The 474rd Convocation at the University of Chicago

Address: “Value in an Uncertain Economy”
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Throughout our lives we are continually asked to confront an uncertain future. Your decision to come to the University of Chicago was not based on full knowledge of what opportunities would be available to you upon graduation or later in life. As you go forward you will make guesses as to beneficial investments in your own development and you will experience surprises. Thus an important purpose of a good education is to provide you with the ability to respond to unanticipated events. Expanding your knowledge and refining your analytical skill are investments in your own human capital, investments that will aid you in a variety of future challenges and opportunities. Researchers and analysts are often surprised by which components of their education are valuable in understanding specific problems. Sources of knowledge or inspiration cannot be fully anticipated. You and especially your teachers can only guess at the future uses to which you will put your intellectual achievements at Chicago.

I want to take this opportunity to consider the consequences of making investments broadly conceived in an uncertain economic environment. These investments might include various sorts of capital, physical capital, human capital, or organizational capital, or even something as specific as financial securities or durable goods such as housing. The precise value of these investments in five or ten years or even further down the road is hard to predict. This uncertainty, however, alters the decisions we make and alters value as determined by a market economy. I will speculate about ways to model how a population of individuals like yourselves interacts in an economic environment and to predict what the collective consequences are of that interaction. Given our academic inclinations, this speculation will be appropriately abstract. I won’t be telling you when to refinance your home mortgage.

Much of what economists do is necessarily quantitative. We put a premium on modeling and measurement. Economic models include specifications of how people make decisions and specifications for how they interact through markets or other mechanisms. We require formalism, in part because formalism facilitates criticism but also because it is needed for empirical inputs and needed to address interesting questions. This formalism does not dehumanize society as is sometimes asserted. It puts forth a structure that can be improved upon through constructive exchange, dialogue, and testing. It is a structure that can be used in prediction.

Why be quantitative? Why be concerned about modeling? What are the predictions that might interest us? Good short-run forecasters of economic time series have less use for formal economics than formal statistics. Understanding how an economy might operate is not a prerequisite for good short-run prediction. Suppose instead we wish to speculate about the consequences of long-run changes in the economic environment caused by policy intervention or other structural change. We aim to project interactions among people beyond environments that we have actually experienced. This fundamentally alters the nature of the prediction problem. As forecasters we now have to decide what features of the economic environment to hold fixed and what features we expect to vary. In contrast to the problem of short-term forecasting, economic theory and modeling become crucial ingredients in predicting the consequences of hypothetical intervention. It is too restrictive to limit predictions only to changes that have been repeated extensively in the past. Empiricism is too confining, and the social cost of economic experimentation is too high.

In what follows I will discuss some of the challenges that face builders of dynamic economic models with capital and uncertainty. The study of capital valuation requires looking backwards and forwards. Capital stocks are the result of an accumulation of past investments. They are typically built up slowly over a sustained period of time. As a consequence, their construction is backward-looking. Their valuation, however, requires looking forward. Since capital stocks last for a long time, their value reflects guesses about how productive today's inputs will be in the future. This value depends on what people believe will happen eventually, and it depends on how people individually and collectively confront *uncertainty*. For instance, your current stock of human capital is dictated by choices you have made in the past about which schools to attend and how

much time, effort, and financial resources to allocate to learning. In contrast, the implicit value of your human capital reflects the benefits of your current education for many years to come.

Understanding market measures of value in today's world may seem a daunting challenge, and it is fair to say that economists still view many aspects of this problem as not solved. Puzzles remain, but even the notion of an empirical puzzle gains content only with the guidance of an economic model to use as a benchmark.

What puzzles or anomalies do we encounter in financial markets? Securities of different types are observed to have widely different returns on average. This is a puzzle if our benchmark model informs us that the average returns should be the same. Since the returns display different degrees of volatility, we might conjecture, as indeed many researchers have, that the differences in the average behavior reflect a premium for the differing degrees of riskiness or volatility of the security returns. Individuals will agree to hold risky portfolios only if there are rewards for doing so. To evaluate or test this explanation requires an economic model that takes a stand on individual investor behavior and on the markets with which these investors interact. Similarly, the values of many financial assets appear to be highly variable. To argue that this volatility is a puzzle requires that we have a benchmark model telling us how much of the volatility we can account for by changes in the economic fundamentals.

As you might guess, to build a model that is rich enough to impute the value of various forms of capital it is natural to begin with a theory of individual behavior. While by its very nature behavior is context-specific, as model builders we seek features of individual behavior that are common across different economic environments. Given that uncertainty is so pervasive, it is natural to look to probability theory for guidance. In the history of scientific development, probability theory is a relatively new field. Even more recent is its use and success in helping people to make decisions. The use of probabilities as a formal vehicle for actions received a "shot in the arm" with the work of James Savage, an eminent statistician at the University of Chicago. He formalized a role for probabilities in making rational decisions in the presence of uncertainty. His work and that of others opened the way to constructing operational notions of risk aversion applicable to many different environments and set a high conceptual standard for subsequent decision theory.

