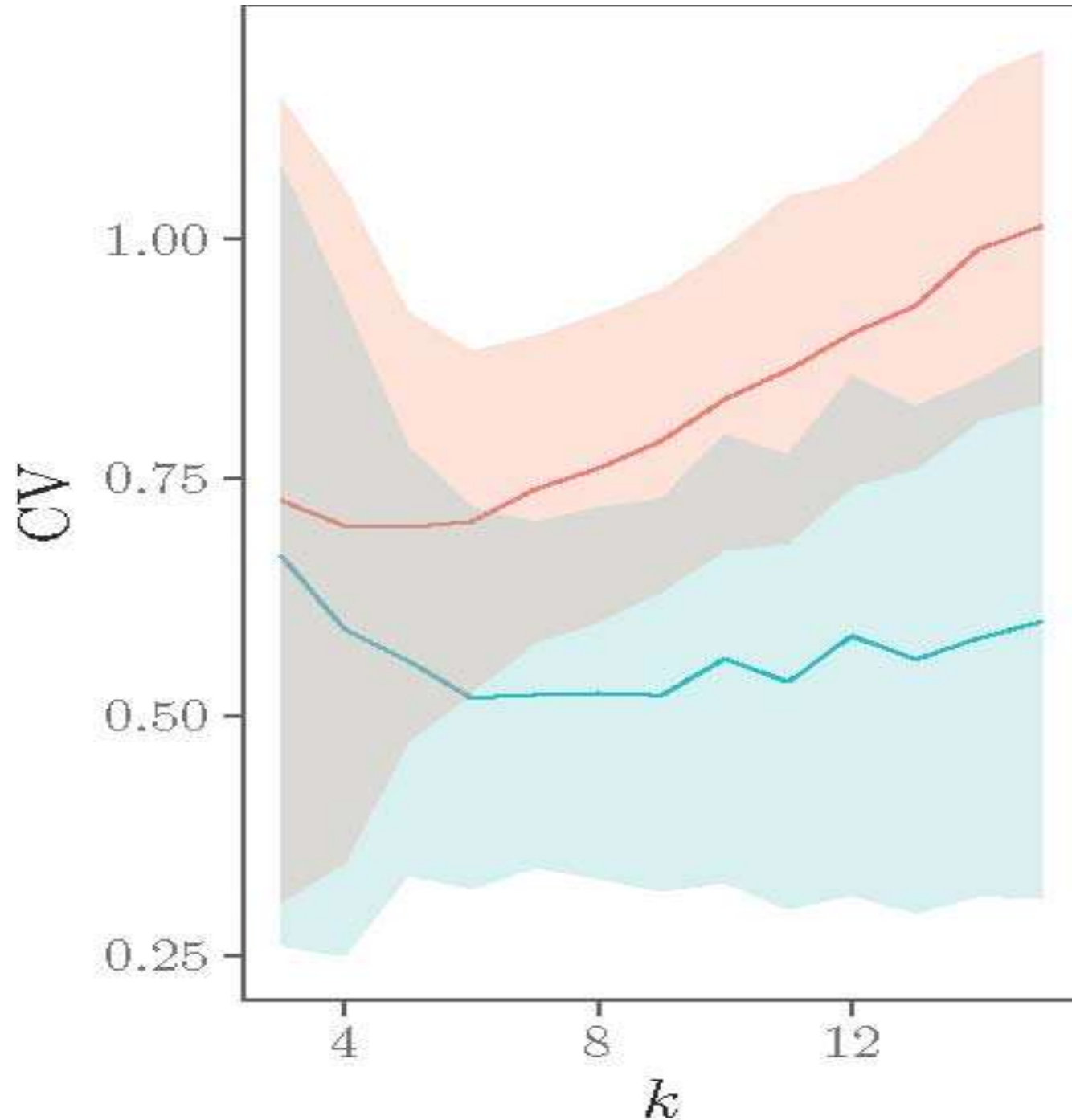
1. Additional information and references >260 references



# 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**

Mathematical  
models  
(continued)

# Mind the assumptions

Assess uncertainty and sensitivity

## Mind the hubris

Complexity can be the enemy of relevance



## Mind the framing

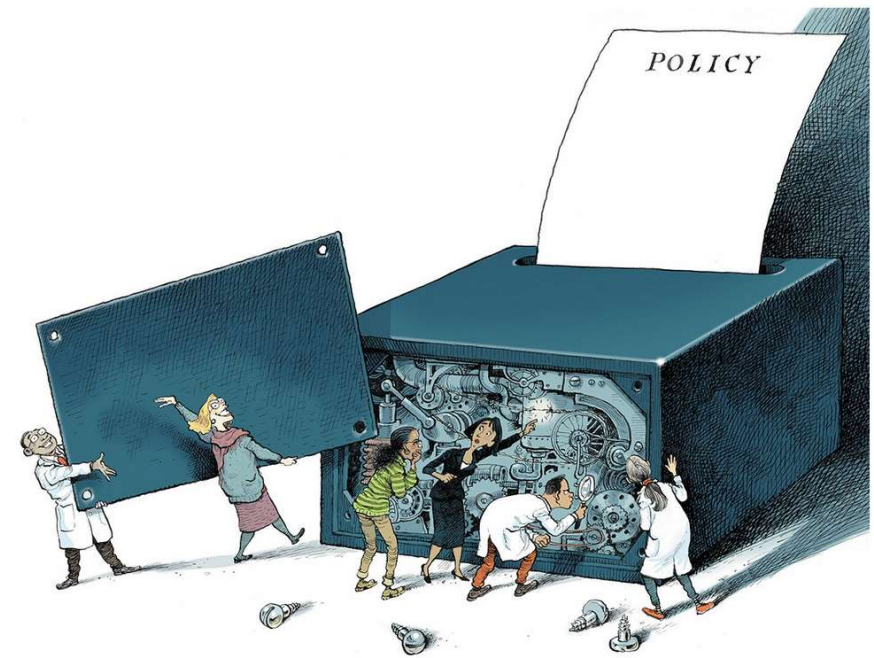
Match purpose and context

## Mind the consequences

Quantification can backfire.

