

The Economic Analysis of Uncertainty & Uncertainty in Economic Analysis

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Probability meets Social Science



Jacob Bernoulli (left)

Law of Large Numbers: how unknown probabilities are revealed (1713)

Dual Roles for Statistics in Economic Analysis

▷ Outside a model

Given a dynamic economic model, researchers:

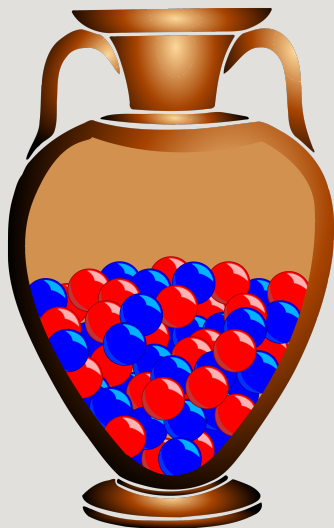
- estimate unknown parameters
- assess model implications

▷ Inside a model

When *constructing* a dynamic economic model, researchers:

- depict economic actors (consumers, enterprises) as they cope with uncertainty
- deduce the consequences for market outcomes and resource allocations

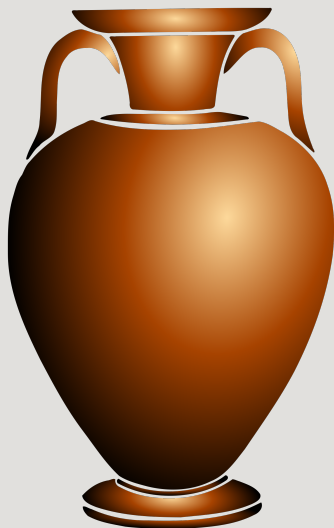
Uncertainty can be *risk*



50 Red Balls

50 Blue Balls

Uncertainty can be *ambiguity*



? Red Balls

? Blue Balls

Uncertainty can *change over time*



? Red Balls

? Blue Balls

Multiple Components to Uncertainty

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- Model *ambiguity* - how much confidence do we place in each model?
- Model *misspecification* - how do we use models that are not perfect?

Uncertainty and Skepticism



The Cheat, Georges de La Tour

Statistical complexity

- ▷ When is it challenging to **learn** and draw **inferences**?
- ▷ When is there **more** scope for **behavioral distortions**?
- ▷ When does **statistical uncertainty** induce **fluctuations** in **market prices** and impact **resource allocation**?

Take a **broader perspective** on uncertainty that is typical in economic analyses.

Long-term Uncertainty

Joel Mokyr

“There are a myriad of reasons why the future should bring more technological progress than ever before – perhaps the most important being that technological innovation itself creates questions and problems that need to be fixed through further technological progress.” (2013)

Robert Gordon

“...the rise and fall of growth are inevitable when we recognize that progress occurs more rapidly in some time periods than others...The 1870-1970 century was unique: Many of these inventions could only happen once, and others reached natural limits.” (2016)

Rational Expectations inside an Economic Model

Muth (1961) and Lucas (1972): Economic actors (investors) use *long histories* of data to infer the model, including its parameters.

- ▷ Yields a stochastic notion of *equilibrium* with expectations determined *inside the model*
- ▷ Gives a coherent approach to *policy analysis*

Influential, but *neglects* some components of uncertainty by featuring only *risk*. Statistical challenges are off the table.

Risk Inside the Model

- ▷ Recent empirical successes in macro-finance rely on endowing investors with knowledge of potentially **statistically subtle** components of the macro time series. Where does this **confidence** come from?
- ▷ Imposes stochastic volatility **exogenously**.
- ▷ Imposes **large** risk aversion.

Success?

Model Misspecification and Ambiguity Aversion

Statistical models we use in practice are **misspecified**.

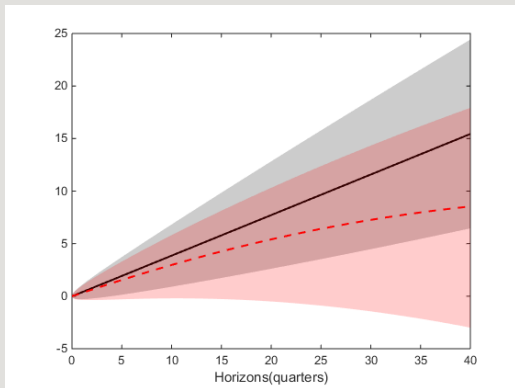
- Aim of **robust** approaches:
 - ▷ use models in sensible ways rather than discard them
 - ▷ use probability and statistics to provide tools for assessing sensitivity to potential misspecification
- **Ambiguity aversion** - averse to **uncertainty** about **probabilities** over future events
- Outcome - **target** the uncertainty with the **most adverse consequences** for the decision maker.

Market Adjustments for Uncertainty

Suppose the private sector is **uncertain** about future macroeconomic growth rates

- ▷ Investors fear **persistence** in **bad times** and fear the **lack of persistence** in **good times**
- ▷ Induces **fluctuations** in the **market price** of uncertainty

Market Adjustments for Uncertainty



The **black** solid line depicts the median under the baseline model and the shaded region gives the .1 and .9 deciles. The **red** dashed line is the median under the worst-case model and the red shaded region gives the .1 and .9 deciles. Source: Hansen and Sargent.

