

# The Economic Impact of Uncertainty

in a Changing Environment

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University of Chicago

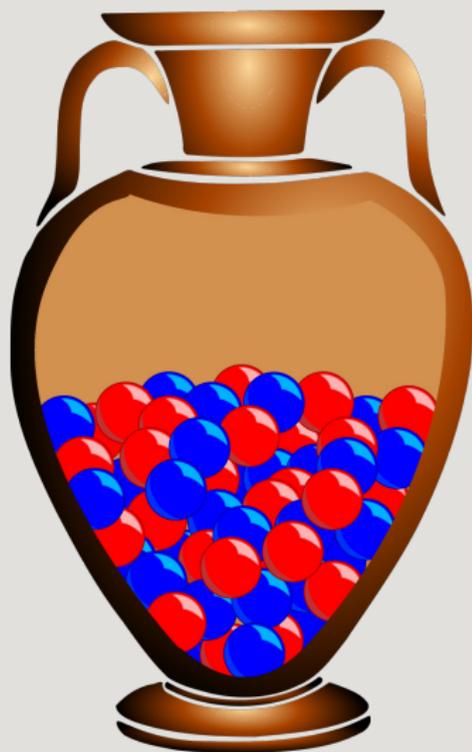
Shanghai Jiao Tong University  
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# Probability and Games of Chance



