



MICHAEL BAZDARICH
Product Manager/
Economist

Why All Defined-Benefit Plans are Short-Term Investors

Executive Summary

- Because of its need to make regular benefit payments, a DB pension plan simply cannot afford to behave like a long-term investor. It must be cognizant of short-term risks.
- Monte Carlo experiments we ran found a better than 50% chance of asset exhaustion (insolvency) for even an adequately-funded plan whenever asset returns varied randomly with some level of volatility.
- Fixed-income portfolios can reduce the risks of insolvency because they can be structured to match the maturity profile of the plan's liabilities and because their random variations display more mean-reversion than do other asset types.
- All these results are just as relevant for public plans as for corporate and multi-employer plans. That is, our simulations were based on asset exhaustion, not of tracking a particular liability valuation (based on a particular accounting regime).

Section 1: Introduction

At a pension plan conference not long ago, a plan manager asked, "Why can't I just forget about de-risking and behave like a long-run investor: maximizing expected total return?" The simple and short answer is that because a defined-benefit (DB) plan makes regular benefit payments, it simply can't afford to focus only on long-run returns. There is always substantial risk that a run of only modestly bad luck—combined with regular benefit payments—could so deplete assets that the plan could not recover even when and as asset returns rebounded to long-run averages.

The allure of the long-term investor arises from investment assumptions that are crucially different from those facing a DB plan. Decades ago, when Harry Markowitz and Paul Samuelson debated whether a "long-term investor" should care about risk or only return, they both considered an investor who could put funds away and let them accrue untouched until some terminal date. Because 100% losses in any specific period were assumed away, the investment pile never went to zero. So it would ultimately fully rebound once average asset returns had returned to their expected levels.

Once intervening—and regular—cash payouts are allowed for, everything changes. Cash payouts can exhaust assets in finite time when asset returns are only slightly negative or even positive but below-average, in which case assets remain depleted even when asset returns have averaged out to long-run norms. So, even long-run-minded investors can find themselves dead in the short-run (apologies to Keynes).

Furthermore, the risks of exhausting assets under a risky asset allocation are substantial. In the following sections, we'll show that when asset returns randomly fluctuate alongside regular payouts, the chances of premature asset exhaustion look to be better than 50%, even with adequate initial funding. When initial funding is less than adequate, such insolvency is almost inevitable.

Every real-world DB plan faces the certainty of having to draw on invested assets well in advance of its "terminal date." It simply can't afford to act as a long-run investor. It must manage short-term risks. There are two steps a DB plan can follow to reduce the risk of asset exhaustion: it can tailor the risk aspects of its plan assets to match those of its liabilities and/or it can fund the plan in excess of what would be considered adequate.

With respect to risk matching, the plan will have some terminal date when final payouts are made. As time passes, that terminal date draws nearer, and its liabilities mature. Asset types such as equities, alternatives, and real estate do not mature, but proceed indefinitely, whereas fixed-income assets do mature. Thus, fixed-income portfolios can be structured to match the maturity structure of a plan's liabilities in a way that other asset types cannot, thereby reducing the risks of asset exhaustion for the plan. Furthermore, fixed-income returns can be viewed as non-random—mean-reverting—and this also makes the chances of asset exhaustion less relevant for them.