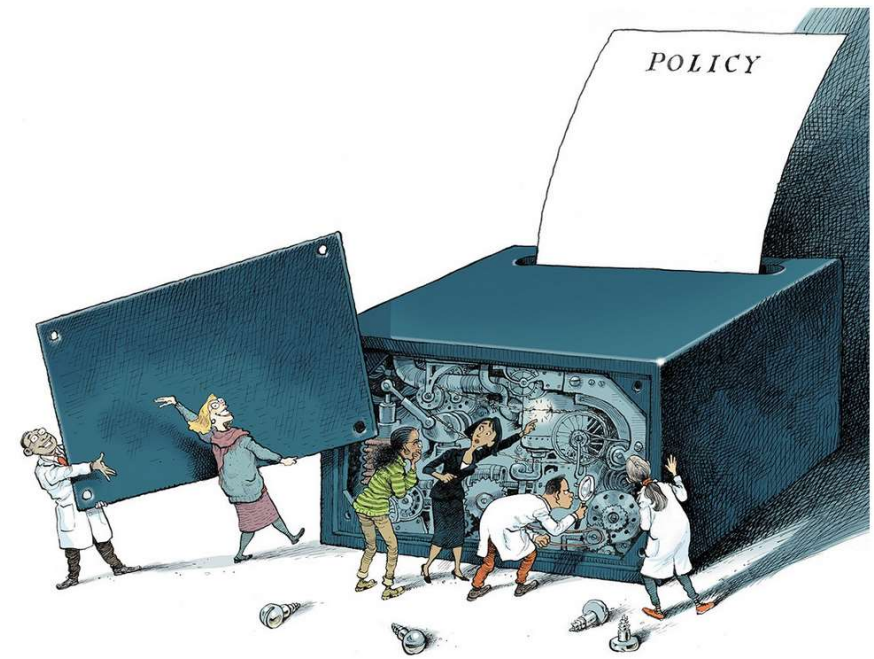
## Mind the unknowns

Acknowledge ignorance



# Mind the framing

Match purpose and context



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

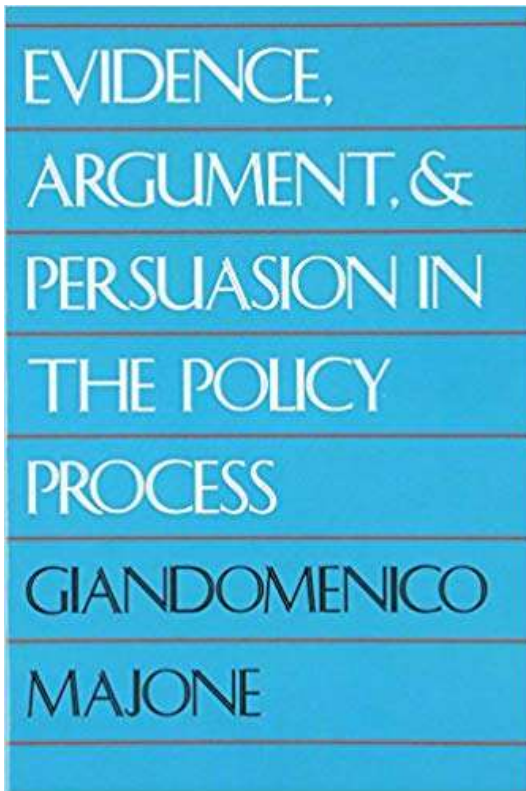
## SUPPLEMENTARY INFORMATION

1. Additional information and references >260 references

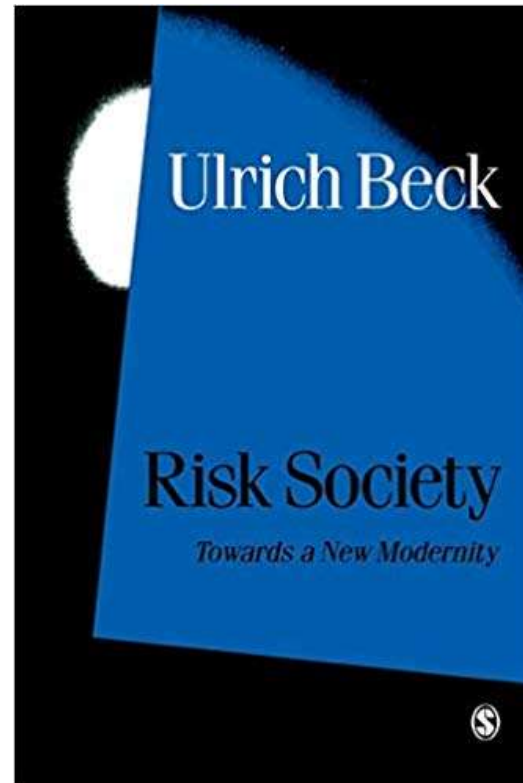
# From Ulrich Beck to Giandomenico Majone: the technique is never neutral



Ulrich Beck  
(1944 –2015)



1989



1992 (1986)



Environmental Science & Policy

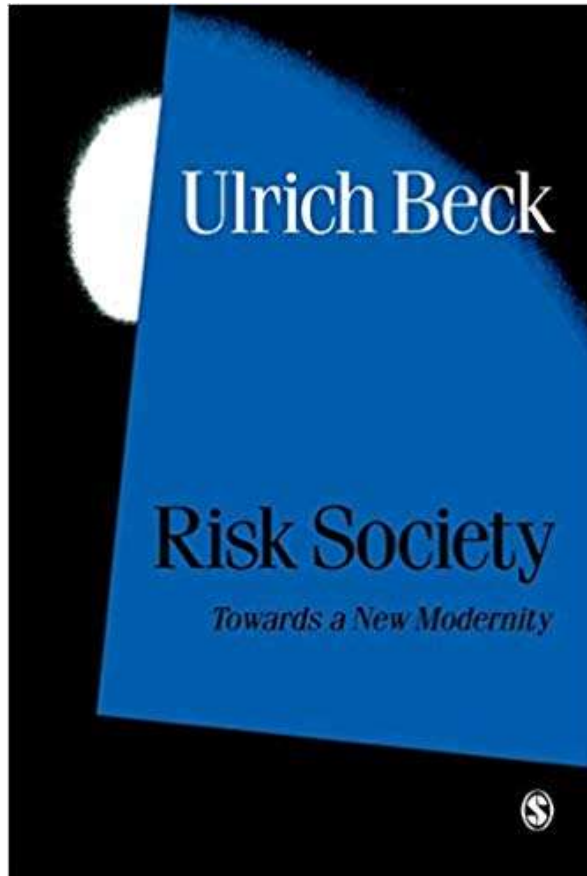
Volume 106, April 2020, Pages 87-98



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

Andrea Saltelli <sup>a, b</sup> ✉, Lorenzo Benini <sup>c</sup>, Silvio Funtowicz <sup>a</sup>, Mario Giampietro <sup>d, e</sup>, Matthias Kaiser <sup>a</sup>,  
Erik Reinert <sup>a, f</sup>, Jeroen P. van der Sluijs <sup>a, g, h</sup>