The practical value of statistical decision theory has been documented in a variety of contexts, most recently in a popular treatise by Michael Lewis on the success of Oakland's professional baseball team. Lewis showed how the formal use of probability models and data on the performance of baseball players helped to allow the Oakland Athletics to field a highly competitive team while spending far less than teams like the New York Yankees or even the Chicago Cubs. There are similar success stories for control theory as an applied tool for making decisions in engineering. Decision theory has become a useable apparatus for making informed decisions.

It is one thing to argue how we *should* make decisions in an uncertain environment and another to argue how we *actually* behave. Nuances of specific markets, institutional practices, and costs of transacting can retard or limit the role of arbitrage and speculation. These frictions can allow for seemingly naive or misguided decisions to survive a market test at least temporarily. Markets, however, have a nasty habit of rewarding the smart and sophisticated and punishing the novices. We can take this argument even further. There are often economic incentives to diminish the trading frictions in markets that play a quantitatively important role in the allocation of resources. At the very least, economists must allow for sophistication in decision making if they are to understand the market pressures for success.

While a study of individuals might focus on how they respond to different forms of uncertainty, a study of valuation goes further to explore how this uncertainty becomes encoded in prices. Since by its very nature capital lasts for a long time, its value depends on what people believe will happen far into the future. It also depends on how they confront uncertainty. When individuals prefer to diminish the role of uncertainty in their investments, the investors who bear this uncertainty require a reward and prices adjust accordingly. This mechanism encodes risk or uncertainty premiums into prices. Economic models predict the magnitude of these premiums and predict how these premiums evolve over time.

Up to this point, I have simply endorsed the role of probability in formulating models of decision making. Let me now add a bit of caution. In retrospect, Savage confronted a rather difficult problem. Should we really expect a seemingly simple answer to the question, What precisely

constitutes rationality when individuals confront uncertainty? More to the point, how might individuals use probabilities when making risky investments? Is there a useful distinction between how we form beliefs about objects like coin tosses or baseball performance in which replication is relatively easy and about events over which there is necessarily a big subjective component? How might individuals simplify the decision-making process in complex environments where the complexity challenges our ability to learn?

Making probabilistic assessments about simple events like the outcomes of coin tosses or the performance of baseball players with a history is straightforward. We have great confidence in our assessment when the process is repeated many times. An uncertain future might look very similar to the replication of many coin tosses or perhaps much different. What happens when the form of replication is not as evident as that of a coin toss? Are the events that have surprised us in the past useful in thinking through the surprises of the future? How do people process information as it arrives? How valuable is past information when we make conjectures about the future?

To be concrete, consider the economic environment of the last few decades. In the 1970s we endured what was called a *productivity slowdown*. In contrast, in the 1990s a *new economy* was trumpeted based on the pervasive adoption of a new information technology. Investors in the early seventies made decisions without a precise knowledge of when the slowdown would be over. By the end of the 1990s there was much speculation about the sustainability of a new growth trajectory, but the subsequent sluggish economy has sobered our thinking. Are these just idiosyncratic events that last for a while, or can they be viewed as highly persistent counterparts to coin tosses?

Economists, control theorists, statisticians, and others continue to explore and challenge alternative ways of enriching or modifying decision theory. Some refinements prevent the simple extrapolation of risk aversion from small gambles to large ones, some avoid having decision makers form precise probabilities over all uncertain events, some aim to have decision makers allow for errors in their typically stylized probability models, and some limit the manner in which information is processed. By preserving the formalism of decision theory, these modified theories of choice continue to provide a key ingredient for economic models. As we explore these alternatives in models with

capital accumulation, price or value adjustments emerge that account for model uncertainty, for ambiguity, or for the complexity of the learning environment. The term “risk premium” used previously to justify differences in average returns takes on a new and different meaning as we explore alternatives to the original Savage formulation. Unfortunately, generalizations of decision theory come at a cost to economic researchers. They make it more challenging to isolate and measure components of the decision problem that should remain invariant when environments change.

Without some form of decision theory, economic model builders are left in the dark. Too much emphasis on the contextual nature of behavior leaves us with too little to use in evaluating hypothetical economic policies in an uncertain environment. The psychology of individual investors makes for fascinating reading, but the useful by-products are the ones that can be incorporated formally into decision theory and the ones that survive the competitive pressures of market discipline.

To conclude, let me return to what we are all here for. Today is a celebration of the completion of one of the major investments you will make in your life. Although I have talked about uncertainty, one thing is for certain: You will graduate today. Support of your family and friends has no doubt been critical to your success. You are to be commended for your efforts. The value of this accomplishment is very real and one for which you should take great pride. Yet the real value of your degree can only be imputed by looking forward. It will unfold as you make choices about the options and uncertainty life will give you. Good luck!

In preparing this talk, I received many valuable suggestions from James Heckman, Richard P. Saller, and Grace Tsiang.

References

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