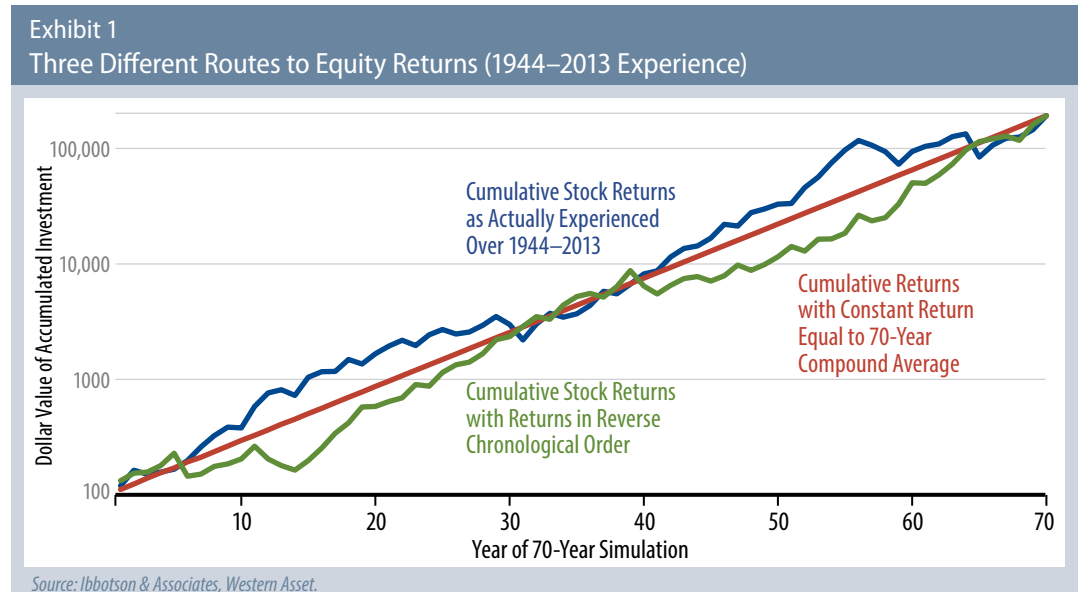
As for more-than-adequate funding, this is an option regardless of the level of risk in the asset allocation, but it contravenes the cost-minimization motive that drives risky DB asset allocations in the first place. Also, the

overfunding should be achieved early. If the plan waits until assets are nearly exhausted, even substantial subsequent contributions may not be sufficient. (Remember that asset exhaustion occurs not necessarily because of negative asset returns, but because of below-average returns alongside continuing cash payouts.) But here again, substantial overfunding runs counter to the desire to reduce pension costs.

Notice that these findings are just as relevant for a public plan as for a corporate plan. We deal here with avoiding asset exhaustion, not necessarily with minimizing funded status volatility. The real benefit of fixed-income assets to a DB plan is that they maximize the chances of plan solvency, an issue that is irrespective of accounting regimes. (Zero assets are zero assets regardless of what the liability valuation is accounted to be.) The fact that fixed-income assets do minimize funded-status volatility under a particular accounting regime is an indication of how well that accounting regime reflects the economics underlying the plan's solvency. The particular accounting regime a plan faces is incidental to it. Maintaining solvency is a palpable reality.

Section 2: Path Matters! Timing Matters!

From 1944 to 2013, the stock market delivered compound average annual gains of 11.41% per year, as shown by the blue line in Exhibit 1. The red line there shows a cumulative return path with steady, 11.41% per year returns. The green line provides the same "distribution" of returns as the blue line, but in reverse chronological order. One might think that a long-run investor should be indifferent among these three paths, since they all deliver the same average return. Think again.

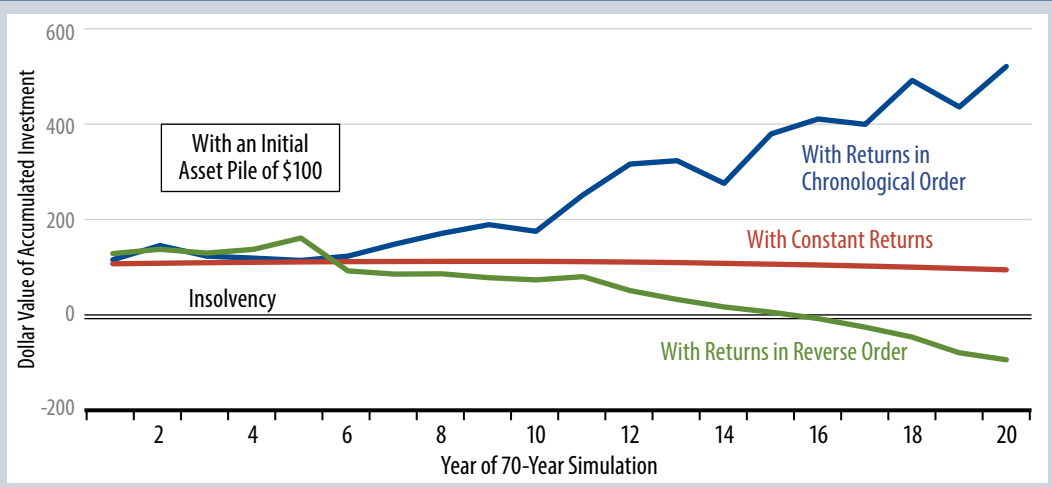


We simulated a DB plan with a representative path of projected benefit payments. Using an 11.41% annual discount rate, the present value of all benefit payments at the starting date was \$100 (scaled), and initial assets of \$100 were then provided and invested according to the returns specified by the three paths in Exhibit 1. Asset paths were then simulated, with assets growing in each period according to realized returns, but decremented according to scheduled benefit payments. For the three resulting asset paths, the first 20 years of the simulations are shown in Exhibit 2.

