Confronting a World of Economic Uncertainty

Lars Peter Hansen
University of Chicago
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Probability meets Social Science

Jacob Bernoulli (left)

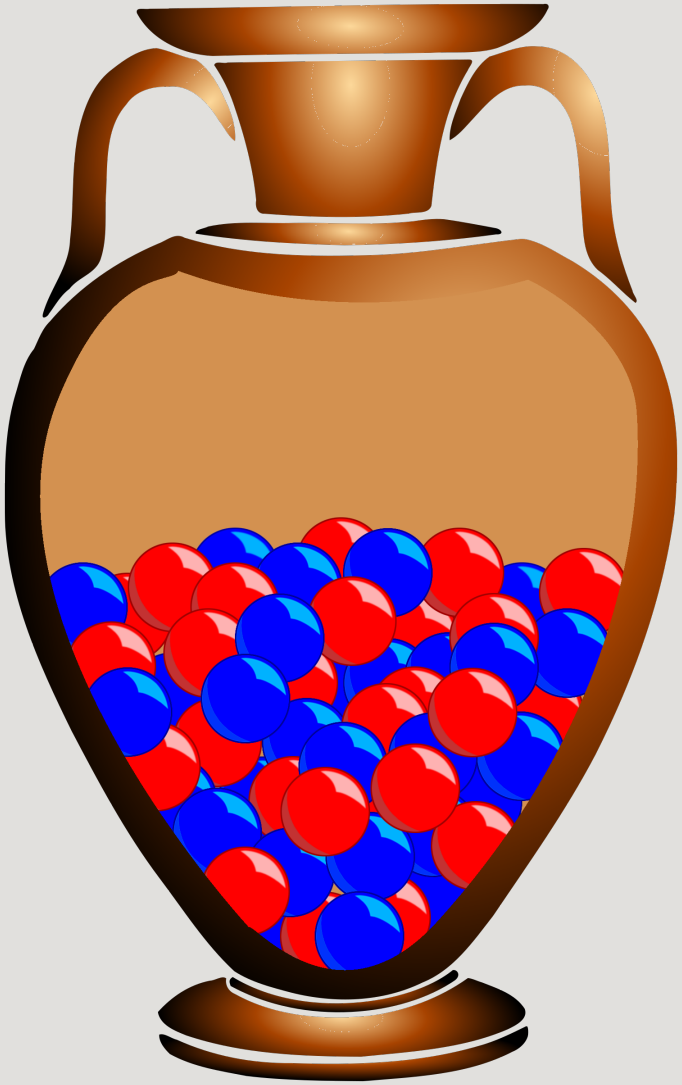
Law of Large Numbers: how unknown probabilities are revealed (1713)

