Appendix to "Toward LDI Solutions That Actually Work"

This Appendix to "Toward LDI Solutions That Actually Work," reports the results of hedging exercises involving alternate discount curves and/or alternate sets of liability cash flows. The text covered solutions for a plan with 14 years duration utilizing a AA discount curve. While a AA curve is relevant for most clients we work with, some clients manage to liabilities discounted by the Treasury's HQM curve (aka PPA curve), using bonds ranging from A to AAA, but mostly A, so solutions for this curve are also of interest.

Similarly, the clients we work with have liability cash flows ranging widely in terms of maturity and duration. The 14-year duration liabilities analyzed in the text are toward the long end of the spectrum for US plans we have analyzed. Here, we also analyze solutions for a plan with only 11 years duration.

The hedging solutions displayed here are parallel to those discussed in the text. To highlight those parallels, we label the solutions here with the same column numbers as the corresponding solutions in the text, but with an A, B or C appended. Thus, Exhibit 6 shows solutions for the same 14-year liabilities as analyzed in the text, but now using the PPA curve, and solutions there have an A appended. The solution in column (6A) there is comparable to the solution in column (6) in Exhibit 2, but for the different discount curve. The same goes for the other solutions listed there.

Exhibit 7 shows solutions for an 11-year set of cash flows using AA curves, and its solutions have a B appended to their column designations. Finally, Exhibit 8 shows solutions for the 11-year flows using the PPA curve, and

Exhibit 6
Solutions for 14-Year Plan Using PPA Curve

	Portfolio Weights (as Percent of Liability Valuation)			
	(4A)	(6A)	(7A)	(8A)
Asset Type	Match KRDs with Credit Only	Optimized, Corporates Only	Minimize Tracking Error, Corps. & STRIPS	Optimize, Corps. & STRIPS
0–1.5 Year A Corporates	4%	0%	0%	0%
1.5–3 Year A Corporates	10%	0%	0%	0%
3–7 Year A Corporates	23%	0%	0%	0%
7–15 Year A Corporates	45%	0%	0%	0%
15–30 Year A Corporates	70%	100%	98%	70%
1.5–3 Year STRIPS	NA	NA	0%	0%
3–7 Year STRIPS	NA	NA	0%	0%
7–15 Year STRIPS	NA	NA	1%	0%
15–30 Year STRIPS	NA	NA	0.4%	30%
Total Portfolio Weights	153%	100%	100%	100%
Average Excess Return Over Liabilities	NA	-1.1%	-1.0%	0%
Hedge Ratio	100%	96%	96%	118%
Tracking Error	2.4%	1.2%	1.2%	5.2%

Source: Bloomberg Barclays, US Treasury, Western Asset

Exhibit 7
Solutions for a 11-Year Plan Using AA Curve

	Portfolio Weights (as Percent of Liability Valuation)			
	(4B)	(6B)	(7B)	(8B)
Asset Type	Match KRDs with Credit Only	Optimize with Credit Only	Minimize Tracking Error	Optimize to Return Target
0–1.5 Year A Corporates	6%	0%	0%	0%
1.5–3 Year A Corporates	14%	0%	0%	0%
3–7 Year A Corporates	31%	0%	0%	0%
7–15 Year A Corporates	48%	0%	25%	13%
15–30 Year A Corporates	42%	100%	39%	55%
1.5–3 Year STRIPS	NA	NA	6%	0%
3–7 Year STRIPS	NA	NA	30%	2%
7–15 Year STRIPS	NA	NA	0%	31%
15–30 Year STRIPS	NA	NA	0%	0%
Total Portfolio Weights	141%	100%	100%	100%
Average Excess Return Over Liabilities	NA	-0.2%	-0.6%	0%
Hedge Ratio	100%	129%	99.6%	117%
Tracking Error	3.5%	2.9%	1.3%	2.0%

Source: Bloomberg Barclays, US Treasury, Western Asset

its solutions have a C appended to their column designations.

