*on*Risks

Econs, humans and the perception of risk

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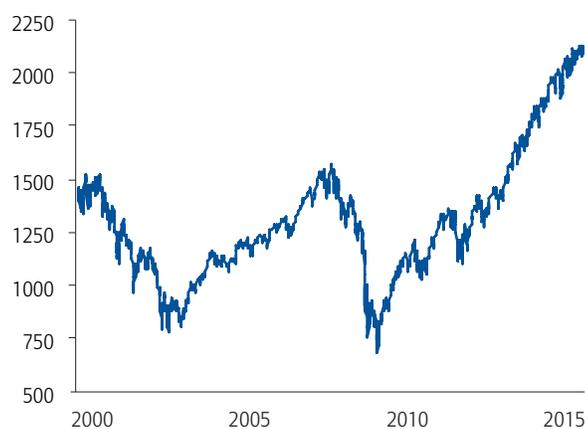Board, Allianz Global
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Our world is full of uncertainty, with plenty of good and bad surprises. For plan participants, and for most people in general, bad surprises loom larger than good ones. Unfortunately, the asymmetric nature of good and bad surprises—or more specifically, investment gains and losses—is missing from standard measures of risk such as variance and standard deviation. Using proprietary research, this paper first documents the loss-averse tendencies of plan participants, advisors and plan sponsors, then suggests ways for financial professionals to think about how asymmetric sensitivity to losses applies to investing.

Introduction

Our world is full of uncertainty; financial markets are no exception. During the dot-com bubble of the late 1990s, the S&P 500 Index peaked at 1527—and then, over the next few years, lost half its value. Right before the financial crisis of 2007–2008, the S&P peaked at 1565 before, once again, losing more than half its value, bottoming out at 676 on March 9, 2009. And yet by May 2015, the S&P tripled and passed the 2100 mark. That is a lot of highs and lows—a rollercoaster of ups and downs.

Figure 1 illustrates the variability of the S&P during the 21st century.[1] Given this never-ending variability, we'd like to pose a question: What do we perceive as "risk"? Put another way, what kind of financial results make us nervous?

Figure 1: **The S&P 500 Index, 2000–2015**

Source: FactSet as of June 18, 2015.

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To help us zoom in on the psychology of risk, we'd like you to consider two hypothetical investments:

- Investment A almost always provides a 9% return per year, but there is also a small chance of 1% to double your money.

- Investment B almost always provides an 11% return, but again, there is a small chance of 1% for things to be different, in this case to lose half your money.

Assuming an investment horizon of one year, which investment, A or B, feels riskier to you? We will discuss this question in detail a bit later, but here's a quick preview: Most industry measures of risk suggest that Investment B is actually safer than A. In other words, the one that might lead you to lose half your money is the safer investment.

This paper is about the gap between what "humans" perceive to be risky and how risk is often measured by economists, or "econs."[2]

The asymmetric nature of gains and losses

First, though, it's worth quickly reviewing some of the academic literature on the nature of risk, which has been the focus of many economists and psychologists. More than half a century ago, Nobel Laureate Paul Samuelson offered one of his MIT colleagues a bet on a coin during lunch.[3] The upside was winning $200 and the downside was losing $100. Would you accept this gamble for real money right now?

If you're like Samuelson's colleague, you rejected the bet. In fact, most people reject the bet. But why? If you think of it as investing $100, then you either get nothing back or $300 back, yielding an average win of $150. In terms of rates of return, this "investment" provides an expected return of 50% in no time, with a worst case scenario that costs about as much as a nice dinner. Put differently, most people reject an investment with an unusually high return and not much to lose.

Samuelson's colleague offered the following reason for rejecting the bet: "I won't bet because I would feel the $100 loss more than the $200 gain." If you also rejected the bet, you probably felt the same way; For the human mind, losses loom larger than gains.

