

## FACING THE CONSEQUENCES

Peter L. Bernstein

As this is the third anniversary of the publication of *Against the Gods*, I thought it might be an appropriate moment to look back at the history of risk and all those brilliant ideas from the perspective of the intensely risk-conscious world of today. There can be no doubt that the subject is alive and well – risk is a lot hotter as a topic than it was when I first began my research in this area some seven years ago.

My sense of what was most important in this story has changed with the passage of time. When I wrote the book, I was fascinated with the mathematical discoveries – probability, the normal curve, sampling, regression to the mean, and mean/variance, among others. I found myself mesmerized by the way that these remarkable innovations seemed to bubble up almost out of nowhere in the minds of strange and often very neurotic men to form the foundation of today's science of risk management. Their achievements were extraordinary intellectual leaps that transformed the way we see the world and the way we respond to it.

On the other hand, these mathematical innovations are only tools, mere instruments to be employed in the search for a much more exciting objective. *Risk is about how we make decisions, and only incidentally about the math that we employ to reach those decisions.* Knowing how it works is just the beginning. Knowing how to use these tools is the introduction to wisdom. And that is no easy task.

At its roots, risk is about mystery. It focuses on the unknown, for there would be no such thing as risk if everything were known. Pascal himself, the father of probability, touched the heart of the matter in his wager: God is or God is not. "Which way should we incline?" Pascal asks. And then he puts the clincher on the matter when he asks: "*Reason cannot answer.*" That is what life is all about: dealing with problems to which there is no certain solution and where any kind of rational decision is often impossible to define.

Today's obsession with risk management focuses too intently on the instruments of the management and measurement of risk. The more we stare at the jumble of equations and models the more we lose sight of the mystery of life. All too often, reason cannot answer. Even the most brilliant of mathematical geniuses will never be able to tell us what the future holds. In the end, what matters is the quality of our decisions in the face of uncertainty.

The theme that I want to emphasize here is the dominance of decision-making over the analysis of probability. I am going to explore these matters from three points of view: Pascal's Wager as the ideal model for making decisions, the impact of time on decisions, and an exploration into the sources of uncertainty, which lead us to philosophical and moral issues that illuminate the same theme.

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The purpose of Pascal's examination of the question of whether God exists was to reveal the dominating importance of decision-making. Pascal differentiates between decision and belief. You cannot wake up one morning and decide, "Today I will believe in God," or "Today I will decide not to believe in God." You believe or you do not believe - that is in your gut, not your head. How you behave in life, however, is a decision that you can make. You can *act* as though God is or *act* as though God is not, no matter how you believe.

The issue is what happens if your choice is wrong. Suppose you act as though God is and lead a life of virtue and abstinence when in fact there is no God. You will have passed up some pleasant goodies in life, but there will be rewards as well. On the other hand, suppose you act as though God is not and lead a licentious and hedonistic life when in fact God is. You may have had lots of fun during the relatively brief duration of your lifetime, but you will spend eternity in Hell. If you care about consequences, you must decide to act as though God is, *whether you believe it or not*. By the time we find out whether God is or God is not, it will be too late. The risk of deciding that God is not has consequences that are intolerable.

Even when we know the probabilities of an outcome, that knowledge is insufficient. Try reassuring a nervous flier by reciting the tiny probability of an airplane crash. Or try to use the laws of probability to dissuade a gambler from betting all his chips on double-zero. The expected utility of an outcome seldom equals the mathematical expectation of that outcome.

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Let us explore this idea in a different framework: the relationship between risk and time. This affinity has broad generality but is especially interesting in the world of investment and business decision-making.

The notion that uncertainty increases with time is obvious. You have a pretty good idea of what is going to happen a minute from now, the rest of today, tomorrow, and possibly the rest of the week. You may have appointments set up or a trip planned for next month or even next year, but the probability that you will be able to keep those appointments or make the trip is certainly smaller than the probability that you will be able to keep your dinner date for this evening or take a plane tomorrow morning. As the time horizon expands, uncertainty increases because the range of possible outcomes widens as we look further and further into the future.

So much for theory and commonsense. Today we hear that the long run in stocks is less risky than the long run in bonds: therefore the Dow should now be at 36,000, perhaps even higher. Therefore asset diversification is nonsense, something for wimps, but surely not for truly knowledgeable investors who know what they are about. All those investors who have been holding bonds and perhaps even a little cash are not only excessively risk averse – they are stupid! Stocks should have the lowest risk premium of all assets.

This position takes the notion that risk grows as the time horizon lengthens and turns that notion on its head. The alarming assumption in this argument, which has been receiving increasing attention in respectable publications, is that we know more about the long run than we know about the short run. This view is both fallacious and dangerous, as I shall demonstrate from two of the heroes of *Against the Gods*.

First I invoke Leibniz. In 1703, the great mathematician Jacob Bernoulli wrote to Leibniz that he found it strange that we know the odds of throwing a seven instead of an eight with a pair of dice, but we do not know the probability that a man of twenty will outlive a man of sixty. Bernoulli suggested that he might be able to calculate such a probability by examining a large number of pairs of men of each age. Leibniz was profoundly skeptical: “Nature has established patterns originating in the return of events, but only for the most part...No matter how many experiments you have done on corpses, you have not thereby imposed a limit on the nature of events so that in the future they could not vary.”