“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 <sup>a, b</sup>  , Lorenzo Benini <sup>c</sup>, Silvio Funtowicz <sup>a</sup>, Mario Giampietro <sup>d, e</sup>, Matthias Kaiser <sup>a</sup>, Erik Reinert <sup>a, f</sup>, Jeroen P. van der Sluijs <sup>a, g, h</sup>

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

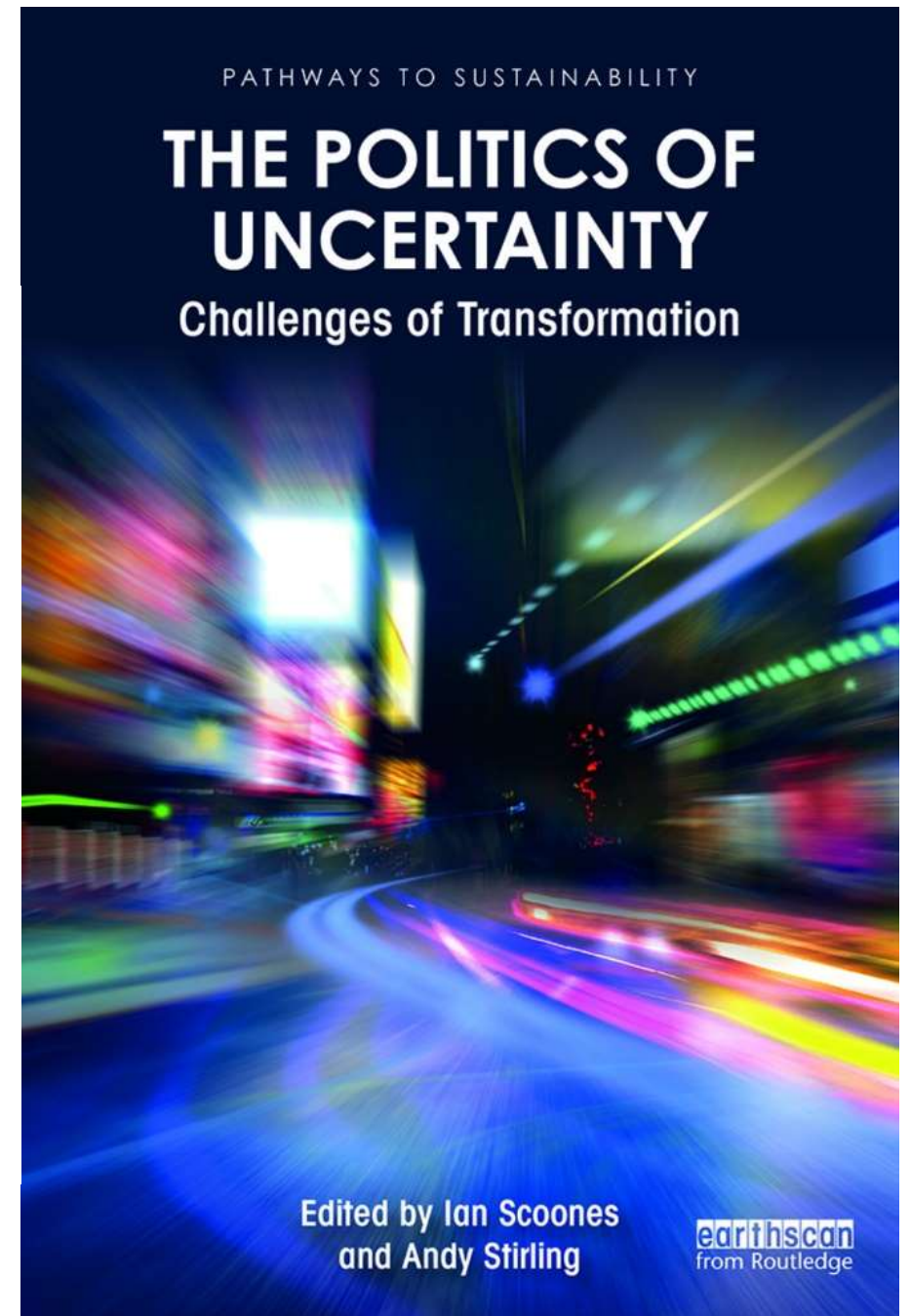
# On reductionism

## 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 is 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

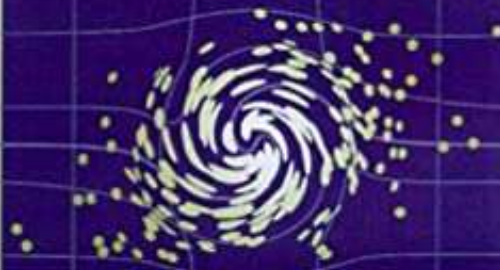
“Bay models are used to track nutrient loads to ensure the cap is not exceeded”

➔ 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.

# PREDICTION

Science, Decision Making,



and the Future of Nature

Edited by Daniel Sarewitz,  
Roger A. Pielke, Jr., and Radford Byerly

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).