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*

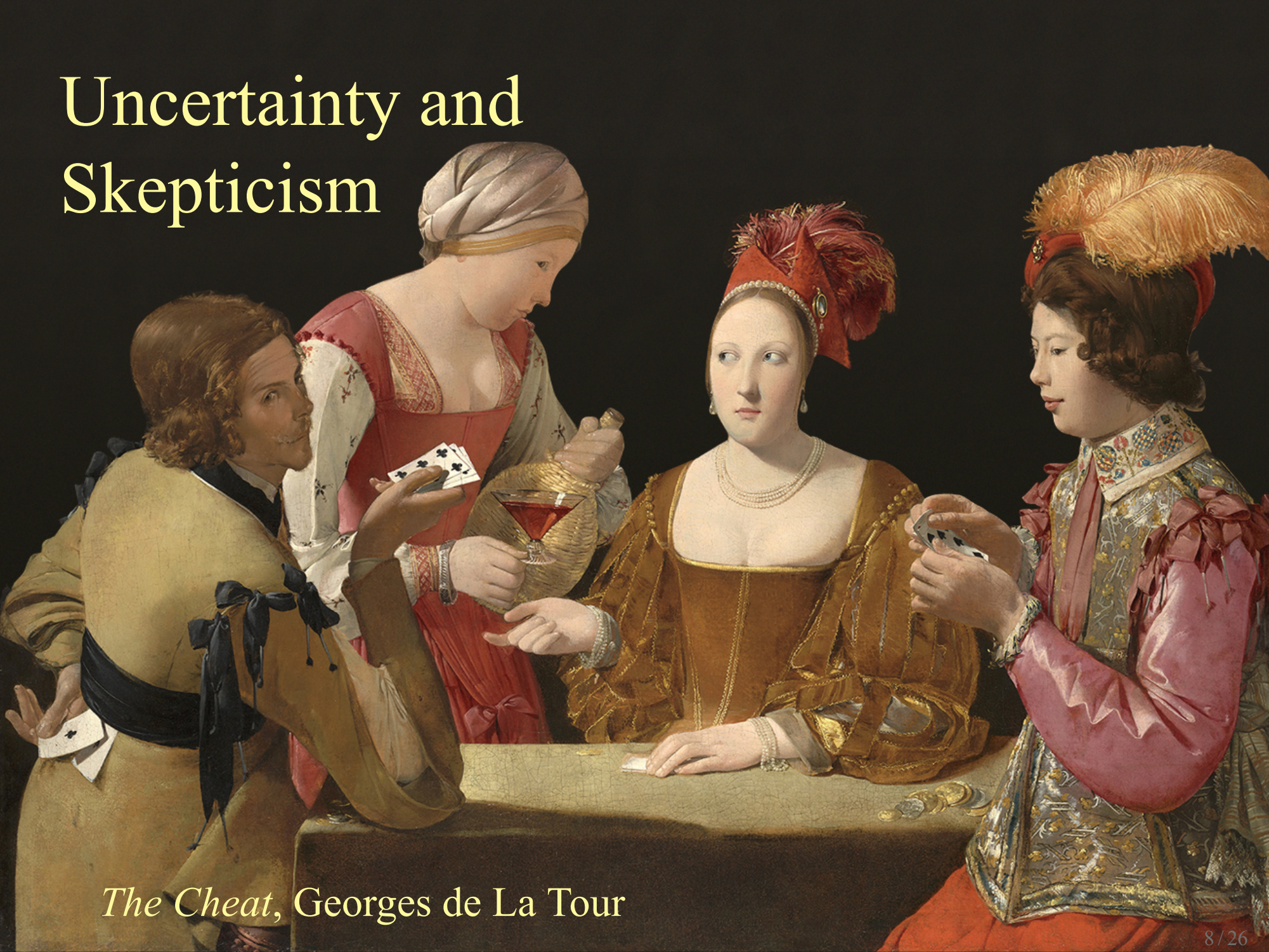
? Red Balls

? Blue Balls

Multiple Components to Uncertainty

- *Risk*
  uncertainty within a model: what probabilities does a model assign to events in the future?
- *Ambiguity*
  uncertainty over models: how much confidence do we place in each model?
- *Misspecification*
  uncertainty about models: 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.