Leibniz wrote the letter in Latin, as was customary for that type of correspondence in those days, but he inscribed the expression “but only for the most part” in Greek to emphasize its overwhelming importance. If it were “always” rather than “for the most part,” there would be no uncertainty. No model has an  $R^2$  of 1.000. Hypothesis testing is a procedure to reject or fail to reject a hypothesis. We know we cannot *prove* a hypothesis; on the contrary, we can only attempt to falsify it. That is why I emphasize that the experience of the past 75 years is only suggestive, not definitive of probabilities.

Nobody knows what the long run holds in store. We can only conjecture. Any argument to the contrary must derive from a model with an  $R^2$  of 1.00. There is no such thing. Yet these projections to 36,000 and beyond allow no error: they tell us that we know more about portfolio values twenty or thirty years from now than we know about what values will be tomorrow or next year.

Once we recognize that the models that support these projections have an  $R^2$  of less than 1.00, we have to accept the possibility that the optimism embedded in Dow 36,000 is misplaced. Forget the probabilities that the optimism is misplaced. When the  $R^2$  is less than 1.00, the crucial element in the decision is the consequences of being wrong.

Now I invoke our friend Pascal. As Pascal reminds us, reason cannot tell us what is going to happen on the Day of Judgment. As Keynes so wisely put it, we simply do not know. If you do not know, you have no choice but to base your asset allocation decisions on the consequences of choosing the wrong allocation. Suppose you put, say, only 60% of your portfolio in stocks and 40% in bonds because you bet that stocks are in fact risky over the long run. Suppose you are wrong. Your fortune will still grow over time as stocks continue to work their miracles over the long run, even if not to the sky. But suppose you put 100% of your portfolio into stocks because you bet that stocks are less risky over the long run. Now suppose you are wrong. *Good bye!*

The return of events – a replay of the patterns of the past seventy-five years of capital market history – will happen *only for the most part*. Most is not all. There is no certainty. Rational people do not bet the ranch on a model with an  $R^2$  of less than 1.00, that works out only for the most part. And God forbid it works out only for the minor part! Consequences, not probabilities, determine the decisions that matter. Diversification is still the optimal strategy for the long run.

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But where does all this uncertainty come from? The answer to that question, above all others, should determine how we manage risk and how we make decisions.

In the old days, when most economic activity consisted of hunting, fishing, and agriculture, the weather was the only source of economic uncertainty. You cannot do anything about the weather. Consequently, people depended on prayer and incantation, in one form or another, as the only available form of risk management. What other approach could you take when everything seemed to be God’s will or the will of the Fates?

As we move toward modern times, nature has declining importance. What takes its place? It is at this point that I would propose John von Neumann as the star among the heroes of *Against the Gods*. The most significant insight in the theory of games was to recognize that men and women are not Robinson Crusoes – each individual isolated from all other individuals. Failure to keep this

distinction in mind is the primary reason that the techniques and concepts of the natural sciences so often lead the social scientists astray.

Before von Neumann, the development of decision theory by innovators like Pascal and Daniel Bernoulli visualized each individual making choices that had no effect on any other individual's range of choices. They calculate their utilities in the privacy of their own rooms. That concept is totally artificial. No man is an island. As von Neumann and Morgenstern point out in emphasizing the difference between a real economy and a Robinson Crusoe economy:

Crusoe is confronted with a formal problem quite different from the one a participant in a social economy faces....[Crusoe] controls all the variables exclusively...to obtain maximum resulting satisfaction....In order to bring [the rules of the game] into the sphere of combat and competition...it is necessary to consider  $n$ -person games with  $n > 2$  and thereby sacrifice the simple maximum aspect of the problem.

All economic systems, even the most primitive, depend on production and technology, but capitalism is about buying and selling even more than it is about production and technology – it is a giant von Neumann game! Buying and selling means human decisions: What will the customer decide? What will the supplier decide? What will the employee decide? What will the politicians decide? The process is intensively interactive. The enemy is us. The decisions that each of us makes as we ask ourselves these questions will in turn have an influence on how customers, suppliers, employees, and politicians will make their choices in response to ours. In the end, the value of your portfolio is not what somebody tells you is likely to happen over the long run but how much other investors out there are going to be willing to pay you for your assets.

Game theory teaches us that human beings create a complex jumble of uncertainties for one another. It is not enough to say that human nature never changes and let it go at that. Human beings learn from experience and learn from technology. Yesterday's response to a given set of circumstances is only a hint of what tomorrow's response to that set of circumstances will be – and in any case Leibniz reminds us that today's circumstances will reappear tomorrow, not precisely, but only for the most part. So we really do not know what the future holds. Risk in our world is nothing more than uncertainty about the decisions that other human beings are going to make and how we can best respond to those decisions.

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Now let us turn to a more philosophical but equally revealing look at these matters. As we work our way through all the complexities of today's systems of risk management, we would do well to recognize that profound moral and even religious influences are woven through the whole process. Human beings are the raw material with which we have to work, and most human beings are less than totally immoral or totally hedonistic. Recognizing these features helps a lot in our efforts to confront uncertainty.