In their seminal work, Nobel Laureate Daniel Kahneman and his long-time collaborator Amos Tversky estimated that, on average, losses loom about two to two and a half times larger than gains.[4] (In technical terms, the average "loss aversion coefficient" is about two to two and a half.) Thus, whenever the upside is "only" twice the downside, as in Samuelson's bet, many people decline the bet.[5]

Losses loom about 2–2.5 times larger than gains—which could cause people to reject a prospect with an unusually high return and not much to lose.

In principle, there is nothing wrong with being loss averse. It is important, however, that when we navigate our uncertain world, we take into account our asymmetric sensitivity to losses and understand how it might impact our choices.

To highlight the influence of loss aversion, let's consider three pairs of gambles. The three pairs are displayed in Figure 2 (see the next page). Taking the first pair as an example, Gamble 1 has equal chances of losing $100, breaking even (that is, neither winning nor losing) and winning $100; Gamble 2 also has equal chances of losing $300, breaking even or winning $300.

The question, then, is for each of the three pairs in Figure 2, would you pick Gamble 1 or Gamble 2? Also, which gamble feels riskier?

Figure 2: **Would you pick Gamble 1 or Gamble 2?**

Pair I		Pair II		Pair III	
Gamble 1	Gamble 2	Gamble 1	Gamble 2	Gamble 1	Gamble 2
$100	$300	-$100	$100	$300	$500
$0	$0	-$200	-$200	$200	$200
-$100	-$300	-$300	-$500	$100	-$100

How to read this: You have an equal chance of winning $300, breaking even or losing $300.

How to read this: You have an equal chance of winning $100, breaking even or losing $100.

If you are an econ, or a trained actuary, then you'd quickly calculate the expected value and notice that within each pair the expected value is identical (zero for Pair I; negative $200 for Pair II; and, positive $200 for Pair III).

Since the gambles within each pair have the same expected value, you'd then zoom in on the variability of each gamble. After all, variability—or, the related technical term "variance"—is a traditional measure that financial economists (and pension consultants) use to measure risk. The work of Nobel Laureate Harry Markowitz on portfolio selection and mean-variance optimization, for example, is all about minimizing the variability of outcomes for every given level of expected returns.[6] You've probably noticed already that Gamble 2 is always more variable than Gamble 1. In particular, the gap between the worst and best outcome is $600 for Gamble 2, but just $200 for Gamble 1. Thus, an econ would always prefer Gamble 1 to Gamble 2—it has the same expected return and it is less risky. However, if you're like most people, then you didn't always pick Gamble 1, or even conclude that Gamble 1 is less risky.

To estimate how most investors feel about the above bets, we recently posed the three pairs to an online sample of 401(k) participants. Our sample consisted of 600 participants between the ages of 30 and 60. Half of our subjects were asked to choose between the gambles, and the other half were asked to indicate which gamble within each pair felt riskier. The order of the questions was randomized,[7] and we used a typical "attention filter" to ensure participants were paying attention.[8]

Our results indicate that only 24% of subjects responded like econs and actuaries and always preferred Gamble 1. Similarly, only 39% of subjects always felt that Gamble 1 is less risky. So what did our 401(k) participants prefer and why?

Results for Pair I
As shown in Figure 3 (see the next page), starting with our first pair, most preferred Gamble 1 (73%). This is not surprising as Gamble 1 not only has lower variability and is therefore attractive to econs, it also has a smaller potential loss and is therefore psycho-logically attractive to loss averse investors. Similarly, 90% of subjects felt that Gamble 1 is less risky. Things, however, get a lot more interesting as we switch to the other two pairs of gambles.

Results for Pair II
The second pair is a transformation of the first pair by simply deducting $200 from each prospective out-come. John Payne and colleagues introduced this technique in 1980 and have used it repeatedly since then in many studies.[9] By deducting the same amount from all outcomes, Gambles 1 and 2 still have the exact same expected value—it is just negative $200 instead of zero. Similarly, the variability of the two gambles did not change at all—the gap between the worst and best outcome is $200 for Gamble 1 and

$600 for Gamble 2. What, then, has changed? Note that the only way now to avoid losses is picking Gamble 2, as Gamble 1 only has negative outcomes. If our 401(k) participants are loss averse, then they will now switch to Gamble 2. And, indeed, the percentage of subjects choosing Gamble 2 more than doubled from 27% to 58%. Similarly, the percentage of subjects feeling that Gamble 2 is less risky has quadrupled from 10% to 43%, even though it has greater variability.