**Blaise Pascal (1654)**

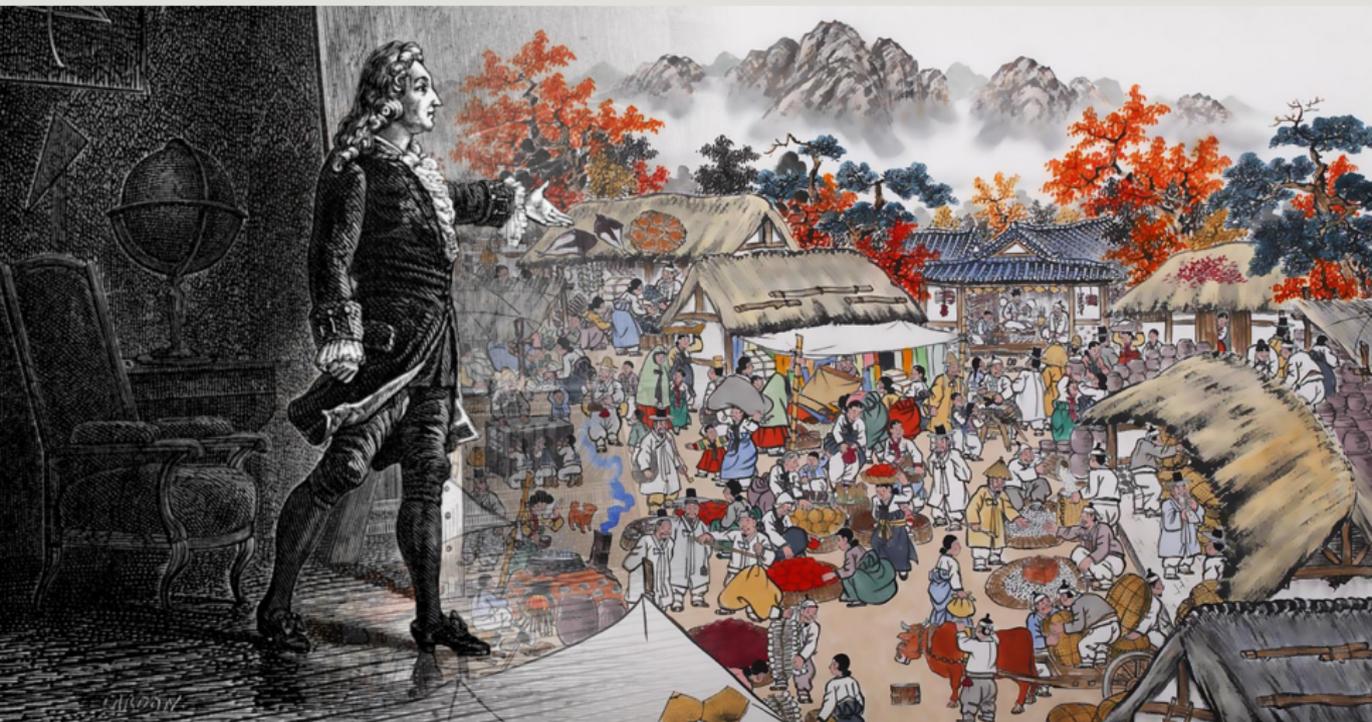
Uncertainty can be *risk*



50 Red Balls

50 Blue Balls

# Probability meets Social Science



**Jacob Bernoulli (left)**

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

# Uncertainty in Economic Analysis

- **Outside a model**

*Given* a dynamic economic model, researchers:

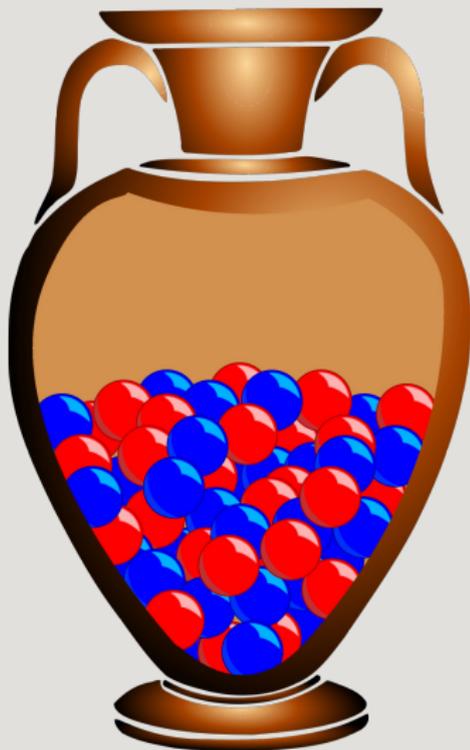
- ▷ estimate unknown parameters
- ▷ assess model implications

- **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*



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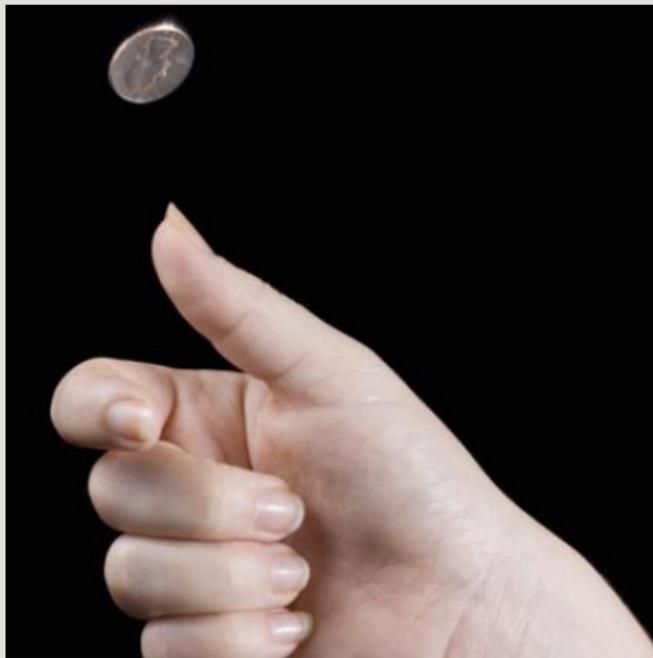
Uncertainty can be *ambiguity*



? Red Balls

? Blue Balls

# Risk



Known Probabilities

# Ambiguity



Unknown Probabilities

Uncertainty can *change over time*



? Red Balls

? Blue Balls

# Uncertainty Can Be Complex



*Las Meninas, Diego Velázquez*

# Multiple Components to Uncertainty

- Model *risk* - what probabilities does a model assign to events in the future?