Friedrich Hayek (1974)



“Even if true scientists should recognize the limits of studying human behaviour, as long as the public has expectations, there will be people who *pretend* or *believe* that they can do more to meet popular demand than what is really in their power.”
(From Hayek’s Nobel address)

Climate uncertainty

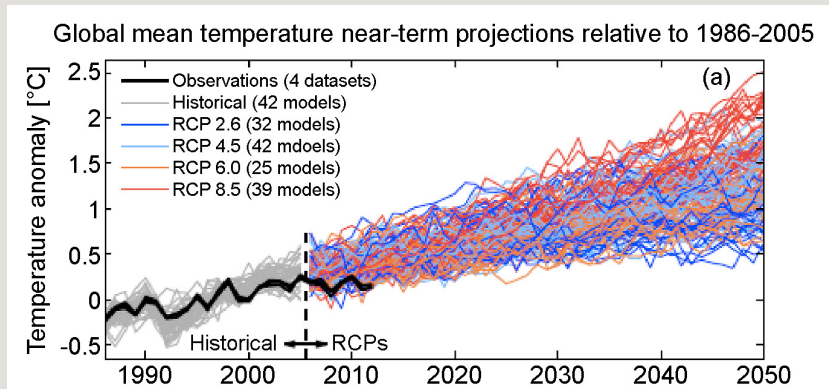
M. R. Allen et al.

“Global efforts to mitigate climate change are guided by projections of future temperatures. But the eventual equilibrium global mean temperature associated with a given stabilization level of atmospheric greenhouse gas concentrations remains uncertain, complicating the setting of stabilization targets to avoid potentially dangerous levels of global warming.” (2009)

American Physical Society Climate Change Statement Review

“While the Global Mean Surface Temperature (GMST) rose strongly from 1980 - 1998, it has shown no significant rise for the past 15 years. That behavior does not track the model projections.” (2013)

Uncertainty of temperature changes



Source: IPCC AP5 (2013) Figure 11.25

Uncertainty and Climate Change Policy

“Any serious discussion of the changing climate must begin by *acknowledging* not only the scientific certainties but also the *uncertainties*, especially in projecting the future. Recognizing those limits, rather than ignoring them, will lead to a more *sober* and ultimately more *productive* discussion of climate change and climate policies.”

Steven E. Koonin (2014, former undersecretary for science in the US Department of Energy)

Uncertainty and Financial Market Oversight

- *Systemic risk*: A grab bag of scenarios rationalizing interventions in financial markets
- *Challenges*: Limited understanding of systemic risk challenges its value as a guiding principle for financial oversight
- *Systemic uncertainty*: Complicated problems do not necessarily require complicated solutions

Do complicated problems require complicated solutions?

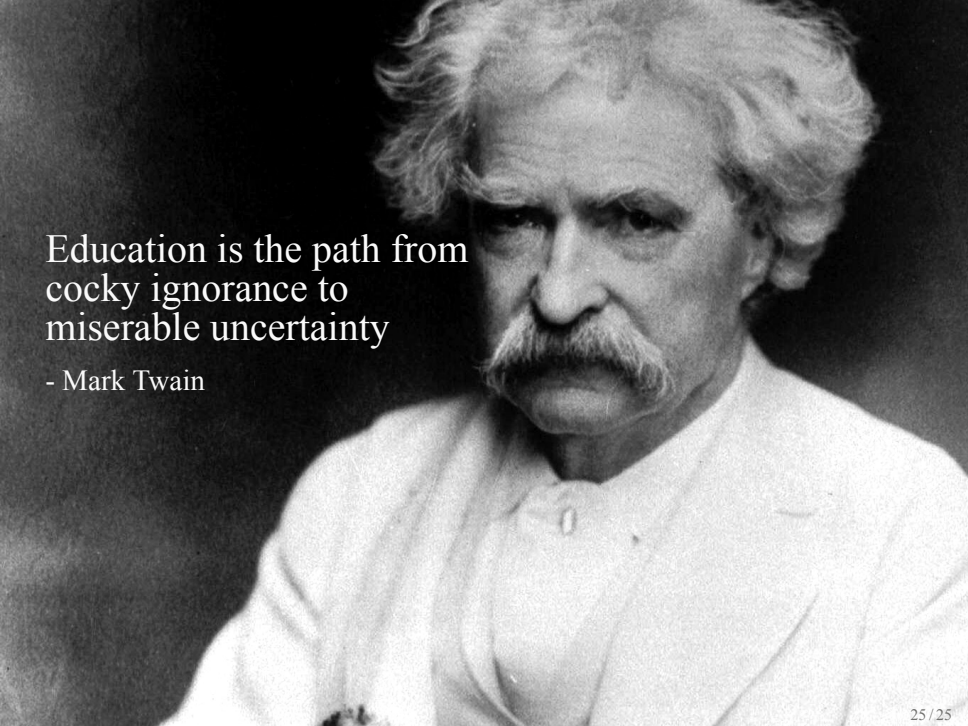
Financial market oversight is arguably a **complicated** problem

- Acknowledge limits to our **understanding** of the linkages between financial markets and the macroeconomy.
- Specific models could imply **alternative** complex solutions.
- “**Robust**” policies perform well across alternative models.
- **Simple** robust policies **avoid** adding uncertainty to the economic environment.

Confronting uncertainty in public policy

- ambiguity aversion or a concern about model misspecification (often) has an implied (restrained) **worst-case** probability model as an **outcome** of robust decision making
- Plato's noble falsehood - **overstate** knowledge to **influence** public policy

Smart courses of action limit **possibilities** of bad outcomes.

A black and white portrait of Mark Twain, showing him from the chest up. He has white, curly hair and a prominent white mustache. He is wearing a light-colored, high-collared shirt. The background is dark and out of focus.

Education is the path from
cocky ignorance to
miserable uncertainty

- Mark Twain