PRANAY GUPTA, CFA
Chief Investment Officer, Lombard Odier Darier Hentsch

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Pranay Gupta, CFA, discusses various avenues of tail risk management that are open to asset allocators and portfolio managers. Specifically, he addresses several topics including whether conventional risk measures and specifications correctly specify tail risk, as well as the interrelationships between tail risk and the asset allocation, security selection, and portfolio construction processes.

PRANAY GUPTA: I guess the first thing to understand is that “tail risk” is a very popular term to talk about, especially over the last 5 years, but where does it come from and what is the source of tail risk?

And if you look at any generic investment management process from the plan sponsor down to the portfolio manager, in general, there are three steps which happen. The first step is an asset allocation step where the plan’s sponsor kind of divides up his pool of assets into equities, fixed income, alternatives; and that is the source of tail risk. The second one is that you take these assets within a particular asset class, and you give them out to a number of managers or internal strategies, and that can be underperforming managers or bad strategies, and that will lead to some negative performance or tail risk. And the third is that the portfolio manager of a particular strategy then invests that money into securities, and he can be a good manager or a bad manager, he can be a poor selector of securities, or he can be constructing the portfolio incorrectly, and that would lead to a drawdown.
So there are these three places where effectively tail risk can happen. And the question really is, How do we improve on each of these three steps if we focus on minimizing tail risk? In the first step, really the question is, Can we design a better asset allocation process which takes into account the concept of tail risk? The second step is, How do you hire good managers and when do you fire underperforming managers? And the third one is, Can we construct portfolios which specifically minimize your ability for a drawdown? What I'm going to present today is more targeted at the first and the third steps.

So let’s look at the asset allocation problem, the first step. What is the kind of assets that we are dealing with and what is the concept of tail risk that arises as a result of that? So in general, the kind of assets that anyone allocates to our broad range of equities, U.S., Europe, Japan, Asia, you can have sovereigns, investment grade, and high-yield credits. You can have commodities. I’ve put gold here. Of course, you can have alternative assets. The one point to note here is that actually this crop of assets is very poor if you take tail risk into account. If you look at the maximum drawdown that each of the equity indices, equity assets, have, it’s more than 50 percent. You have a negative tail, where you can lose half your money if you invest into any kind of equity assets, and this is over the last 10, 12 years, but if you take a longer timeframe, you have a similar number. This is just for illustration.

For the investment grade and high-yield assets, it’s about 30 percent. Indeed, for the sovereign ones, it’s lower, but one can argue that these numbers are not over a full cycle. We are at a low point as far as yields are concerned, and if you were to take this study over the next 20 years, then that would also show a drawdown of about 20, 30 percent.

The basic conclusion is that the ingredients for an asset allocation actually have very poor tail risk characteristics, so it’s not as if the problem is simple. You have very poor set of assets when you’re managing this problem.

One can argue that the tail risk in each of these assets doesn’t happen at the same time, so there is diversification to be had, and, therefore, we can manage tail risk as a result. Not that true. If you look at the correlation of these assets—and here are the three equity indices—four equity indices—and I put high yield, obviously, it has, you know, equity-like characteristics—you will see that the correlation of returns between these five assets has gone up, especially in the last 5 years to about 80 to 90 percent. So there is very little diversification to be had within the equity space by allocating to four or five different buckets.

Similarly, on the fixed income side, yes, you’re taking credit risk, which is kind of a newer asset, but if you strip that out between sovereigns and corporates, the correlation is about 90 percent.

So the asset allocation problem in reality is not allocating to a diverse set of eight or nine different asset classes, it’s basically saying how much equity, how much credit. That’s all you’re doing. And
that, loosely translated, means that you’re trying to time the equity market, which means you’re probably going to fail because we know that doesn’t work all the time. So the asset classes are very poor, diversification is limited.

Let’s assume that you were a perfect manager, that you were able to time the market. So you have this time machine, you go forward over the next 10 years and you figure out—or you go back 10 years—sorry—and you see what the returns of each of those asset classes are every year, and then you come back in time and you say, okay, I’m going to invest in the best two asset classes. So you have a full look ahead, you know exactly how the market is going to perform. What does your portfolio look like then? So if you were investing in the best two asset classes with full knowledge of what the returns are going to look like over the same period, with a 10 percent chance you would still have a drawdown over 12 percent. So even if you were a perfect manager, if you were a perfect foresight manager, your tail risk is still very high.

