

## RESEARCH BRIEF

# New Research Program to Explore Methods to Quantify Uncertainty

Based, in part, on [“Aversion to Ambiguity and Model Misspecification in Dynamic Stochastic Environments,”](#) by Lars Peter Hansen, professor in economics, statistics, and the Booth School of Business, University of Chicago, and director of Becker Friedman Institute’s Macro Financial Research Initiative; and Jianjun Miao, professor of economics, Boston University; and BFI Working Paper 2018-77, [“Structured Uncertainty and Modeled Misspecification,”](#) by Hansen and Thomas J. Sargent, BFI Distinguished Fellow

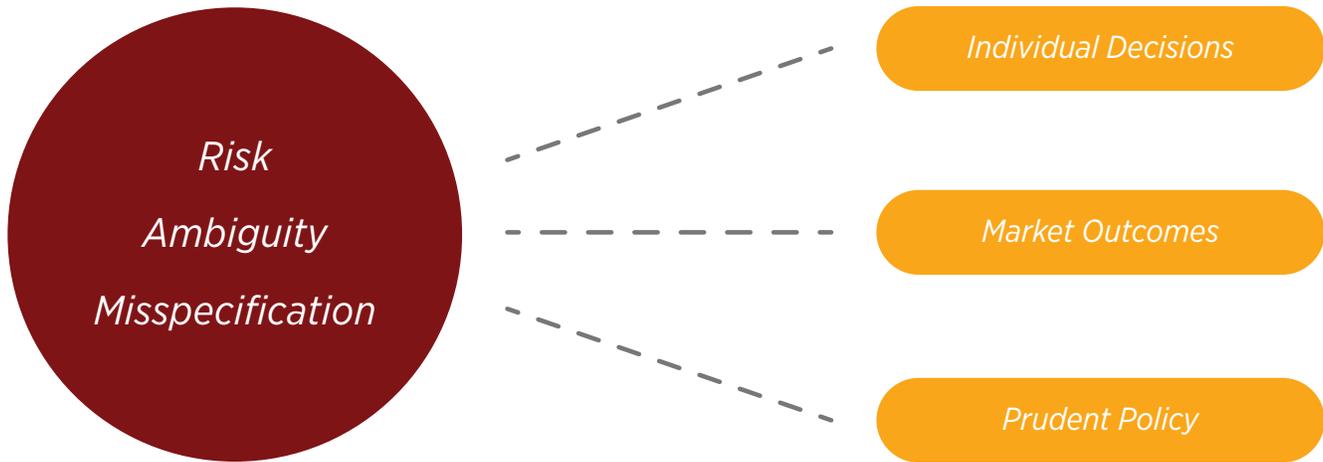
### KEY TAKEAWAYS

- ✓ People must confront uncertainty about the future when making decisions
- ✓ At the same time, policymakers must make decisions based on some understanding of people’s preferences
- ✓ Economists have long struggled with incorporating uncertainty into their models
- ✓ New research looks to enrich economists’ quantitative models by introducing new ways for uncertainty to impact economic outcomes

Imagine you are an economist who wants to understand the effects of climate change on an economy. First, you would have to begin by confronting the many climate models that exist. These are complex models based on long periods of time that offer different outcomes. But you have to choose at least one to incorporate into your economic model.

As an economist you are interested in how an economy may affect the climate. For example, how do carbon emissions impact the atmosphere and affect temperature levels? And how do these man-made changes influence such sectors of the economy as agriculture and tourism? Circling back, how do these changes in human activity then affect the climate in the long term? In other words, the economy affects the climate, which then affects the economy, and so on, in a widening spiral of complexity and uncertainty. And there are many more climate issues besides carbon emissions to consider.

Your challenge, then, is to incorporate all of that uncertainty into a model that best approximates reality and offers useful insight for policymakers. Broadly speaking, that’s the charge for a new research project under Becker Friedman Institute’s Macro Financial Research Initiative (MFRI): Behavioral Implications of



Uncertainty in Macroeconomics (BUMP). Two of the initial papers develop and justify tractable, conceptual frameworks for incorporating the various components of uncertainty into the decision making of individuals and businesses. These facilitate macroeconomic models in which economic entities within the model wrestle with a complex future. The first paper in that series, “[Aversion to Ambiguity and Model Misspecification in Dynamic Stochastic Environments](#),” by the UChicago’s Lars Peter Hansen and Jianjun Miao of Boston University, was published in PNAS, a publication of the National Academy of Sciences (August 2018). The second paper, entitled, “[Structured Uncertainty and Model Misspecification](#),” by Hansen and BFI Distinguished Fellow, Thomas J. Sargent, is available as a BFI/MFRI working paper [here](#).