Pascal developed the theory of probability as a solution to a puzzle that related to a game of chance, the so-called Problem of the Points. This puzzle had tantalized many mathematicians but had remained unsolved for a hundred years since it was first proposed by the ingenious mathematician Luca Paccioli (to whom we are indebted for our knowledge of double-entry bookkeeping). As Paccioli put it:

A and B are playing a fair game of *balla*. They agree to continue until one has won six rounds. The game actually stops when A has won five and B three. How should the stakes be divided?

Pascal's solution was to propose that the stakes be divided in accordance with the probability that each player would win; clearly A, the leader, would be entitled to the larger share.

The interesting point is that Pascal recognized that his solution was only one solution out of many possibilities. For example, there was no law to prohibit A and B from splitting the stakes 50-50, if they so chose, or perhaps giving B a larger share because he would beat up A under any other arrangement. Pascal believed that dividing the stakes on the basis of the probabilities was the fair, the moral decision, not necessarily the optimal decision under other circumstances. This view reminds us once again that probabilities are only a tool to a decision, not the binding and dominant consideration that should define our actions.

Now let us take a further step and try to plumb the deepest mysteries of uncertainty. Pascal was by no means the only one of the early mathematical innovators to be concerned by the mystery of his discoveries. Jacob Bernoulli, for example, in his heart could not accept what Leibniz had to tell him about "only for the most part." He was convinced that Leibniz was wrong about nature and that it is only the shortcomings of human knowledge – of the available information - that explains why the return of events appears to occur only for the most part:

If...all events through eternity could be repeated, one would find that everything in the world happens from definite causes and according to definite rules, and that we would be forced to assume amongst the most apparently fortuitous things a certain necessity, or, so to say, FATE."

Listen to Abraham de Moivre, who surely knew that no outcome was certain, for in the 1730s he discovered the normal curve and the existence of standard deviation. Nevertheless, like today's worshippers of the long run outlook for stocks, de Moivre predicted that,

Altho Chance produces Irregularities, still the Odds will be infinitely great that in process of time those irregularities will bear no proportion to recurrency of that order which naturally results from ORIGINAL DESIGN.

Bernoulli and de Moivre are contending that there is in fact an immutable regularity in nature, but human beings lack enough information to be able to model that regularity. Neither of these men could accept the terrifying thought that we can *never, ever* know what the future portends, that even at the limit the information is insufficient.

We should recognize that this was not a quaint judgment held only by thinkers four hundred years ago, who were convinced that God managed the universe under some kind of rational grand plan. Here is the man who brought science into the twentieth century, Albert Einstein, perhaps the greatest scientist of all time, writing to a colleague named Max Born: "You believe in a God who plays with dice, and I in complete law and order in a world which objectively exists." Einstein is four-square in the camp of Bernoulli and de Moivre.

The difference between Einstein and Born is irreconcilable. Born believed that effect follows cause only in an unsystematic manner – that is, only for the most part – and that therefore we cannot escape from uncertainty. Where nature is concerned, we would like to think that Einstein had it right, otherwise the study of science should be replaced by voodoo or the equivalent. But when it comes to

human beings, taking sides in the dispute is not so easy. Is it more desirable for us if God plays with dice than if we live in a world in which complete law and order objectively exist? How we feel about these matters will mold every aspect of how we deal with uncertainty. Once you encounter risk, you are into the basic questions of what life is all about.

At first glance, the idea that God plays with dice is repugnant. Who would want to kneel in worship to such a god? Everything would be ergodic, random. Every event would be independent of all other events – no cause, no effect. But that also means no free will, no power to influence outcomes any more than we can influence the throw of the dice or the spin of the roulette wheel. Under these conditions, why be in business at all? We are better off working as waiters or creating abstract painting and sculptures.

Suppose, however, that Einstein's vision was the right one and that everything in life is preordained in an eternally prevailing system of order that objectively exists – that is, a system that exists beyond the control of human beings. For example, imagine what life would be life if everything did indeed regress to the mean, as Galton predicted, and that the mean itself was never-changing. In such a stationary world, making decisions would be a waste of time. What is going to happen is going to happen regardless of the action we take; even the action we take is not our choice but is totally determined by God's system. You can forget about the deviations from normal and the outliers that make life exciting and are the source of the greatest profits to be earned in business and investing. Einstein's world is Nazism run wild. In Einstein's world, free will – our most precious attribute – would be meaningless, null and void. We would be God's prisoners rather than God's children.

The best of all worlds would be something like what I believe we actually do have, a world where the game of life is like bridge or like poker rather than roulette or not even a game at all. That is, outcomes are uncertain, but we have some control over what is going to happen or at least some control over the consequences of what does happen. That is what risk management is all about.

Remember, however, that we pay a high price for this minimax kind of life. We cannot have free will – we cannot be free to make choices that matter – without uncertainty, without the inevitability that forecasts will often be wrong. But if uncertainty is our friend rather than our enemy, let us treat uncertainty like a friend – with care, consideration, and attention to consequences.