Results for Pair III

The third pair is yet another transformation of our first pair, but this time adding $200 to all outcomes. Note that loss averse investors would now find Gamble 1 unusually attractive, as there is no way to lose money. And indeed, the percentage of subjects picking Gamble 1 jumped to 82%, while 87% felt it is the less risky bet.

Summary of results

Let's think for a moment about what our 401(k) participants are telling us about their preferences and perceptions of risk. Had they focused on expected returns and variability, as econs would, they would have always picked Gamble 1 over Gamble 2. But that's not what happened. Rather, their choices were guided by the desire to avoid the pain of losing money.

As psychologists would have predicted, 401(k) participants do not care about theoretical measures of risk like variance, but are instead driven by the fear of losing. As even monkeys know, losses hurt more than gains feel good.[10]

401(k) participants don't care about theoretical measures of risk like variance; they're driven by the fear of losing.
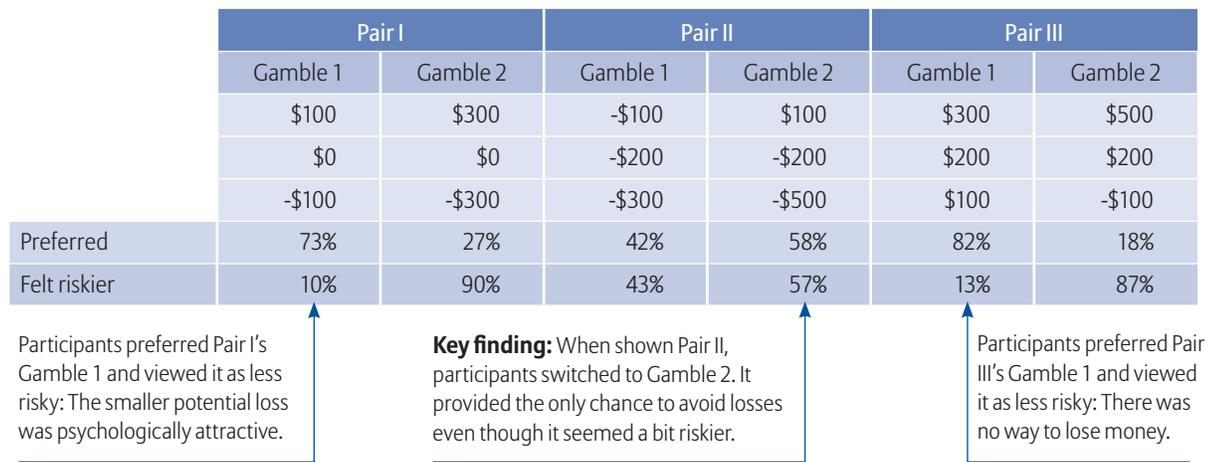

Loss aversion and investment decisions

To illustrate the role of loss aversion in investing decisions, let's reconsider the two hypothetical investments, Investment A and Investment B, that we started this paper with.

(As a quick reminder, Investment A almost always provides a 9% return per year, but there is also a small chance of 1% to double your money. Investment B almost always provides an 11% return, but again, there is a small chance of 1% for things to be different, in this case to lose half your money.)