With constant returns, assets would be exactly sufficient to discharge benefit payments, and the resulting asset stock gradually declines, hitting zero as of year 70, the terminal date of the plan. With actual historical stock returns, assets are hugely more than sufficient to discharge benefit payments. By year 20, assets have grown to \$500—from \$100 initially—and they continue to grow rapidly through the end of the 70-year

Exhibit 2

When DB Benefits are Paid Annually, the Same Average Asset Returns Result in Vastly Different Paths for Plan Assets



Source: Ibbotson & Associates, Western Asset.

simulation period. In dramatic contrast, by merely reversing the chronological order of returns, the plan goes insolvent after only 15 years!¹

As seen in Exhibits 1 and 2, returns as per the blue line enjoy a run of very good fortune over years six through 12 (corresponding to the stock market boom of 1949–1955). That boom accumulates so much in assets that the plan sails through subsequent runs of bad luck. In contrast, on the reverse order path, the plan suffers a run of bad luck over years six through 14 (corresponding to the period of 2000–2008 in reverse) from which it is never able to recover.

Clearly, short-term timing is crucial. These three investment paths have the same long-run average return, but drastically different results for plan solvency. It is not enough merely to have an investment allocation for which long-run average returns appear adequate to meet benefit payments. Whether the plan will remain solvent depends on the luck of the draw as much as—or more than—its calculations of expected return and necessary initial funding. At the very least, timing is crucial when it comes to embarking on a risky allocation.

This result is not a trick depending on the particular order (or reverse order) of historical stock returns. For the “population” of returns generated by the stock market over the period of 1944 to 2013, we ran a Monte Carlo test, generating 10,000 re-orderings of these 70 returns. The simulated plan exhausted assets well before the terminal date in 52% of those re-orderings. What looks to be adequate—or more than adequate—funding opposite certain returns happens to be woefully insufficient most of the time when returns are random, even when the plan correctly assesses long-run average returns.

Section 3: DB Plans Face Risk of Ruin With Virtually Any Level of Random Risk

In Section 2, we saw that funding that appeared adequate to discharge plan liabilities based on long-run averages in fact turned out to be inadequate most of the time when the luck of the draw—good or bad timing—was in play. This result is not specific to high-volatility asset allocations such as equities. We’ll see in this section that the same finding occurs across a broad range of asset volatilities. In fact, for any volatility

¹ Exhibit 2 stops at year 20 in order to preserve some resolution in the chart. For the simulation through year 70, net assets under the blue line hit \$45,000, from an initial level of \$100. On the green line, they decline to -\$58,000, while on the red line, they decline to exactly zero. With a scale wide enough to handle these extremes, the descents to zero assets at year 15 on the green line or at year 70 on the red line are not visible.

levels relevant to real-world assets, we find a better than 50% chance of short-term insolvency when plans are only “adequately” funded.

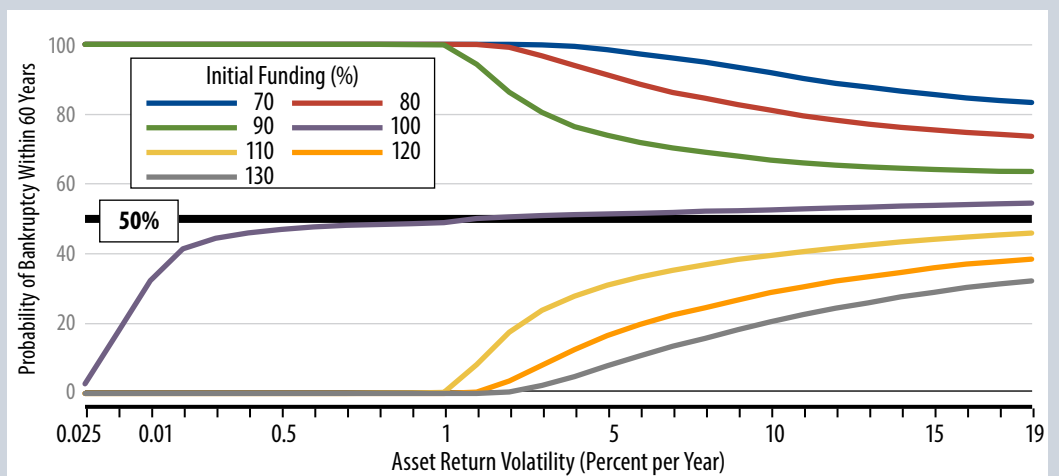
In Section 2, returns were chosen from the historical “distribution” of stock market returns over the last 70 years. Here, we let annual volatility levels range from zero to 19% per year (the approximate volatility of annual stock market returns over recent decades). For each level of volatility, average returns were chosen to correspond to return/risk relationships exhibited by historical data for the US.² Asset return series were then generated from a lognormal distribution with specified mean and volatility, with returns identically and independently distributed over time. The same benefit path was used as in Section 2, and asset paths were again simulated as in Section 2: asset stocks incremented according to asset returns and decremented according to scheduled benefit payments.