So how do we change that? How do we make this better? Given that the avenues of diversification are limited, given that the assets which we are dealt with are relatively poor from a tail risk standpoint, can we construct a portfolio which helps us minimize this tail risk? So we know, as we just said, that asset allocation obviously is by far the biggest determinant of tail risk because of the volatility inherent in it. We know that all of the individual asset classes have a high drawdown, and there is minimal diversification between them. But here is the odd part: if you look at any plan sponsor across the world, whether it’s a sovereign wealth fund or it’s an insurance company or it’s a corporate plan, this is very well known, but they choose a single asset allocation methodology to allocate the total pool of assets, one methodology, no diversification at all from a strategy standpoint.

The second ironical factor is that if you look at the resources inside the plan’s sponsor, in general, all of the resources, a majority of the resources, are spent in finding the right managers or firing the wrong managers, and not on the asset allocation decision. That’s done by an economic group of limited resources or it’s outsourced to a consultant. So the framework with which plan sponsors manage assets is not focused on managing tail risk, and, in reality, if you look at all the underfunded situations, if you look at the underfunded situations for all plan sponsors across the world, this is where the underfunding happens, it’s from the asset allocation decisions. The structure seems to be a little bit odd.

But what if we are to ask the question that, like we diversify managers, so in which you, for example, have a plan sponsor which invests in U.S. equities, they will find five different managers to diversify the risk of each individual manager. What if we follow that same approach for asset allocation? If we have a multi-strategy approach to asset allocation, would that help?

If you look at asset allocation as a concept, all it basically is, is that you invested in multiple asset classes and you’re allocating capital risk with a particular methodology to each of these individual
boxes, and there are many ways to do it. The simplest way—I characterize them here in terms of “Active,” “Semi-Passive,” and “Non Beta”—there’s a group of people obviously which says, “We don’t want anything to do with asset classes at all.” So if you look at the Yale model, for example, they just do alpha, there is no beta allocation as such, it’s alternatives and market-neutral strategies. Or you have insurance companies which say, “Well, you know, we’re just going to hedge out all the liabilities,” and there is very little risk left at the end. These guys are not really doing asset allocation at all when they manage their plans.

And then you have two broad categories. There is what I call a semi-passive category. Most people follow kind of a long-term risk premia approach: you do a 20-year study, look at the career risk premium, you look at the return required for your plan, and then you do a long-term allocation on a 3- to 5-year basis to create a plan portfolio. That’s the way almost everyone—that’s how everyone does asset allocation. For individuals, that translates to kind of a balanced portfolio, or target date funds, which has been proposed as the right measure for individuals’ liabilities. And lately over the last, you know, 5 years, you’ve seen a greater preponderance of minimum variance and risk parity strategies. These are all very semi-passive strategies, you’re not taking an active decision in terms of, “I think equities are going to do better next quarter or next year,” they’re just passive from a long-term perspective.

And then there’s a whole group of active asset allocation styles. You have the fundamental indexation kind of allocation, which says market-cap weighted allocation is incorrect. You have thematic. You have the traditional economic viewed based where you take an active position, and so on, macro hedge funds and CTAs and managed futures. All of these strategies are allocating to multiple asset classes, but when a plan sponsor manages assets, he puts all his faith in one box in most cases.

It’s well known that obviously if you use a multi-strategy approach in your investment decision, that gives diversification benefits. This is just a stylized example where you have return on the Y axis, you have risk on the X axis, and N is the number of strategies that you have. If you have one strategy, you have a frontier of your risk reward tradeoff. As you add the number of strategies, you can effectively decrease your risk, and you move from N=1 to N=5 with the same level of alpha. So loosely what it means is that if you do follow a multi-strategy approach in your investment decision, the probability is that you will end up with a lower risk just because of the diversification within the strategy framework, and that’s what I am proposing here.