# Mind the assumptions

Assess uncertainty and sensitivity

## Mind the hubris

Complexity can be the enemy of relevance

## Mind the framing

Match purpose and context

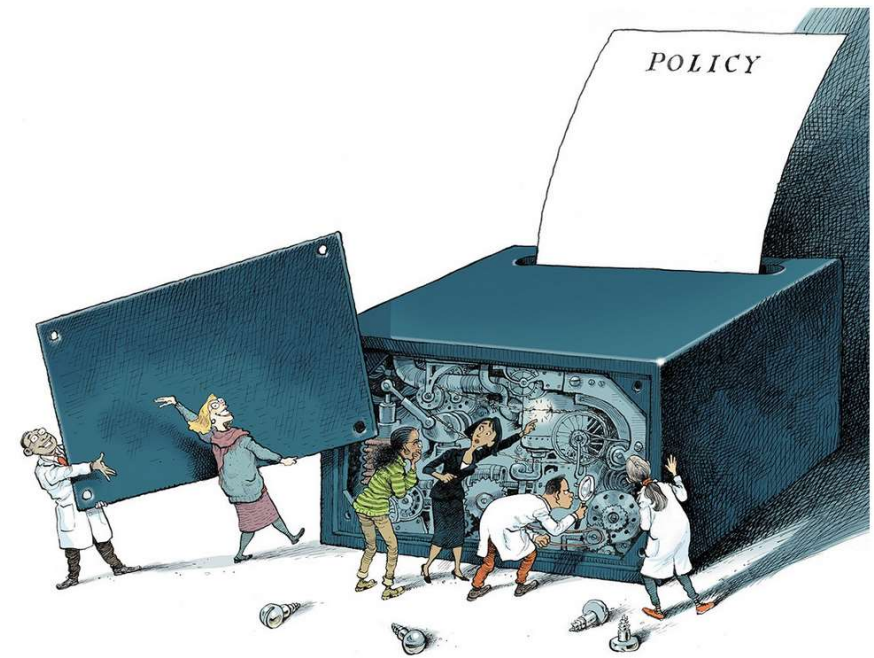


## Mind the consequences

Quantification can backfire.