If you are a financial advisor, think about the client you have seen most recently. If you were to invest his or her entire portfolio in either Investment A or Investment B for one year, which one would you choose? Similarly, if you are a plan sponsor and were to pick a default portfolio for 401(k) participants who are

Figure 3: **How plan participants perceive risk**

	Pair I		Pair II		Pair III	
	Gamble 1	Gamble 2	Gamble 1	Gamble 2	Gamble 1	Gamble 2
	$100	$300	-$100	$100	$300	$500
	$0	$0	-$200	-$200	$200	$200
	-$100	-$300	-$300	-$500	$100	-$100
Preferred	73%	27%	42%	58%	82%	18%
Felt riskier	10%	90%	43%	57%	13%	87%

Participants preferred Pair I's Gamble 1 and viewed it as less risky: The smaller potential loss was psychologically attractive.

Key finding: When shown Pair II, participants switched to Gamble 2. It provided the only chance to avoid losses even though it seemed a bit riskier.

Participants preferred Pair III's Gamble 1 and viewed it as less risky: There was no way to lose money.

automatically enrolled in the plan, would you pick Investment A or Investment B?

It turns out that if you use traditional measures of risk that focus on variability, the choice is really easy: You should pick B. While it might be a bit counterintuitive, let's look at the numbers.

As shown in Figure 4, Investment B has a higher expected rate of return—it is almost 10.5% (10.39%) versus about 10% for investment A (9.91%). In addition, and this is probably the surprising part, Investment B also has less variability. The numbers are clear: The gap between the best and worst outcomes for B is just 61%, but for Investment A it is actually 91%. This means that B is safer than A, at least according to calculations based on the variance or standard deviation of the two investments. Because B has a higher return and lower risk, it also has a much higher Sharpe ratio, which means that by most traditional measures B is simply a superior investment to A.[11]

If you use traditional risk measures that focus on variability, you should pick Investment B. Yet, most financial advisors and plan sponsors we surveyed picked Investment A.

And yet, most financial advisors and plan sponsors we surveyed selected Investment A and felt that B was riskier, not safer. In our sample of advisors, 92% selected A, and 94% felt A was less risky. Our sample of plan sponsors, which is admittedly small, consisted of 20 individuals managing large corporate plans. Again, 80% selected Investment A and 90% felt A was less risky than B.

How can we reconcile the huge disconnect between common industry measures of risk and the fact that 90% of plan sponsors think Investment B is actually the riskier investment? We recently asked the CIO of one of the mega plans we interviewed why he felt Investment B is riskier. His answer was very telling: "We don't define risk in standard deviation terms."

When we kept asking what risk is, the CIO thought it was pretty obvious that risk is about "losing." As a behavioral economist (Shlomo) and a psychologist (John), we are not surprised that plan sponsors are loss-averse. We are also loss-averse.

What to do about our loss aversion
The question, of course, is what should we do about our loss-averse tendencies? In the spirit of a publisher that recently asked us to write a book about rewiring our brain to cure all our bad money habits (in a few minutes), should we rewire our brains to eliminate loss aversion? Obviously not.

First, we have no idea how to rewire the brain (nor how to write that book). Second, and more importantly, there is nothing fundamentally wrong with being loss averse. But, and this is a big "but," if we accept loss aversion as part of human nature, then we have to ensure that our investment strategy fits how we feel about losses.

Figure 4: **How financial advisors perceive risk**

	Investment A	Investment B
Likely outcome (happens 99% of the time)	9%	11%
Unlikely outcome (happens 1% of the time)	100%	-50%
Expected rate of return	9.91%	10.39%
Range of outcomes	91%	61%
Standard deviation	9.05%	6.07%
Sharpe ratio	1.09	1.71
Investment preferred	92%	8%
Investment that felt riskier	6%	94%

Source for standard deviation and Sharpe ratio calculations: risklab.

If we accept loss aversion as part of human nature, then we have to ensure that our investment strategy fits how we feel about losses.

To help financial advisors, pension consultants and plan sponsors incorporate loss aversion into their day-to-day activities, we came up with four key questions to ask:

1. How do the limitations of standard deviation and Sharpe ratios factor into your strategy? These measures of variability assume that good and bad surprises are equal, but we know that's not the case. Losses loom larger than gains.