The papers published in this series will provide new insights for economists as they incorporate complexity and uncertainty into models that address a host of important issues.

### **When rational expectations confront deep uncertainty**

In many macroeconomic models today, uncertainty plays only a small role, largely because the models incorporate the assumption of rational expectations, which says that people know the probabilities implied by the given model. This is sometimes the case and, likewise, rational expectations theory provides a valuable tool

for analyzing certain problems. However, many important questions today—from climate to tax policy to financial oversight and others—have so many layers of uncertainty that it is a stretch to assume that people understand all the possible outcomes of given probabilities.

The charge, then, for BUMP and its researchers, is to expand the usual rational expectations approach in macroeconomics by attributing uncertainty about probabilities that people in models are facing. Take tax policy, for instance: Say that Congress passes a law that lowers corporate tax rates. Companies would then have to consider whether they believe the lower rates will last beyond the short- to medium-term or will change once another party takes control of Congress and/or the White House. Should these companies make big capital investments or increase hiring? Or is it best to retain increased profits and expand cautiously, if at all? Further, these companies must not only confront political uncertainty but also the possible decisions that their competitors might make. How will Company A’s decisions impact Company B’s choices?

The challenge for BUMP researchers is to incorporate uncertainty into a model that best approximates reality and offers useful insight for policymakers.

Once rational expectations are removed from the equation, economists must make calculated assumptions about likely behavior. Economists must incorporate their assumptions, along with the uncertainty and heterogeneity among economic decision-makers, into their models to provide prudent guidance to policymakers. However, models are intrinsically flawed, leaving policymakers to wonder how much they should trust a model's outcomes. How do policymakers account for likely mistakes in these models?

In their papers, Hansen, Miao, and Sargent address these issues by drawing on decision theory to create models that incorporate behavioral responses to uncertainty. Their methodology is necessarily formal, but generally speaking it offers a way to move beyond descriptions (or axioms) of people's behavior when they are confronted with uncertainty, and provides tractable mathematical representations for such behavior to build models supporting quantitative investigations. The goal of this work, along with the forthcoming papers in this project, is to sharpen economists' models and, thus, provide better guidance to policymakers.

Hansen, Miao, and Sargent draw on decision theory to create models that incorporate behavioral responses to uncertainty.

## Conclusion

Policymakers often weigh decisions where they must consider the likely responses of those affected by a given policy. All of these people face uncertainty about the impact of those policies and act, in part, on their estimation of likely outcomes, their aversion to risk, and other factors. By incorporating quantitative methods to address how people respond to uncertainty and how they make decisions, BUMP's researchers hope to aid in the development of models that offer more helpful guidance to policymakers.

### CLOSING TAKEAWAY

"We must infer what the future situation would be without our interference, and what changes will be wrought by our actions. Fortunately, or unfortunately, none of these processes is infallible, or indeed ever accurate and complete."

### Frank Knight (1885-1972)

UChicago professor and an intellectual pillar of Chicago economics

### READ THE WORKING PAPERS

AUGUST 2018

#### Aversion to Ambiguity and Model Misspecification in Dynamic Stochastic Environments

[larspeterhansen.org/lph\\_research/aversion-to-ambiguity-and-model-misspecification-in-dynamic-stochastic-environments](https://larspeterhansen.org/lph_research/aversion-to-ambiguity-and-model-misspecification-in-dynamic-stochastic-environments)

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#### Structured Uncertainty and Modeled Misspecification

[bfi.uchicago.edu/Hansen-WP-201877](https://bfi.uchicago.edu/Hansen-WP-201877)

### MORE ABOUT



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[economics.uchicago.edu/directory/lars-peter-hansen](https://economics.uchicago.edu/directory/lars-peter-hansen)