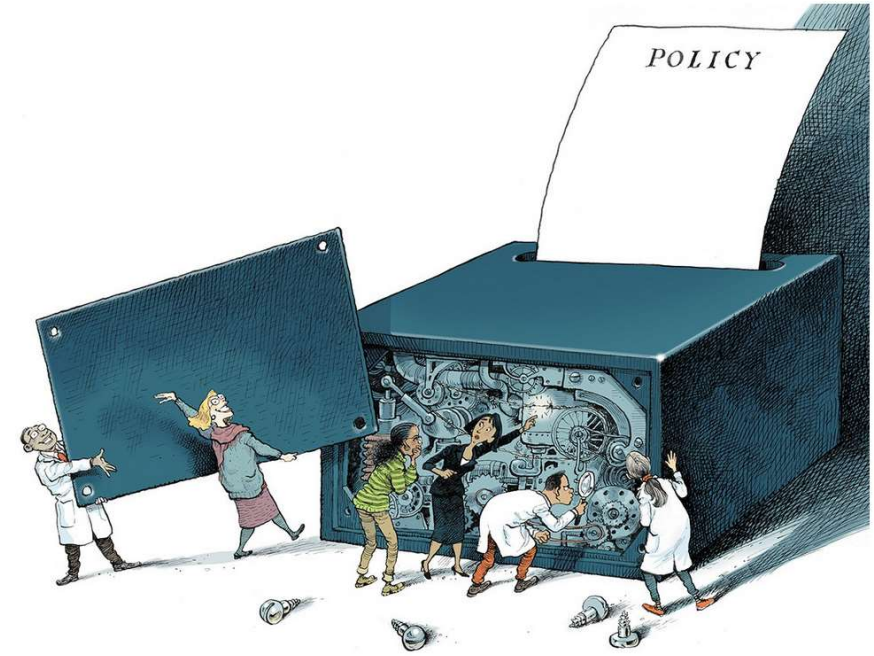
## Mind the unknowns

Acknowledge ignorance



# Mind the consequences

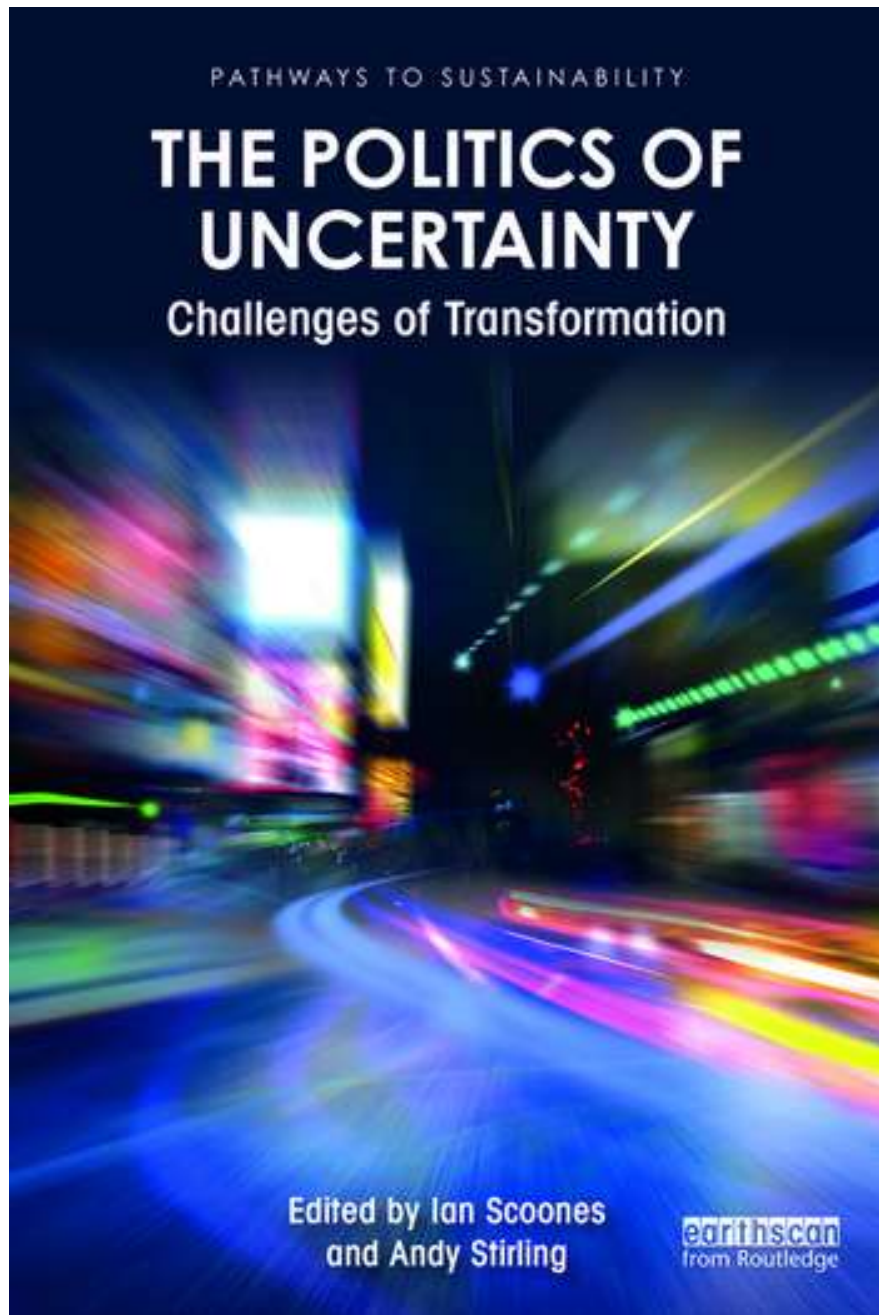
## Quantification can backfire



From the risk of financial products to the management of coastal 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



# Mathematical models (continued, II)

# Mind the assumptions

Assess uncertainty and sensitivity

## Mind the hubris

Complexity can be the enemy of relevance

## Mind the framing

Match purpose and context

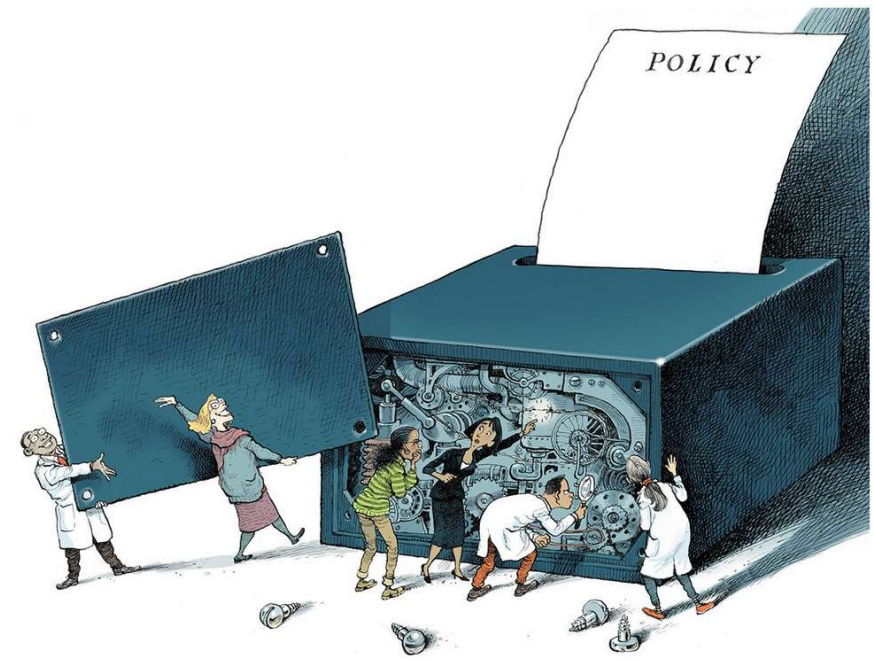
## Mind the consequences

Quantification can backfire.



## Mind the unknowns

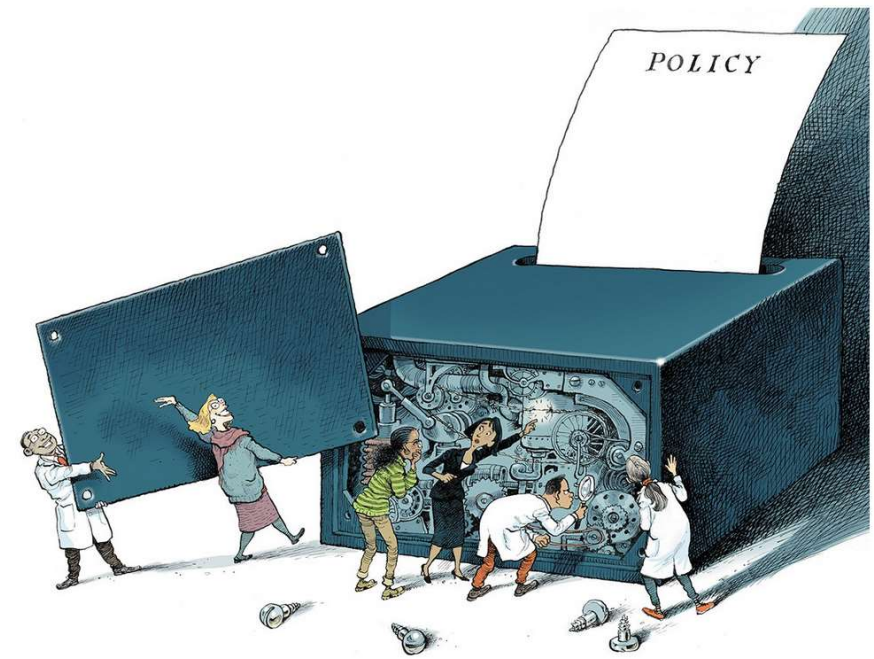
Acknowledge ignorance



# Mind the unknowns

## Acknowledge ignorance

“there is no  
number-answer to  
your question”