For each combination of mean and volatility, seven different initial levels of funding were simulated, ranging from 70% to 130%. Once again, 100% initial funding meant that funding was exactly sufficient to discharge liabilities if asset returns were constant at their long-run average. Other initial funding levels from 70% to 130% were defined as proportional to this 100% level. For each combination of mean/volatility and initial funding, Monte Carlo tests involving 10,000 simulations were run.

The results of this experiment are summarized in Exhibit 3. This chart shows the incidence of insolvency within 60 years (again, across a 70-year simulation) for each combination of mean/volatility and initial funding. As seen there, **when initial funding was exactly 100%, there was still more than a 50% chance of insolvency at any level of volatility above 1% per year.**³ For lower initial funding levels, the chances of insolvency were much higher.

Exhibit 3

Probability of Bankruptcy Within 60 Years Depending on Initial Funding and Asset Return Volatility



Source: Western Asset.

Only with substantial, initial overfunding were the chances of insolvency below 50%, and even there, those chances were on the order of 20% to 40% at volatility levels reflective of real-world assets. If a plan were to

² Return/risk ratios were based on market results across a variety of assets over 1960–2013, using annual holding period returns.

³ By way of comparison, long bonds and stocks exhibited annual return volatilities of 9% and 19% per year, respectively, over 1960–2013. Note also that when insolvency after 40 years is plotted, the probability is above 50% at volatility levels above 5%. So, the insolvency probabilities shown are not merely a reflection of assets being exhausted just prior to the 70-year terminal date.

invest all assets in the stock market—with historic annual volatility of 19%—and were to provide 120% of the assets that “actuarial calculations” deemed necessary, it would still face nearly a 40% chance of exhausting assets well before all benefit payments had been made.

The simulations here focused on whether or not plan assets became exhausted. They are not dependent upon any particular accounting of liability valuation or funded status. Yes, the way initial funding levels were chosen conforms with present public plan pension accounting (Governmental Accounting Standards Board) protocols, but the economics of the simulations are equally relevant for Financial Accounting Standards Board (FASB)-compliant reporters, once the initial funding levels specified here are translated into FASB-compliant funded ratios.⁴ Notice that probabilities of insolvency depend only modestly on initial funding: they don’t dwindle to zero even when initial funding levels hit 130%. So, it is clear that even under FASB funding calculations, risks of insolvency will be substantial even for well-funded plans (with risky asset allocations).

Notice that the chance of insolvency depends differently on return volatility for “overfunded” plans from the way it does for underfunded plans. For “overfunded” plans, chances of insolvency increase as return volatility rises. For underfunded plans, chances of insolvency decline as return volatility rises. For an initially overfunded plan, it needs really bad luck—high volatility—to become insolvent. An underfunded plan needs really good luck to survive, so it needs a high-volatility allocation to have a shot at such luck. This is just another way of saying that an underfunded plan is more likely to “shoot for the moon” on its asset allocation than a well-funded one.

One might think that by holding volatility constant and raising mean returns above those of historical experience, the chances of insolvency could be reduced. However, this holds true only if initial asset levels are held steady as expected returns rise. If initial funding is kept at only “barely adequate” levels as higher expected returns reduce the actuarial value of future benefit payments, then the level of volatility will remain dominant in driving insolvency rates, and results will be similar to those in Exhibit 3. And how many actual plans can resist the temptation to cut funding levels when higher asset returns are targeted?