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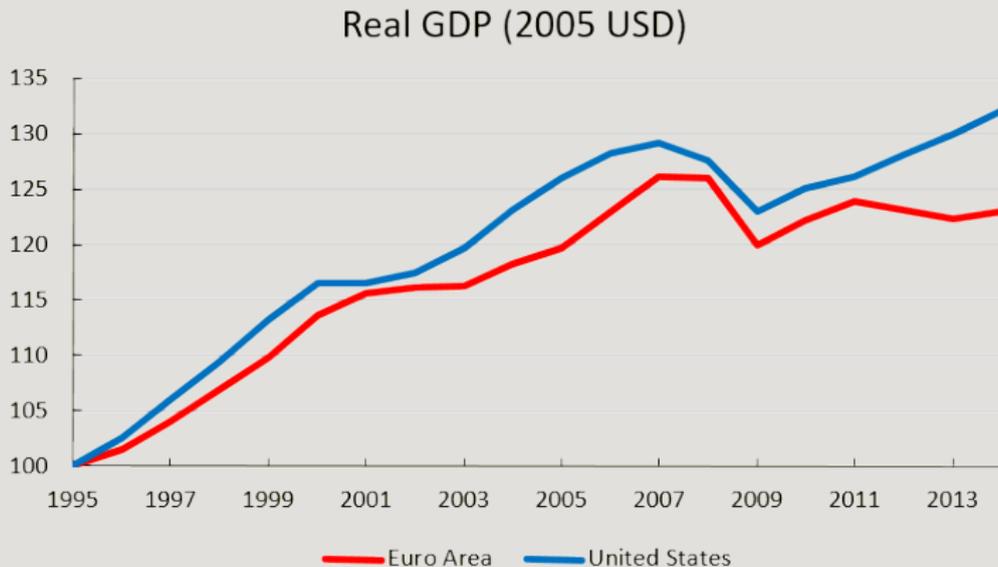
- Model *risk* - what probabilities does a model assign to events in the future?
- Model *ambiguity* - how much confidence do we place in each model?
- Model *misspecification* - how do we use models that are not perfect?

# Uncertainty and Skepticism



*The Cheat*, Georges de La Tour

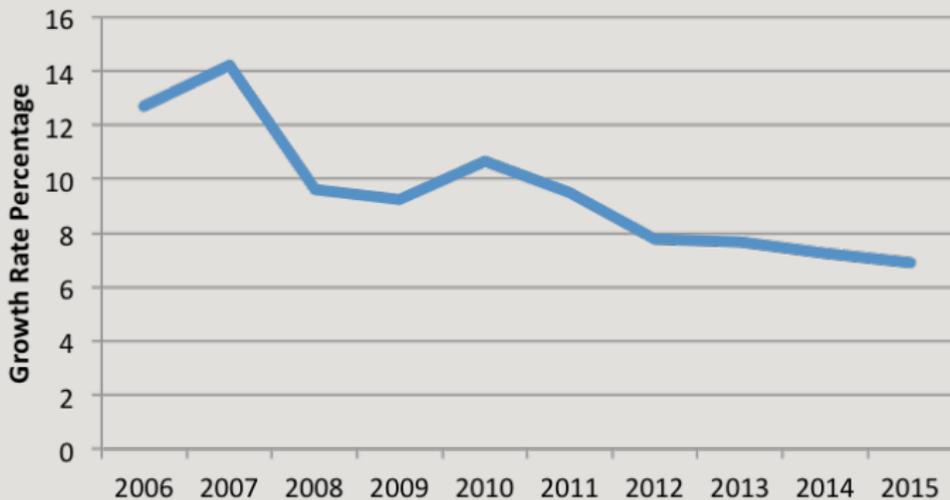
# Evidence from Macroeconomic Data



Source: World Bank

# Evidence from Macroeconomic Data

## GDP Growth Rate for China



# Secular Stagnation?

Joel Mokyr, Northwestern University

“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, Northwestern University

“...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 Financial Market Data

Private sector observation: Risk-On Risk-Off

- Investors' appetites for risk rise and fall over time

Academic research: Time-varying expected returns

- Measured risk-return tradeoffs from financial markets fluctuate over time
- “Risk-prices” are bigger in magnitude sometimes than others

What explains these movements?