Uncertainty Can Be Complex

Las Meninas, Diego Velàzquez

Long-term Uncertainty

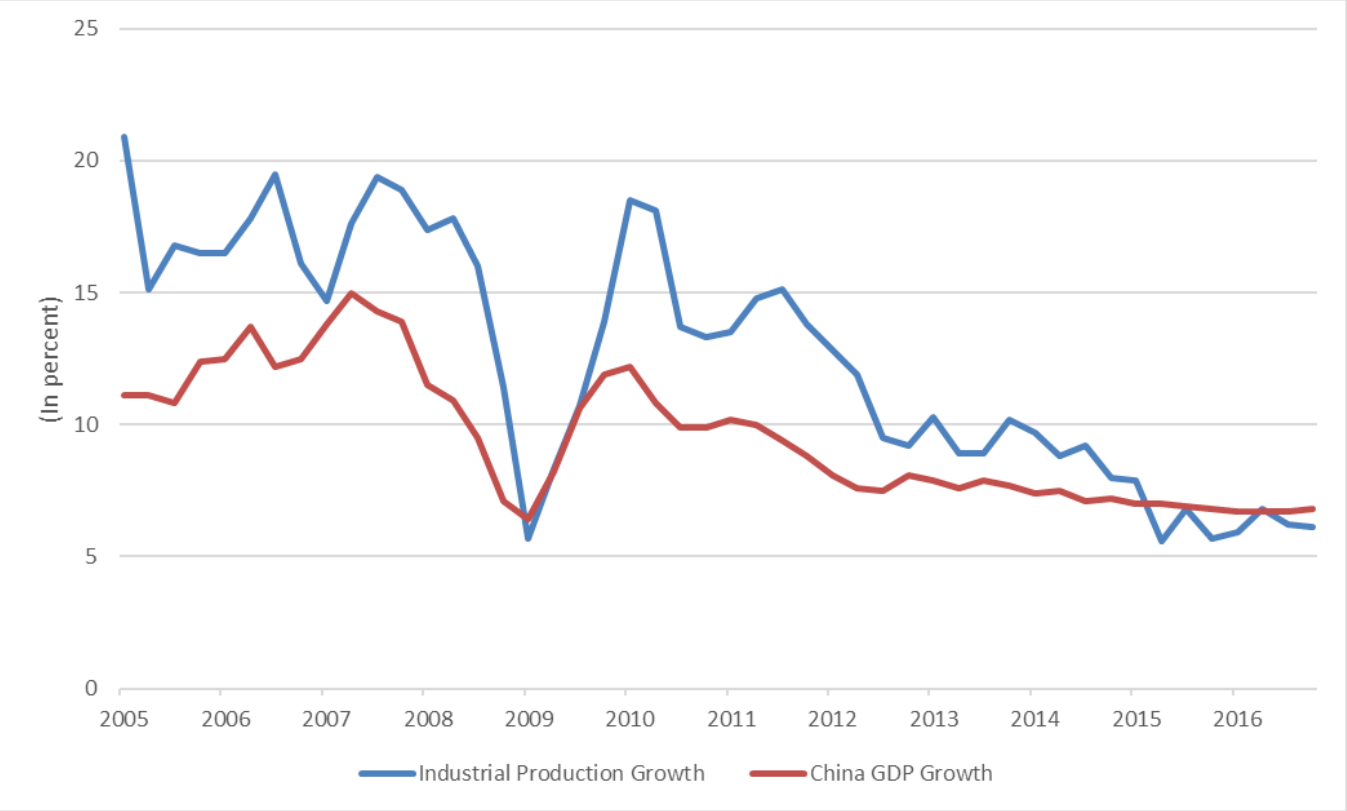
Joel Mokyr

"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)

Evidence from Macroeconomic Data



China GDP and industrial production growth

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.

Uncertainty and Financial Markets

Bear Bull Rumble, Adrian deRooy

Evidence from Financial Market Data

Private sector observation: risk-on risk-off

- Investors' appetites for risk rise and fall over time

Academic research: time-varying risk premia

- Measured risk-return tradeoffs from financial markets fluctuate over time

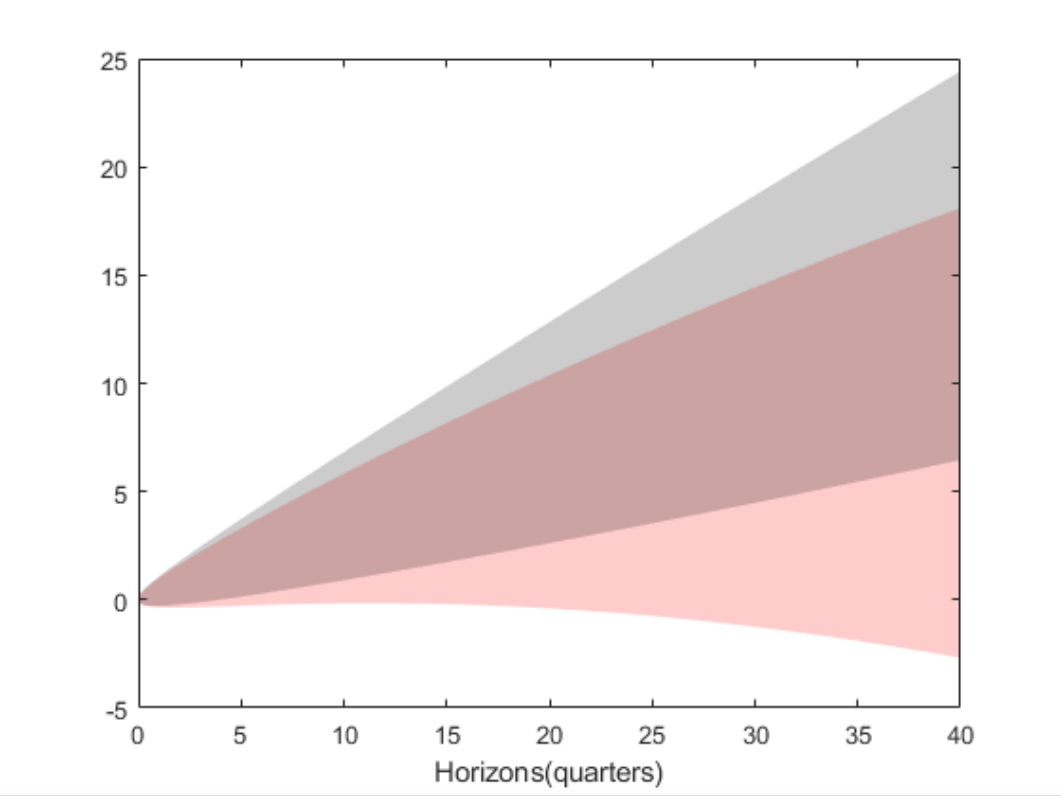
What explains these movements?