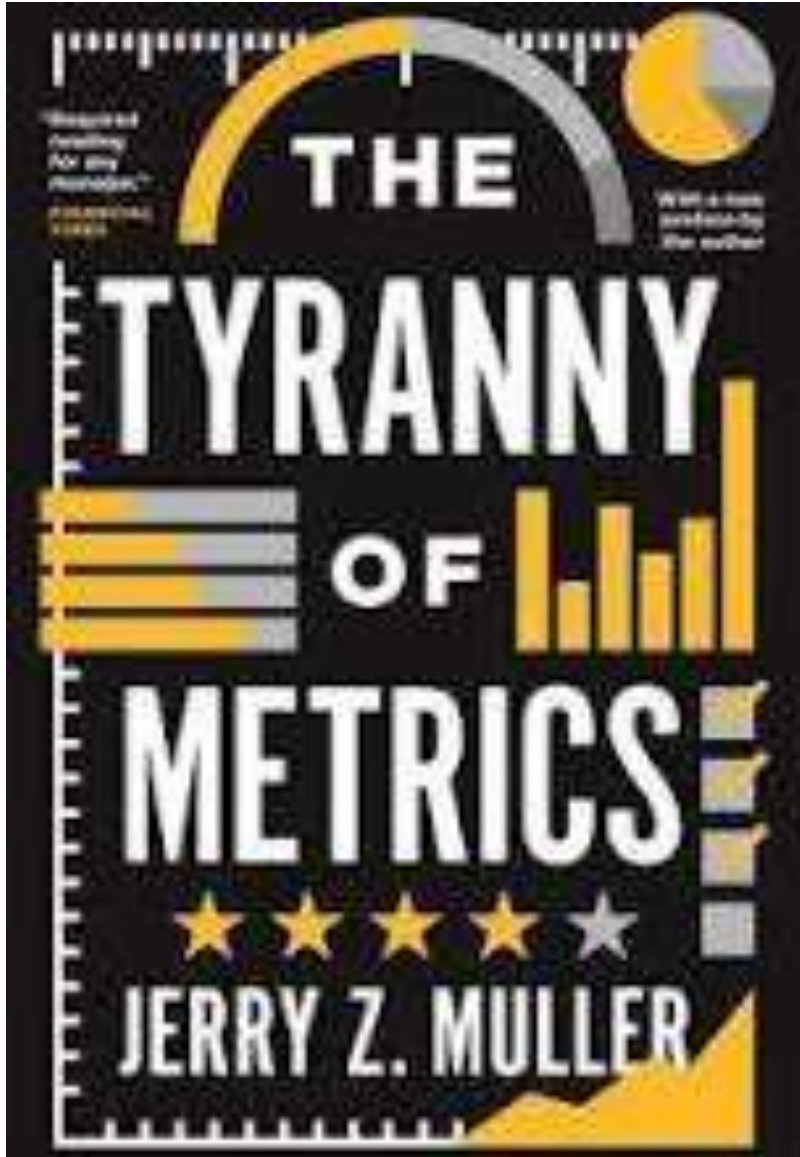


### SUPPLEMENTARY INFORMATION

#### 1. Additional information and references

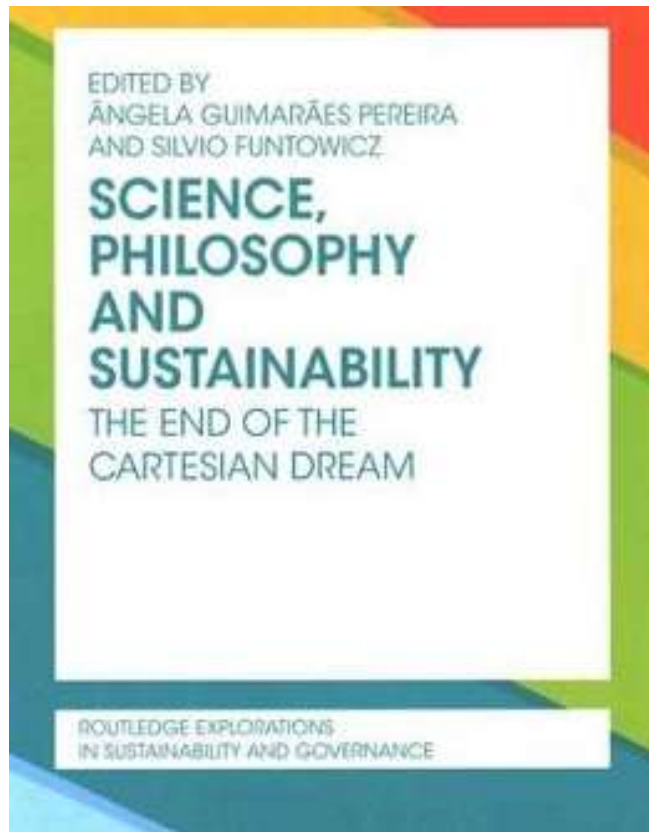
>260 references

Anthony Fauci



As already mentioned:

“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.