# Pushing Uncertainty to the Forefront of Economic Analysis

- Increase the *exposure to uncertainty*

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- Increase the *exposure to uncertainty*
- Enhance decision-maker *concerns about uncertainty*
- Impose *frictions* in financial markets and “shocks” to those frictions

The *interplay* among these factors has *important consequences*.

# Research Frontiers That Fascinate Me

- Investors confront the **intertemporal composition of uncertainty**.
- Adjustments for **long-term** uncertainty are prominent in asset prices.
- Modern decision theory allows us to express investor concerns about **model ambiguity** and **model misspecification**.
- These concerns are transmitted into how financial markets value **uncertain investments** over **alternative horizons**.

# Placing Uncertain Investors Inside an Economic Model

When *constructing* a dynamic economic model, researchers:

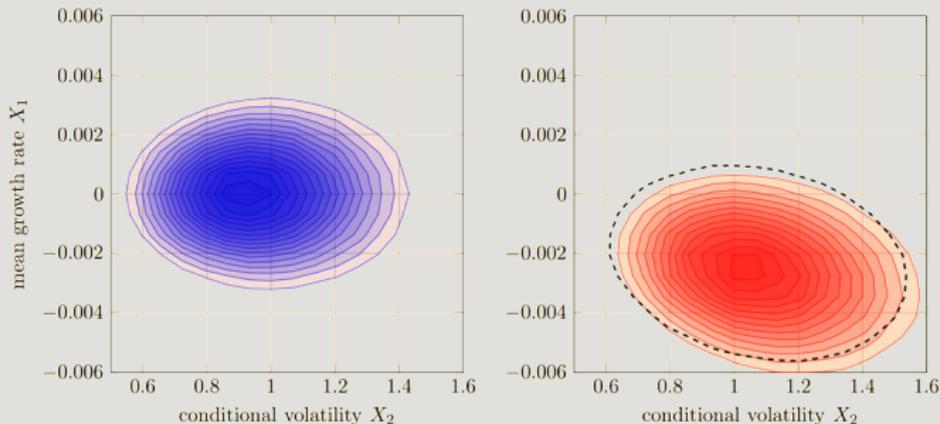
- depict **economic actors** (consumers, enterprises) as they cope with uncertainty when making economic decisions with future consequences
- deduce the resulting **market responses** and consequences for resource allocations

# Using Decision Theory to Broaden the Notion of Uncertainty

- Investors **struggle** with how to perceive the future in a meaningful way
- They approach this struggle with **differing degrees of confidence** in their beliefs
- The impact of the struggle **varies** over time as new evidence or perspectives emerge

*Outcome:* New sources for fluctuations in **uncertainty prices** emerge in models of financial markets. Concerns about **long-term** uncertainty influences even **short-term pricing**.

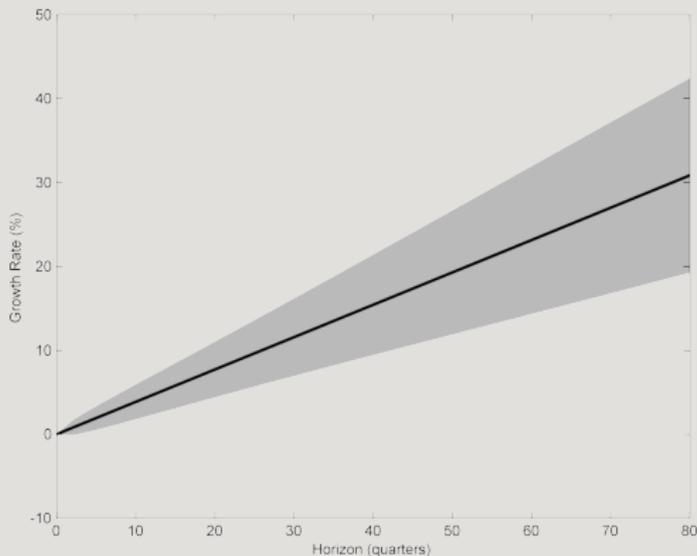
# Market Adjustments for Long-term Uncertainty



Left-hand side (blue) are the actual probabilities and right-hand side (red) includes market adjustments for long-term uncertainty.