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: Price of Uncertainty

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

"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)

M. R. Allen *et al*.

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)

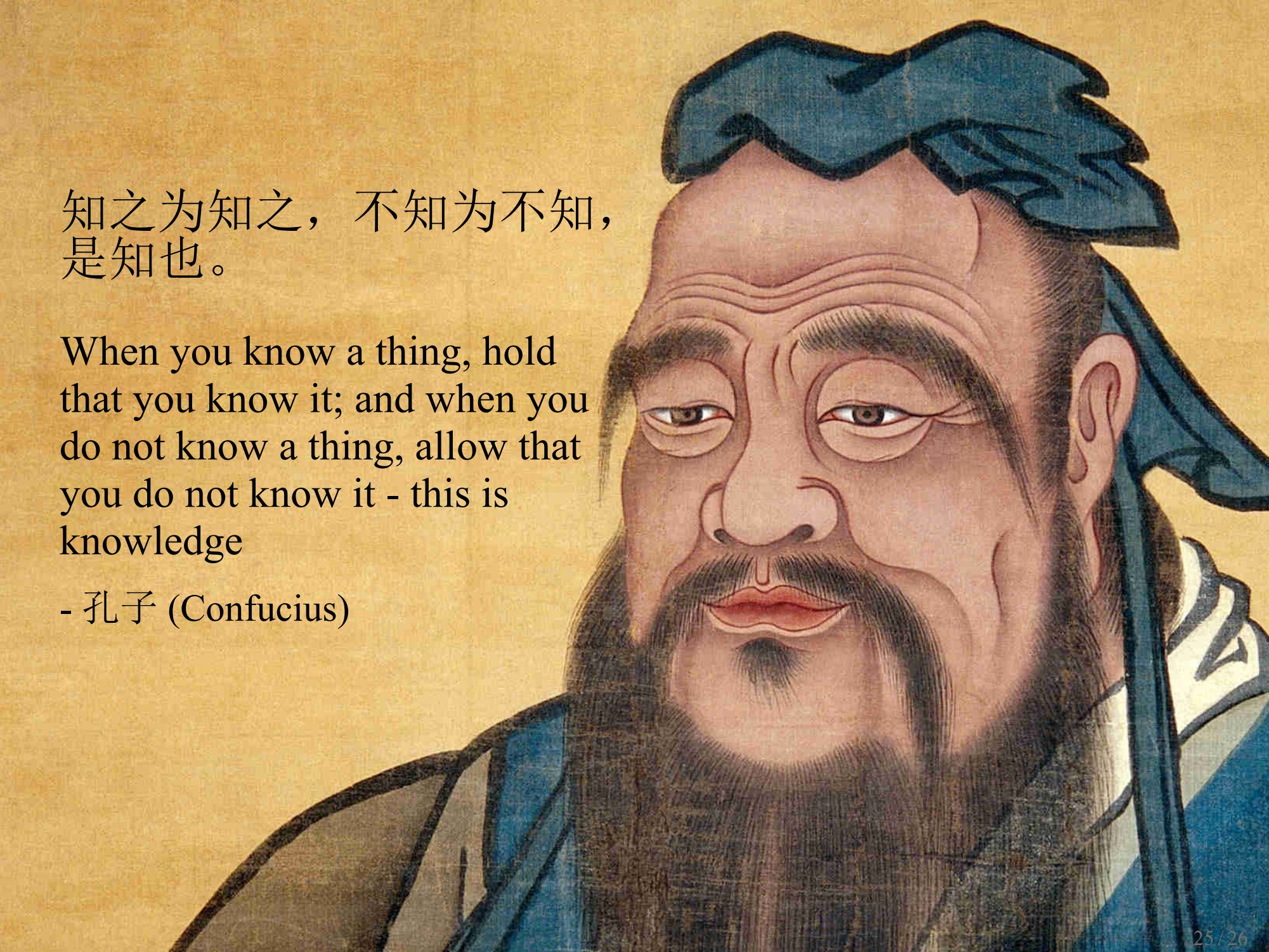
Uncertainty and Financial Market Oversight

- United States: Financial Stability Oversight Council (created in 2010)
- China: Financial Stability and Development Committee (just created)
- Challenges:
  - What is systemic risk: A grab bag of scenarios rationalizing interventions in financial markets
  - Systemic uncertainty: Limited understanding of systemic risk challenges its value as a guiding principle for financial oversight

Do complicated problems require complicated solutions?