# 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<sup>a, b, c</sup>  , Mario Giampietro<sup>a, c, d</sup>

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



## Futures

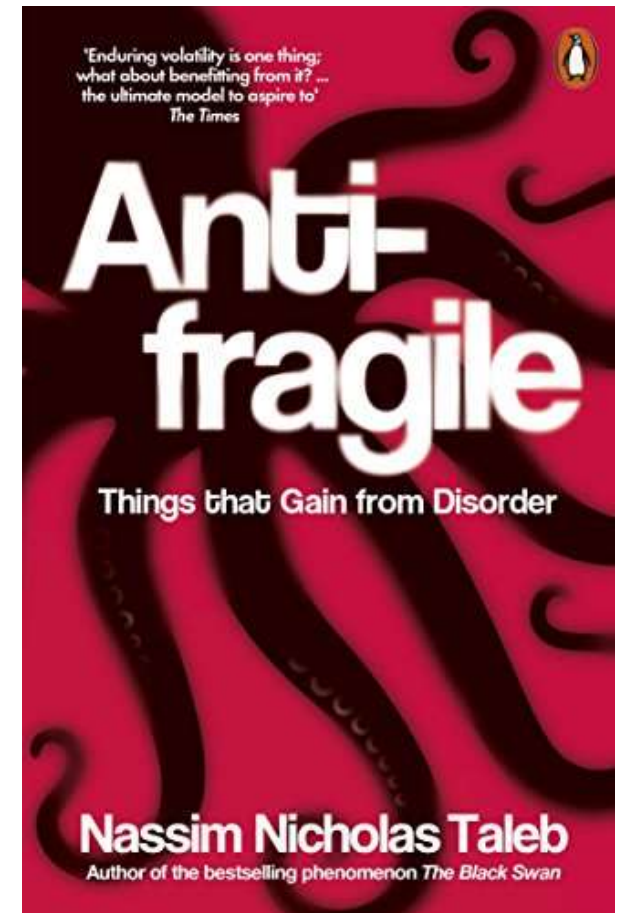
Volume 91, August 2017, Pages 62-71



Original research article

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

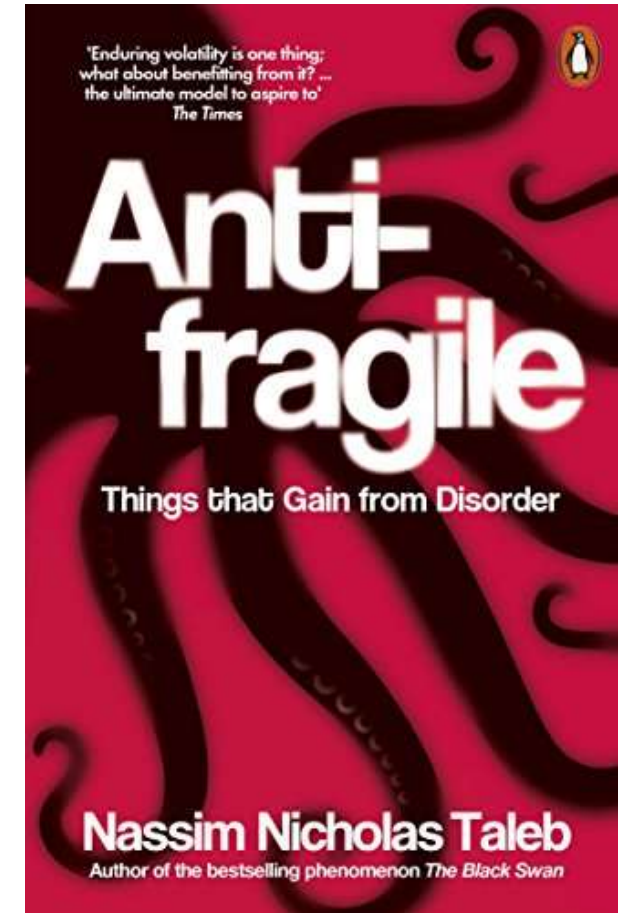
Andrea Saltelli <sup>a, b, c</sup>  , Mario Giampietro <sup>a, c, d</sup>



“...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)



Futures  
Volume 91, August 2017, Pages 62-71



Original research article

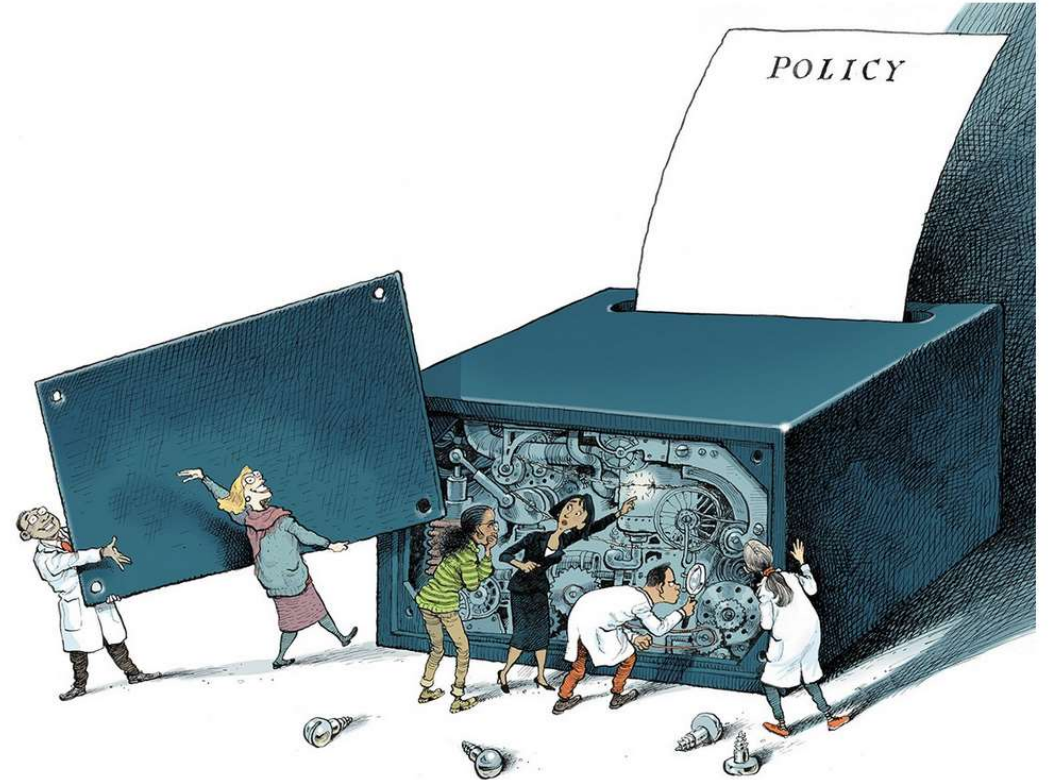
What is wrong with evidence based policy, and how can it be improved?

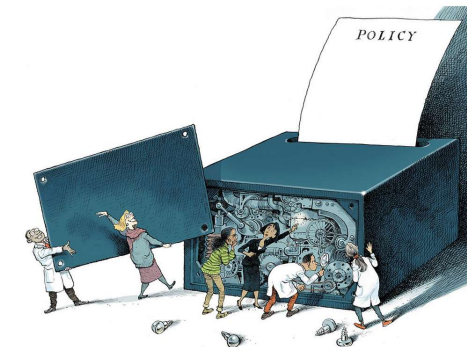
Andrea Saltelli <sup>a, b, c</sup> , Mario Giampietro <sup>a, c, d</sup>

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”

Beyond models

# Why ethics of quantification is needed now



**UCL Institute for  
Innovation and  
Public Purpose**

---

## **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

---

WORKING PAPER  
WP 2021/05



... 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



**UCL Institute for  
Innovation and  
Public Purpose**

WORKING PAPER  
WP 2021/05

Numbers capture our attention; they illuminate the part of reality which is being numerified, and fatally push those parts into the background which come without the clothing of ...

... numbers are so deeply entrenched in our existence that we barely reflect on them critically them anymore — too close to us, they have become part of the very lens through which we attend to and comprehend the world.