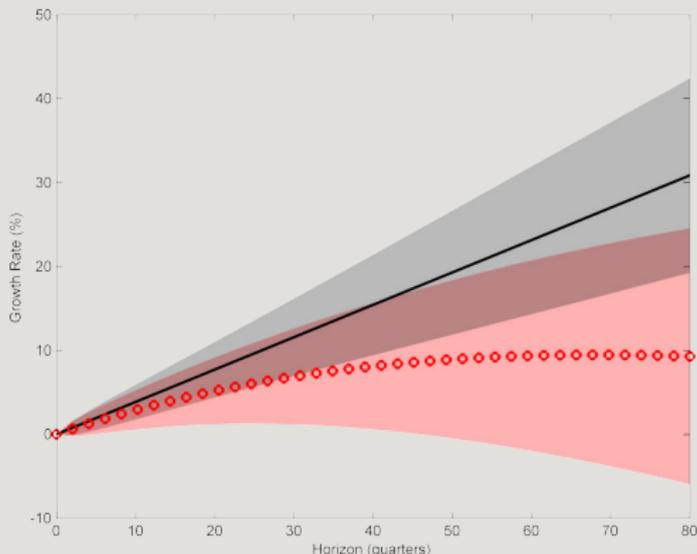
Source: Borovicka, Hansen and Scheinkman

# Investor Perceptions Induced by Caution



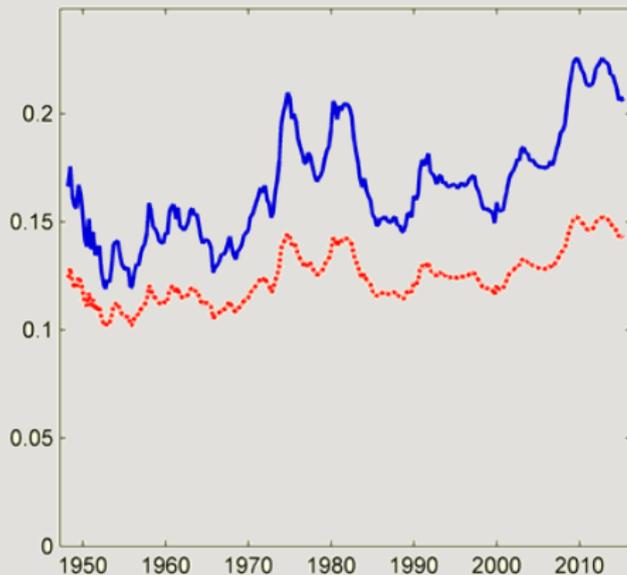
Source: Hansen and Sargent

# Investor Perceptions Induced by Caution



Source: Hansen and Sargent

# The Fluctuating Price of Macroeconomic Uncertainty



Source: Hansen and Sargent

# Macroeconomic Policy

## Milton Friedman

“There is much evidence that monetary changes have their effect only after a considerable lag and over a long period and that the lag is rather variable.” (1960)

## Kenneth Rogoff

“It’s wrong to vilify the Fed for hiking, and it’s wrong to vilify it for not hiking; if it is such a close call, it probably doesn’t matter so much. But, at this critical point, it is fair to ask the Fed for a much clearer message about what its strategy is, and what this implies for the future.” (2015)