So from a simple standpoint, basically the one proposition I would say to manage tail risk from a plan sponsor standpoint is don’t have a single asset allocation. Have your overall plan divided up into different boxes. All of them are asset allocation strategies. You can have one which is a traditional long-term risk premia kind of framework, which is what is done today, but then you can have other ones which have different time horizons, and that should diversify the creation of tail risk from an asset allocation perspective. Obviously, it’s difficult to prove that mathematically
or empirically because data of economic view base is not available, it depends upon what kind of strategist or strategy that you follow, but from a conceptual standpoint, I would suggest that if you have your overall plan broken up into these four or five boxes, then you stand a better chance to manage the tail risk that arises if equity markets fall.

The second step—the third step—sorry—security selection. How do we construct a portfolio which is able to better manage the tail risk?

So what is the typical problem that a portfolio manager has? In general, when money is given to a portfolio manager, there is an expectation of some kind of excess return. And explicitly or implicitly there is a maximum drawdown threshold. He is told or his boss tells him or his client tells him that, “If you lose more than minus 5, then we’ll fire you,” or minus 10. It may not be stated that way, it might be stated as volatility, but there is always a maximum drawdown threshold which specifies a risk aversion of the asset owner or the client. And the question is, How does he take this into account to construct his portfolio?

What is intrinsic in this problem is that obviously he has a Sharpe ratio, he’s an active manager, so he has a certain level of skill, and there is an asset universe that he’s investing in. He’s told that he’s an active manager in U.S. equities with an X percent tracking or whatever. That’s the problem that’s given to him. The controls that he has in his hand, he can select the securities that he wants, he can select the number of securities in his portfolio, and he can select the more volatile assets or less volatile assets. He can choose over what horizon he makes his forecasts. So you have the very long-term traditional managers who say we’ll do some kind of a dividend discount model and forecast over the next 12 to 18 months. You have the short-term traders, who do technical analysis or short-term trading, and that is within the control of the manager, what time horizon he chooses for his forecast. And the third is he can choose to implement a stop loss at the asset level or at the portfolio level.

So let’s look at this problem a little bit more analytically and look at what tail risk here is. So here in the chart, let’s assume you buy a stock here, and the reason you buy it, of course, is that you believe that it’s going to give you a positive return. That’s the basic concept, and you believe that positive return is going to be, let’s say, 5 percent over 24 months. This is where you want—you think the stock is going to go based upon your forecast. Of course, in reality, the stock will not move that way, it will have different paths. One facet of this is that at the end of the horizon, it doesn’t reach what you expect it to reach. So there is a tail or drawdown which happens because your forecast was not as certain as you thought, and there is a negative return compared to what you expected the stock to perform over your investment horizon, and that I call end of horizon risk.

A more pertinent risk which I believe is overlooked or not factored in, in the portfolio construction is intra-horizon risk, that the stock moves like this and touches a negative threshold. Now, if you were completely oblivious to the path that you said, okay, I’ve given you the money for X
months or X years, and you don’t look at it within that period, then you don’t need to look at this, then you just wait for 2 years, and you come back and you see whether the results are good or bad. But that’s not the way the world functions. In reality, every plan sponsor can say that I have a very long-term horizon, but he is governed every quarter by the board of trustees or by the regulator or by the boss of the portfolio manager. So everyone looks at it intra-horizon. And we know for a fact that if it touches a particular level, then there is a stop to that strategy. So this intra-horizon risk is very critical if you’re going to manage tail risk. Your risk is not just what happens at the end, it is also at every point of time. Can we factor that in? That’s the question. So I use risk as end of horizon and intra-horizon, the probability that you will touch a particular level here, and the probability that you will not meet the return that you targeted at the end of horizon.

We’ll go through the math, but one point I’ll make here, which I just said, is that the tail risk is basically the probability of both your intra-horizon and your end of horizon risk. And the conventional philosophy doesn’t allow for both.

So what’s the result? If we parameterize some of the mathematics, what do we end up with? The graph here shows what happens to the risk as your investment horizon goes up, as your investment horizon increases. So what is conventionally accepted, which is correct, is that as you increase your investment horizon, your end of horizon risk goes down. You’re more likely to meet your target if you increase your end of horizon, and that’s why people say that you should have a long-term horizon. But the facet that’s often missed is that as investment horizon increases, the probability of a breach goes up. So you may not breach it if you’re just doing it for the next month or the next day, but if you say over the next 2 years, then there is a higher probability that you will touch some given drawdown threshold, and your real risk is the sum of the two.