**UCL Institute for  
Innovation and  
Public Purpose**

WORKING PAPER  
WP 2021/05

Scope for harm from ‘wrong numbers’ e.g. in :

- Medical research
- Higher education
- Governance of science
- Finance
- Numbers from international organizations
  - Food and Agriculture Organization
  - The World Bank
  - OECD
  - ...
- ...



**UCL Institute for  
Innovation and  
Public Purpose**

WORKING PAPER  
WP 2021/05

‘Trendy’ methods may also harm

- Randomized control trials) may be misused to suggest more general conclusions that may not be valid
- Sophisticated statistical/econometric techniques that can be designed in ways that promote particular policy conclusions reflecting researchers’ biases

## A global observatory for gene editing

Sheila Jasanoff and J. Benjamin Hurlbut call for an international network of scholars and organizations to support a new kind of conversation.

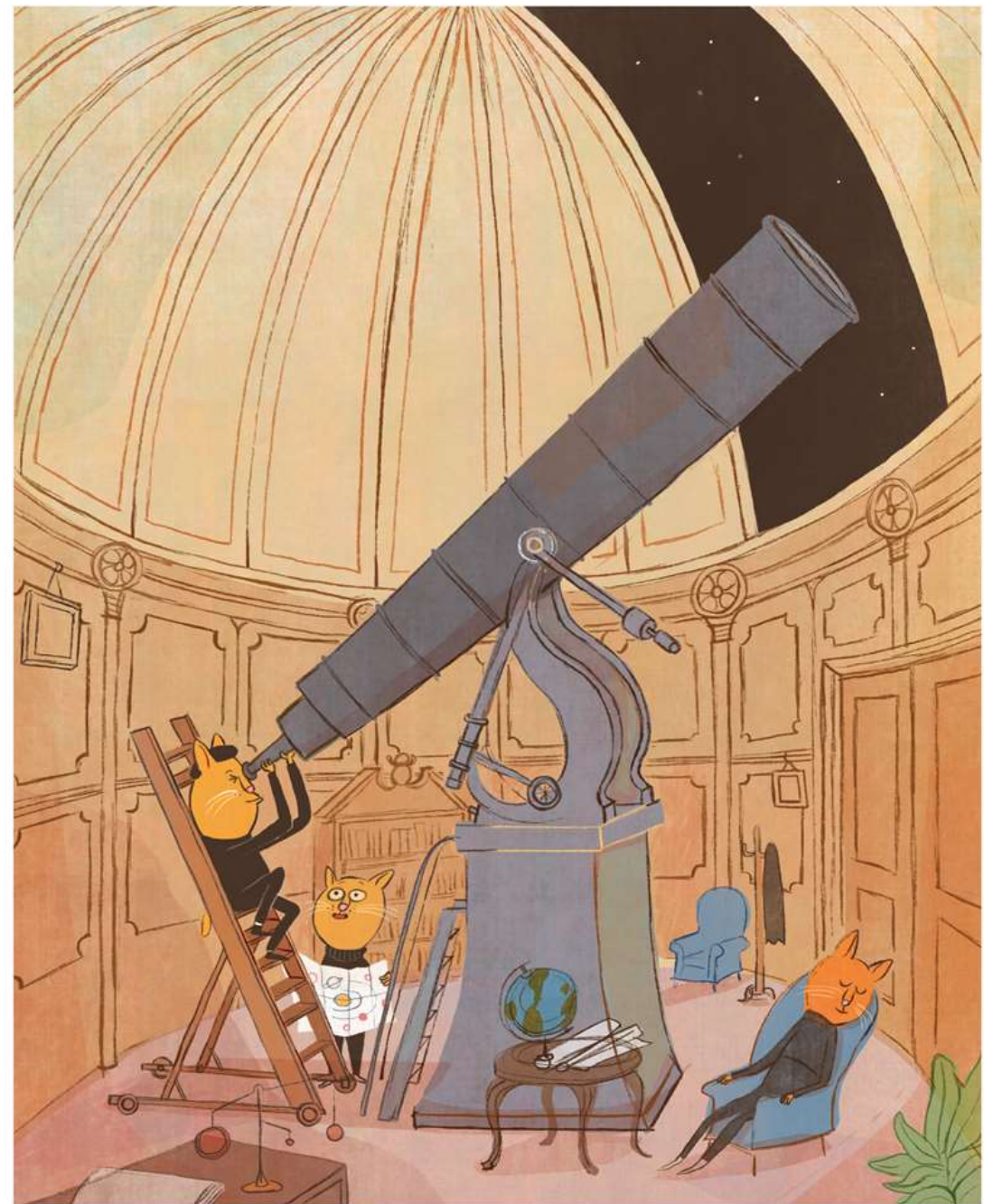
Sheila Jasanoff & J. Benjamin Hurlbut



Illustration by Marina Muun

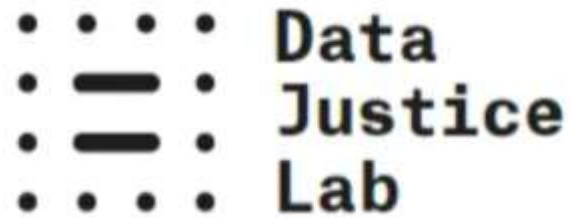
... the potential of numbers to inflict harm is on par or superior to those of biotechnologies

... then how about an observatory for visible and invisible numbers ?



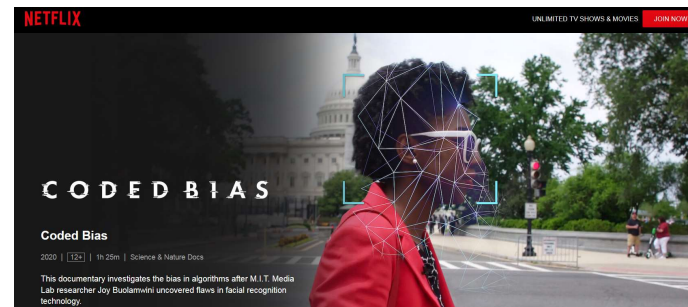
Source: Tor Freeman, <http://tormalore.blogspot.com/>

# Existing initiatives looking at quantification



## Radical Statistics Group

Using statistics to support progressive social change



THE ALGORITHMIC JUSTICE LEAGUE

# The End



@andreasaltelli