Section 4: Why Properly-Constructed Fixed-Income Allocations Substantially Reduce Risk of Ruin

Based on the results of Section 3, one might think that fixed-income allocations provide just as great a chance of insolvency as equity-based allocations. After all, over the range of volatilities relevant to real-world stocks and bonds—9% to 19%—there is not much difference in the probabilities of insolvency reported in Exhibit 3. However, fixed-income allocations differ in at least two important ways from the assumptions underlying the Monte Carlo tests in Section 3.

⁴ While corporate plans use high-grade bond yields to discount their cash flows to a present value, public plans use their expected return on assets. So, for a corporate plan, its liability valuation is independent of its asset allocation. Also, since its liability valuation is dependent on bond yields, bonds provide a good hedge of those liability accounting valuations. For a public plan, different asset allocations result in different expected returns on assets and so different liability valuations. Hedging liability accounting valuations thus becomes impossible. Still, as stated in the text, the economic features of the two types of plans are essentially identical, the only difference being that many public plan benefit flows are inflation-indexed, whereas most corporate plan benefit streams are not.

With a 1989–2013 historical compound average return on equities of 10.26% and a 1989–2013 average return on liabilities of 9.38%, as per our simulated AA yields curves over 1988–2013, 100% initial funding as calculated in the text would correspond to an initial funded status of 93% as per FASB rules. So, even a 93% funded plan invested solely in equities would be likely to eventually become insolvent if that allocation were maintained. A 100% funded status as per FASB would correspond to 108% funding as calculated in the text and would result in about a 46% chance of eventual insolvency. The 120% initial funding mentioned in the text corresponds to a FASB funded status of 111%. These conversions to FASB funded status from the “initial funding” levels described in the text are dependent on specified “alphas” for equity returns over projected returns on FASB-generated liability valuations. As the latter are subjective and not directly historically observable, we don’t explicitly discuss these conversions in the text.

As stated there, our simulations assumed asset returns were distributed identically and independently over time. The resulting asset return series were random walks. The random walk model is indeed relevant for equities and other “risk assets,” but not for fixed-income.

Stocks and real estate never mature. They are open-ended allocations. In contrast, bonds certainly do mature, and it is possible to construct a fixed-income allocation in which the maturity rolls down over time. Clearly, DB obligations with a terminal date mature over time, and it is this mismatch between assets and liabilities—maturing liabilities versus non-maturing assets—that drives most of the Section 3 results.

Thus, if a long-duration allocation—with annual volatility around 9%—were established and maintained over time, its chances of resulting in insolvency for a DB plan would be similar to that of an equity allocation. It is because a long-duration allocation can be structured to match the maturity structure of the plan’s obligations and because it can then be allowed to mature over time that allows greatly reduced chances of insolvency relative to those found in Section 3.

Also, unlike equities, fixed-income returns do exhibit mean reversion. High returns one period are caused by declining yields which imply lower returns going forward and vice versa. This negative autocorrelation in fixed-income returns stands in contrast to the random walk (zero autocorrelation) nature of stocks. Along with the ability to mature, it contributes to the efficacy of fixed-income in improving solvency chances.

It is beyond the scope of this paper to demonstrate these assertions via Monte Carlo tests comparable to those in Section 3. To do so, we would have to simulate randomly-generated Treasury yield curves, spread curves, default incidences and actuarial swings, and calibrate them to generate volatility levels consistent with real-world experience across maturity and quality levels. Still, a simple extreme case is instructive.

Suppose a plan allocated to a fixed-income portfolio that exactly defeased its obligations: that generated cash flows (coupon and principal payments) identical to its path of benefit payments. Then, by construction, the plan would never go insolvent, regardless of how much bond prices swung, since, again, the allocation would generate exactly enough cash flow to meet benefit payments, and the value of remaining assets could not go to zero so long as zero asset prices are ruled out (à la Markowitz et al.).

In the real-world, a plan can’t defease all benefit payments since liquidly-traded bond maturities typically don’t stretch beyond 30 years, while DB obligations stretch to 70 years or farther. Also, the incidence of defaults and of actuarial adjustments to benefit projections further reduce the ability to eliminate chances of insolvency altogether. However, our simple example here, along with the stated differences of fixed-income allocations from the random walk features of Section 3, should provide a good intuitive idea of how fixed-income allocations can reduce “risk of ruin” for any DB plan. In any case, we have established that the long-run investor mantle is inappropriate for any DB plan.