So if you take that into account, then the logical conclusion is, Should you really have a long-term horizon, or are you prepared to take the risk intra-horizon if you have a long-term investment horizon? Or put another way, if you define what is your maximum tolerance for loss at any point of time, that automatically puts a cap as to what can be your maximum horizon. You can’t afford to have an investment horizon longer than a particular amount if you define your threshold of maximum loss.

Now, this is obviously in a scenario where your mean was known, but that’s—we know that we don’t know the mean. The mean is uncertain. Forecasts are not certainty. So there is an uncertainty about this mean which has to be factored in. And this is not new. Obviously, we have Bob Litterman. He can probably expound on this a lot more, but this was used by the Black-Litterman model, of incorporating uncertainty into your framework. The difference here is that the definition of risk incorporates intra-horizon, and that changes things. Two facets of that. The standard deviation is no longer a function of the square root of time. There’s an additional uncertainty element that we are factoring in. And the second is that the Sharpe ratio is not the same time after time. It’s a function of the time horizon.
So if we take this into account and we reformulate our problem—if you have any questions on the mathematics, I have my co-author here, who can—more than happy to answer all the mathematical questions—but if we take the results of this mathematics, what do we end up with? Right? So obviously there is an impact of skill, how good you are as a portfolio manager. Now, we use a term called mu, which is the uncertainty around the mean, and obviously if your uncertainty is higher, it means that you have lower skill. If you are a higher skilled, higher Sharpe ratio, portfolio manager, then mu would be smaller, and that’s what this graph shows, that as uncertainty goes up, then your intra-horizon risk also goes up. It's kind of logical, both from an intra-horizon perspective and obviously from a total return perspective.

And it brings back the same thing which I said earlier, that if you are given a maximum threshold of loss by your client, your maximum tail that you’re allowed to have, and you have some expectation of what is your uncertainty or your Sharpe ratio, then you can calibrate what your investment horizon should be, and longer than that is not acceptable.

Of course, no presentation would be complete without a nice colored chart, so that’s what we put here, also to wake you up. But the context of this chart really is that you have a parameter here which is the uncertainty of your forecast, you have the investment horizon over which you make the forecast, and both of them determine what kind of intra-horizon risk you will end up with.

An interesting conclusion of that is how you compare long-term fundamental managers with shorter term managers. And what it basically means is that if you're a long-term manager, if you are the traditional long-term fundamental dividend discount model, believe in the story the stock is going to come back, that kind of a manager, then you need to be very sure what is your forecast. A small change in your forecast for a long-term manager has a very high impact on your drawdown, on your tail. For a short-term manager, that’s not the case or it’s much smaller.

So one part was, okay, we use—we’ve got a portfolio of assets. Now we’ve incorporated our uncertainty, we incorporated the time horizon over which we’re doing the forecast, so we’re telling our—you know, the portfolio manager is looking at each stock and saying, “I think it’s going to up by 5 percent,” but he’s also saying, “I expect to reach that 5 percent over the next 6 months or 12 months,” and he’s also saying, “Am I really certain or less certain of reaching this target?” You're incorporating the level of uncertainty of the forecast and the horizon over which the forecast is made and hopefully getting to a better portfolio which is acceptable from a tail risk standpoint.

The second thing you can do is actually apply a stop loss. So let’s look at the stock. So you bought a stock here with a particular forecast, and it goes through time, and one of two things can happen. It either hits the stop loss that you set for it, and then you cash out and you reinvest into a new stock or a new manager, or, like in the second case, you invest in the second stock and you hold it for the overall horizon, so it actually meets the return target that you have, and you keep doing that. So you bought the stock, you set a stop loss and a target, it goes through that, it hits
the stop loss, you cash out and invest again, or it goes to the end of horizon, you take profit, invest again, and so and so forth. It’s a multi-horizon problem, that you’re basically investing in a set of stocks or a set of managers over and over again, but you’ve defined a stop loss for each of them, and the question is, How do you define that stop loss for making a better portfolio?

And this is the problem. I think one of the things to mention here is obviously the analytical form here is much more difficult to obtain, and so it’s a numerical solution, but we can get some results.

So let’s look at the three factors. So there is a transaction cost obviously, that every time you’ve sold a stock, either because of a stop loss or because it has met your target, you incurred a transaction cost to reinvest into a new stock. The second is each stock obviously has a mean uncertainty, that there is a certain level of confidence that you bought the stock with in terms of a forecast. And there is a horizon over which you bought that asset.