# 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)

# Do complicated problems require complicated solutions?

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

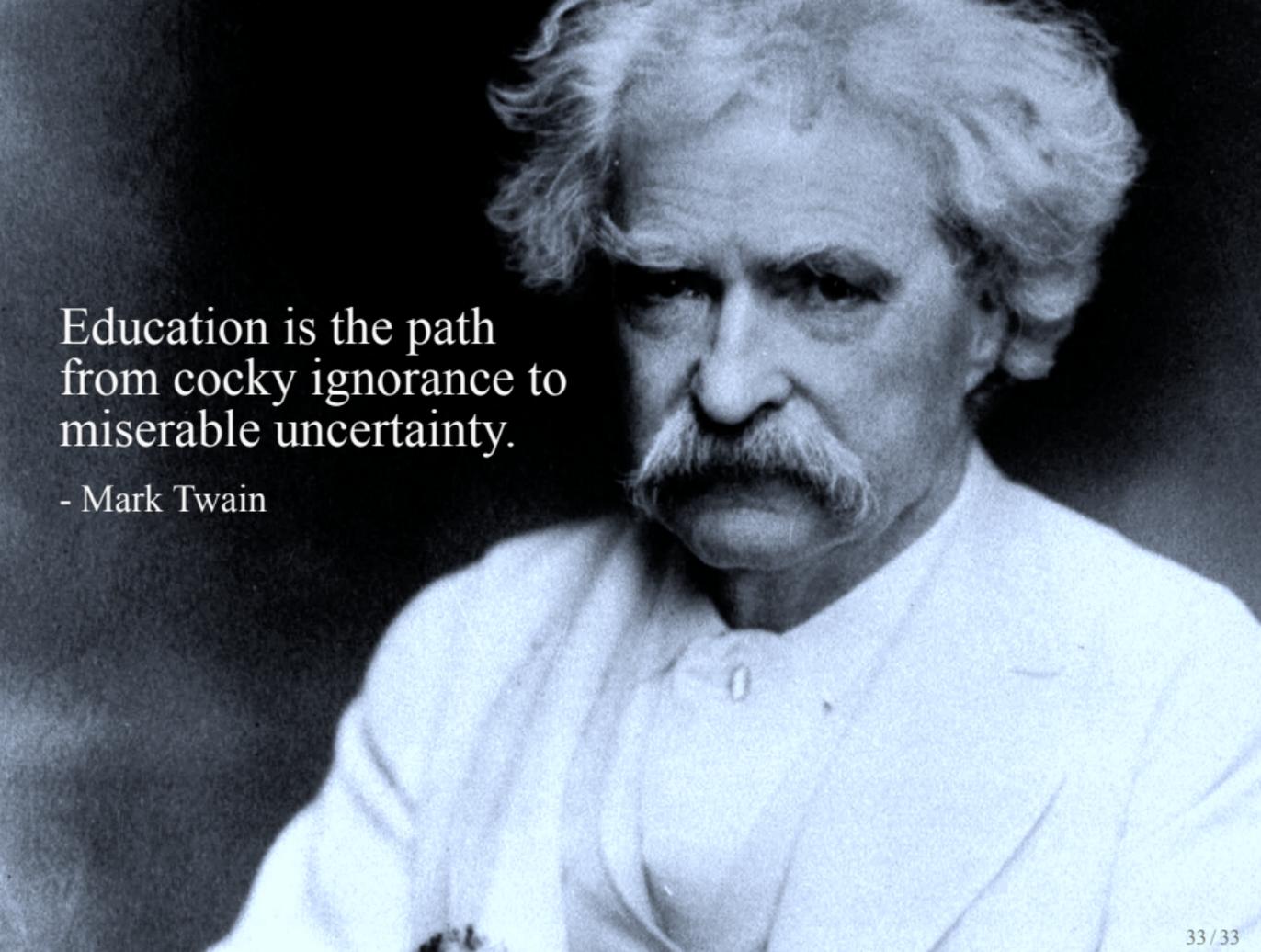
- Acknowledge limits to our **understanding** of the linkages between financial markets and the macroeconomy.
- Specific models could imply **alternative** complex solutions.
- “**Robust**” policies perform well across alternative models.
- **Simple** robust policies **avoid** adding uncertainty to the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

真正的認知是知道自己的無知。

Real knowledge is to know the extent of one's ignorance.

- 孔夫子 (Confucius)





Education is the path  
from cocky ignorance to  
miserable uncertainty.

- Mark Twain