Section 5: Why Don’t Plan Bankruptcies Occur More Often?

With most DB plans historically invested in high-volatility asset classes, why haven’t real-world plan bankruptcies been as prevalent as our simulations predict? First, plan failures are hardly unknown. The Pension Benefit Guaranty Corporation is currently custodian of more than 4,000 failed plans, and while the plan sponsor itself failed in these cases, the plans in question were also on the brink of insolvency. Similarly, various public plans across the country have experienced such severe depletion of assets that eventual insolvency seems inevitable.

Still, the two main reasons that real-world insolvency rates may be lower than our findings suggest are: still-open plans and ongoing contributions by plan sponsors. Most real-world plans are non-frozen, with regular

benefit accruals and regular contributions. Our simulations did not allow for any “evolution” over time of DB payment streams, so, in effect, we assumed closed, frozen plans. Also, we did not allow for subsequent cash contributions. However, these assumptions are consistent and don’t invalidate our results.

If ongoing contributions are made only to fund ongoing benefit accruals, then such contributions will delay insolvency but may not prevent it. If existing assets are insufficient to discharge existing liabilities, this will still eventually bankrupt the plan, even if subsequent contributions fund subsequent benefit accruals. And if contributions are used to better fund existing liabilities, this can prevent insolvency, but it supports our finding that the initial funding for plan will usually prove insufficient. After all, our simulations merely show that under risky asset allocations, apparently adequate initial funding levels will in fact prove insufficient over half of the time.

Section 6: Conclusions

The first task of any long-run investor is to survive to the long-run. If nothing else, the analysis here has shown that in order for a DB plan to have a high probability of long-run survival, it has to think about more than long-run returns. Even with the highest expected returns (and corresponding volatility levels), chances of near-term insolvency will be substantial unless the plan is willing to dramatically overfund the plan initially or make large contributions later. And the whole point of investing in high-return/high-risk assets is to minimize the costs of the plan: to minimize contributions.

There is no “low-cost allocation” that also protects against risks of insolvency (or of massive future contributions). This doesn’t mean that all DB plans should de-risk, but it does mean that they all have to manage short-term risks and provide for contingencies, rather than merely relying on the mantra of the “long-run investor.” Meanwhile, plans can de-risk through “matching” allocations that reduce or eliminate the random return features that drive high insolvency probabilities in our simulations. These matching allocations work just as well for a public plan as for a corporate one. While they involve higher levels of initial funding, the long-term costs of these allocations may not be any higher in actual practice than those of more “aggressive” allocations.

Past results are not indicative of future investment results. Investments are not guaranteed and you may lose money. This publication is for informational purposes only and reflects the current opinions of Western Asset Management. Information contained herein is believed to be accurate, but cannot be guaranteed. Opinions represented are not intended as an offer or solicitation with respect to the purchase or sale of any security and are subject to change without notice. Statements in this material should not be considered investment advice. Employees and/or clients of Western Asset Management may have a position in the securities mentioned. This publication has been prepared without taking into account your objectives, financial situation or needs. Before acting on this information, you should consider its appropriateness having regard to your objectives, financial situation or needs. It is your responsibility to be aware of and observe the applicable laws and regulations of your country of residence. Potential investors in emerging markets should be aware that investment in these markets can involve a higher degree of risk. Any forecast, projection or target is there to provide you with an indication only and is not guaranteed in any way.

Western Asset Management Company Distribuidora de Títulos e Valores Limitada is authorised and regulated by Comissão de Valores Mobiliários and Banco Central do Brasil. Western Asset Management Company Pty Ltd ABN 41 117 767 923 is the holder of the Australian Financial Services Licence 303160. Western Asset Management Company Pte. Ltd. Co. Reg. No. 200007692R is a holder of a Capital Markets Services Licence for fund management and regulated by the Monetary Authority of Singapore. Western Asset Management Company Ltd is a registered financial instruments dealer whose business is investment advisory or agency business, investment management, and Type II Financial Instruments Dealing business with the registration number KLFB (FID) No. 427, and members of JIAA (membership number 011-01319) and JITA. Western Asset Management Company Limited (“WAMCL”) is authorised and regulated by the Financial Conduct Authority (“FCA”). In the UK this communication is a financial promotion solely intended for professional clients as defined in the FCA Handbook and has been approved by WAMCL.