

Why We Underestimate Risk by Omitting Time as a Factor

Comments by Mark Buchanan in Bloomberg

Suppose I offer you a simple gamble. Throw a dice: If you get a six, you win \$10; if not, you lose \$1. The loss is more likely; the win brings more money. Willing to play?

The generally accepted way for deciding in such cases -- developed originally by the French mathematician Blaise Pascal in the 17th century -- is to think of probabilities. The outcome will always be a win or loss, but imagine playing millions of times. What will happen on average?

Clearly, you'll lose \$1 about five times out of six, and you'll win \$10 about one time out of six. Over many gambles, this averages out to about 83 cents per try. Hence, the gamble has a positive "expected" payoff and is worth it, even if the gain is trifling. Play a million times and you're sure to win big.

But here's something odd. Suppose I offer precisely the same gamble, only scaled up. Roll a six and you now win not \$10, but 10 times your total current wealth; if you roll anything else, you lose your entire wealth (including property, pensions and all possessions). Your expected profit is now far bigger -- equal to 83 percent of your total current wealth. Still want to play?

It turns out that most people won't take the latter bet, even though it will, on average, pay off handsomely. Why not? For most of us, putting everything on the line seems too risky. Intuitively, we understand that getting wiped out carries a brutal finality, curtailing future options and possibilities.

'Risk Averse'

Economic theories generally ascribe such cautious behavior to psychology. Humans are "risk averse," some of us more than others. But there's a fundamental error in this way of thinking that still remains largely unappreciated -- even though it casts a long and distorting shadow over everything from portfolio theory to macroeconomics and financial regulation. Economics, in following Pascal, still hasn't faced up honestly to the problem of time.

Anyone who faces risky situations over time -- and that's essentially everyone -- needs to handle those risks well, on average, over time, with one thing happening after the next. The seductive genius of the concept of probability is that it removes this history aspect, and estimates the average payoff by thinking of a single gamble alone, with two outcomes. It imagines the world splitting with specific probabilities into parallel universes, one thing happening in each. The expected value doesn't reflect an average over time, but over possible outcomes considered outside of time.

This is so familiar that most of us take it as the obvious method of reasoning. That's a mistake. As the physicist Ole Peters of the London Mathematical Laboratory has shown in several recent papers, averages through time and over probable outcomes aren't the same, and the latter calculation offers a dangerously misleading guide to risky choices. Especially whenever downside risks get large, real outcomes averaged through time are much worse than the expected value would predict. Even in the absence of risk aversion, there can be sound mathematical reasons for being unwilling to take on gambles (or projects), despite wildly positive expected payoffs.

So what? Well, the assumption of the equality of these different averages -- technically known as the assumption of "ergodicity" -- is considered a given by most of contemporary economics. It makes the mathematics easier in the financial portfolio theory that influences countless investors and in frameworks for designing regulations to keep financial risks at acceptable levels. Unfortunately, this error systematically underestimates prevailing risks.
Confidence Brake

It also may encourage overly optimistic ideas about the ability of an economy to recover from a crisis. For example, those who support policies of fiscal austerity believe that companies, in seeking to maximize their profits, will naturally drive an economy back to steady growth. The economy will spring back if companies and individuals have confidence that their investments will pay off. If that's the case, why aren't businesses investing globally when interest rates are at historic lows. What's holding them back?

The fairly obvious answer is serious downside risk, which makes the reticence entirely sensible -- if you live in the real world where time matters.

Such behavior is in fact sensible in this "balance-sheet recession" -- the term coined by Nomura Research Institute Chief Economist Richard Koo to describe what happens after big asset bubbles burst, leaving companies mired in debt, their assets worth less than their liabilities. Low interest rates won't encourage borrowing -- even to finance positive-return investments -- because companies need to pay down their debts, and fear going bust altogether.

Unfortunately, errors of analysis embedded within core theories can ultimately become errors of intuition for the millions of people educated in those theories. It's ironic -- and a little alarming -- that so much of our thinking remains founded on aspects of Pascal's ideas that are still largely unexplored.