2. To what extent does your investment strategy balance loss aversion and gain seeking? Standard deviation is based on the faulty assumption that gains and losses are equal, but "semi-variance" makes another faulty assumption that we are only loss averse and don't care to seek gains at all.[12] We need a more balanced approach to how we feel about losses and gains.

3. Are you assessing the magnitude and likelihood of potential losses? Possible losses should be evaluated prior to making investment decisions, and thus, before the losses occur.

4. To what extent does your approach account for differences among individuals and their sensitivity to loss? While the median individual has a loss aversion coefficient of about 2–2.5, there are significant individual differences: Some people are actually not loss-averse and others are extremely loss averse.

Summary
Let's go back to the stock market and the performance of the S&P 500 Index in the 21st century. If you are loss-averse, like most humans, then "risk" is about losing half your portfolio during the dot-com crash or the financial crisis of 2007-2008. However, you don't think about the market tripling since its 2009 low as risk. Similarly, we speculate that the founders of Uber, Airbnb, Snapchat and Tinder view their surprising growth and ever increasing valuations as success, not risk.

Observers often refer to the stock market as a rollercoaster. It has ups and downs and they are often quite surprising. However, decades of research suggest that people only get scared by the steep falls, not the volatile ups. But you know what they say: What goes up must come down. Given our loss-averse nature, we need to think about losses before they occur, and how we might better manage risks when losses loom larger than gains.

Endnotes

1. Source: FactSet as of June 18, 2015.

2. A lively discussion of humans versus econs is offered by Richard Thaler and Cass Sunstein in their book *Nudge: Improving Decisions about Health, Wealth, and Happiness,* Yale University Press, 2008.

3. Paul A. Samuelson. "Risk and Uncertainty: a Fallacy of Large Numbers." *Scientia* 98.612 (1963): 108–113.

4. Kahneman, Daniel, and Amos Tversky. "Prospect theory: An analysis of decision under risk." *Econometrica: Journal of the Econometric Society* 47.2 (1979): 263–291.

   Tversky, Amos, and Daniel Kahneman. "Advances in prospect theory: Cumulative representation of uncertainty." *Journal of Risk and Uncertainty* 5.4 (1992): 297-323.

5. Shlomo Benartzi and Richard Thaler have researched how people react to multiple plays of the Samuelson bet, or the stock market, in the following papers:

   Benartzi, Shlomo, and Richard H. Thaler. "Myopic loss aversion and the equity premium puzzle." *The Quarterly Journal of Economics* 110.1 (1995): 73–92.

   Benartzi, Shlomo, and Richard H. Thaler. "Risk aversion or myopia? Choices in repeated gambles and retirement investments." *Management Science* 45.3 (1999): 364–381.

6. Markowitz, Harry. "Portfolio selection." *The Journal of Finance* 7.1 (1952): 77–91.

7. Our analysis is based on the first question each subject answered, but the results are similar when all three questions are included.

8. Oppenheimer, Daniel M., Tom Meyvis, and Nicolas Davidenko. "Instructional manipulation checks: Detecting satisficing to increase statistical power." *Journal of Experimental Social Psychology* 45.4 (2009): 867–872.

9. Payne, John W., Dan J. Laughhunn, and Roy Crum. "Translation of gambles and aspiration level effects in risky choice behavior." Management Science 26.10 (1980): 1039–1060.

   Payne, John W., Dan J. Laughhunn, and Roy Crum. "Note—Further Tests of Aspiration Level Effects in Risky Choice Behavior." *Management Science* 27.8 (1981): 953–958.

10. Chen, M. Keith, Venkat Lakshminarayanan, and Laurie R. Santos. "How basic are behavioral biases? Evidence from capuchin monkey trading behavior." *Journal of Political Economy* 114.3 (2006): 517–537.

11. Sharpe, William F. "Mutual fund performance." *Journal of Business* 39.1 (1966): 119–138.

12. Markowitz, Harry M. *Portfolio selection: efficient diversification of investments.* Vol. 16. Yale University Press, 1968.

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