So what happens as transaction costs go up? The Y axis here is the portfolio return, and the X axis here is the stop loss. I think I can’t see it very clearly, but obviously what your objective is to have the highest portfolio return. So if you look at the tangent of these three lines, which are different levels of transaction costs, one conclusion is that as the transaction costs increase, then you need to widen your stop losses. Why? Because if the stop losses are very close and you touch it very often, then you will be forced to trade a lot more. And if transaction costs are high, you will incur a lot of transaction costs. So if transaction costs are very high, you need to set a little bit wider stop loss so that you don’t incur transaction costs to keep churning the portfolio. If transaction costs are very low, then you can afford to do that, that if you take a loss, that’s fine, you move on, and you look at the next stock.

The second one, which are not obvious from these charts, but they are just depictions, is that uncertainty increases, then stop losses need to be tightened. Obviously, if you are not so sure about the stock, then it’s better to have a tight stop loss. If you are sure about the stock, then you can have a little bit of a way, you can give it a little bit more leeway. And simply from an investment horizon perspective—remember we looked at this before—if you have a long-term investment horizon, then intra-horizon risk goes up, so you need to have a tighter stop loss.

Let’s look at this in practice. So just an example of six different kinds of assets. So the first one is a long-term certain asset. Right? So you’ve got a horizon of, let’s say, 18 months. You’ve forecasted that the return is going to be 20 percent, and there is some level of uncertainty. The objective is to contrast it with, let’s say, a long-term stock where you are more uncertain about the return. The same investment horizon, similar kind of return, but your uncertainty parameter is much higher. The delta here is the transaction costs. So let’s say if we pick one, let’s say if we pick 40 basis points of transaction costs, what it means is that, let’s say, for a long-term stock, if your uncertainty goes up, your stop loss has to be tightened. You can use the parameters which are defined by you to define a stop loss for that particular kind of stock.
Similarly, if you compare time horizons, so let’s say you compare an uncertain stock with a medium-term uncertain stock. So instead of 18 months, you’re making a 6-month forecast, similar return of 20 percent, similar uncertainty, the difference really here is in the time horizon over which you are making it. And if you compare the stop losses, you can see that you need a tighter stop loss for a longer term forecast.

Another interesting factor is if you have a short-term certain stock—it’s kind of obvious—so if you know that you’re going to get this return, it’s very short term, then maybe you don’t need to set a stop loss. Obviously, if it’s short-term and uncertain, you still need to set a stop loss at a custom level based upon the market that you’re trading in, which is a transaction cost, based upon what is the investment horizon for that stock, what’s your expected return, and the level of uncertainty of that expected return.

So what are the conclusions?

The first conclusion is that of the three steps—asset allocation, manager selection, and stock selection—the asset allocation step obviously is the biggest determinant of underfunding in most plans. It is the most undiversified decision that is taken by a plan, and it is probably the biggest cause of the asset liability problem in most plan sponsors. And if you have to manage that tail, the tail of a plan sponsor, you have to transform your asset allocation process from a single strategy to a multi-strategy approach that don’t bet the farm on just one method long-term risk premia, but are different methods of doing asset allocation.

The second is that the investment horizon has to be a critical ingredient in terms of how you construct a portfolio of assets or of managers. Simply having a long-term investment horizon doesn’t mitigate tail risk; it’s quite the reverse, it increases tail risk. And if you truly are a long-term investment horizon asset owner and you don’t look at assets in the middle, then it’s fine, but that’s not the way, in most cases, the practical world works, which means that there is automatically a cap as to what the investment horizon can be as a function of the tail risk you are allowing. Set a stop loss for each asset in your portfolio.

And, finally, some of the work that we’re doing, you know, we haven’t gone into how you would use this to define criteria of when to hire or fire a manager. We can construct efficient frontiers with this new definition of risk. So I think the basic concept here is that risk is not just what is end of horizon, risk is what you go through intra-horizon because that is the real risk that you’re taking in terms of managing assets or if you’re a plan sponsor. And if you incorporate that, there is probably a new definition of efficient frontiers that can get created.

And we can also tackle how to allocate assets over managers which have different time horizons and different skills and so on.