Financial market oversight is arguably a complicated problem

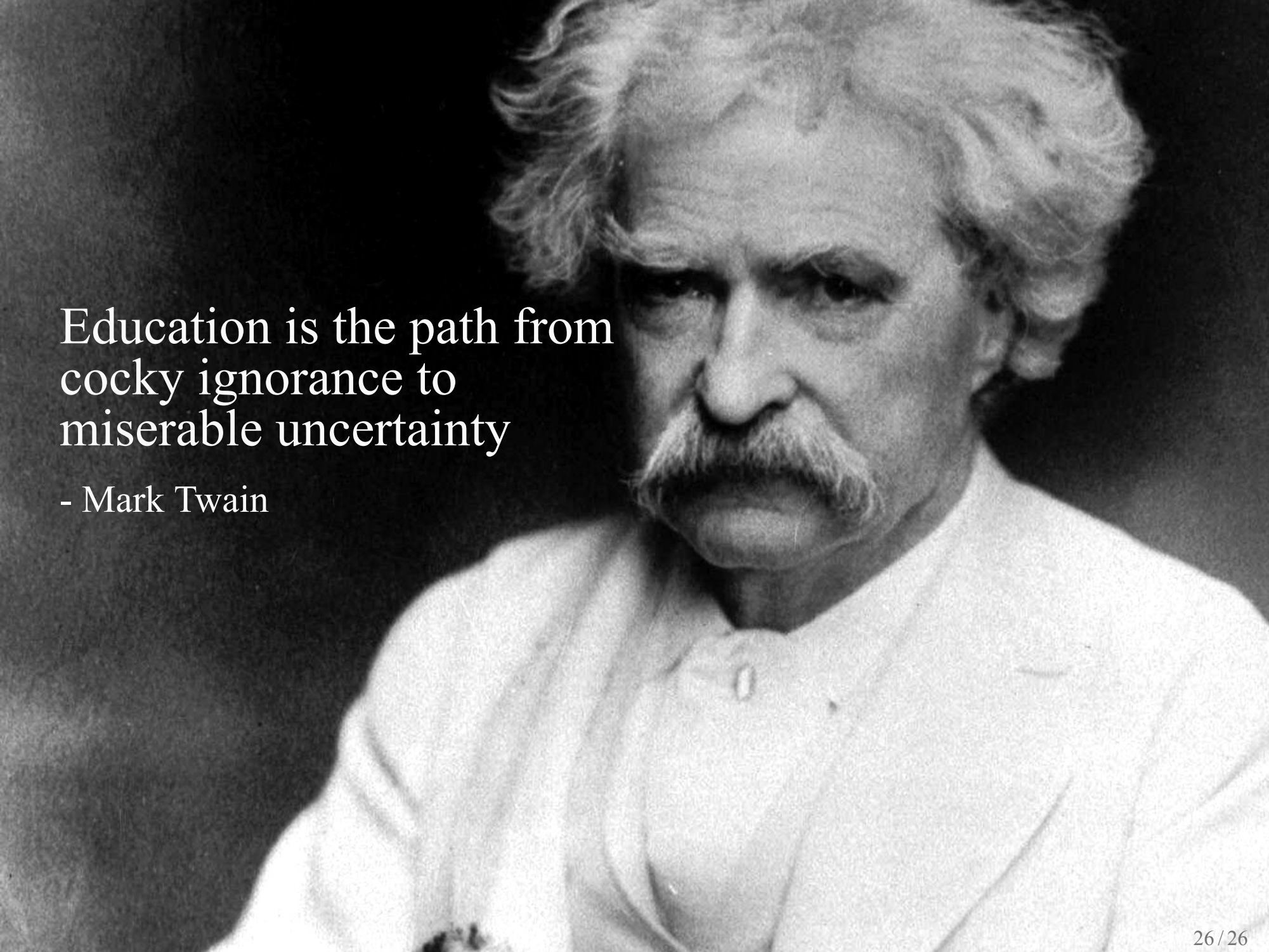
- Acknowledge limits to our understanding of the linkages between financial markets and the macroeconomy.
- Specific models could imply alternative complex solutions.
- "Robust" policies perform well across alternative models.
- Simple robust policies avoid adding uncertainty to the economic environment.



知之为知之，不知为不知，
是知也。

When you know a thing, hold that you know it; and when you do not know a thing, allow that you do not know it - this is knowledge

- 孔子 (Confucius)


Education is the path from
cocky ignorance to
miserable uncertainty
- Mark Twain