As seen in Exhibit 6, as with the AA curve, matching KRDs with credit instruments using the PPA discount curve, column (4A), requires vast over-funding (155%) and still results in higher tracking error than that seen in column (6A), where all assets are invested in the 15-30 year corporate bucket. Column (6A) produces both minimum tracking error and maximum average return for all-credit portfolios, but it still falls short of average liability returns by 110 bps per year over the sample period. By allowing STRIPS in the allocation, tracking error can be reduced slightly further, but not enough to show up when these are rounded to the nearest 10th of a percent: column (7A).

Exhibit 8
Solutions for 11-Year Plan Using PPA Curve

	Portfolio Weights (as Percent of Liability Valuation)			
	(4C)	(6C)	(7C)	(8C)
Asset Type	Match KRDs with Credit Only	Optimize, Corporates Only	Minimize Tracking Error, Corps. & STRIPS	Optimize, Corps. & STRIPS
0–1.5 Year A Corporates	6%	0%	0%	0%
1.5–3 Year A Corporates	15%	0%	0%	0%
3–7 Year A Corporates	31%	0%	2%	0%
7–15 Year A Corporates	47%	0%	44%	0%
15–30 Year A Corporates	40%	100%	51%	83%
1.5–3 Year STRIPS	NA	NA	0%	0%
3–7 Year STRIPS	NA	NA	3%	0%
7–15 Year STRIPS	NA	NA	0%	13%
15–30 Year STRIPS	NA	NA	0%	4%
Total Portfolio Weights	139%	100%	100%	100%
Average Excess Return Over Liabilities	NA	-0.3%	-0.8%	0.0%
Hedge Ratio	100%	132%	102%	135%
Tracking Error	1.6%	1.8%	0.7%	2.8%

Source: Bloomberg Barclays, US Treasury, Western Asset

However, allocations to STRIPS do produce a portfolio that is able to match liability returns on average, column (8A). Notice, though, that the tracking error for this solution is well above those for the other three: 520 bps per year. With PPA curves dominated by A bonds, such liability valuations show much more sensitivity to movements in credit spreads than do liabilities discounted with AA curves, and so STRIPS are simply not as effective a hedge of such liabilities. However, they have been a source of higher returns over the sample, which is why they enter the solution in (8A).

Otherwise, the solutions in Exhibit 6 are similar to those in Exhibits 2 and 3. Solutions utilizing only a few of the available buckets perform better than (matched) solutions that allocated to all buckets.

Exhibits 7 and 8 show solutions for a shorter, 11-year, set of cash flows, using AA and PPA curves, respectively. Here, again, matching KRDs requires vast overfunding, though not as much as for the 14-year flows. With a shorter set of cash flows, there is less sensitivity to the long end of the curve, and so less over-funding is necessary. Nevertheless, solutions that allocate all assets to the 15-30 year bucket still produce the lowest tracking error (and highest average returns) of any all-credit portfolio. (Compare 6B and 6C to 4B and 4C.)

It is interesting that with these shorter flows and a AA discount method, large allocations to relatively short maturity STRIPS allow minimum tracking error. Apparently, being able to hedge these maturities with STRIPS, rather than a much larger dollar value of corporates, frees up assets that can then be used to hedge the long end of the maturity spectrum. It also seems to be the case that shorter-maturity credit spreads are more stable than longer ones, so that STRIPS adequately hedge the shorter maturities, while corporate bonds are needed to hedge the longer maturities for these liabilities. This type of result arises readily from our use of empirical data. It could not have been arrived at using "mere" KRD-matching techniques.

The optimal solution in (8B) is also an interesting mix of intermediate STRIPS and long-maturity corporates. Here, too, intuition would be that STRIPS were best utilized at the longer maturities—because of their higher duration—but analysis of real-world data tells us otherwise.

Finally, using a PPA curve to discount these shorter liabilities again induces more spread sensitivity in the liability returns, so much so that hardly any allocation to STRIPS is necessary here, even for the optimal solution (8C). Here again, we can see that "select" allocation to credit or credit-and-STRIPS can produce lower tracking error than a substantially over-funded KRD-matched allocation. Here, too, as in Exhibit 6, requiring assets to keep up with liabilities on average requires substantial allocations to longer-maturity corporates and to STRIPS. Here again, these allocations result in higher tracking error than the other solutions, but this higher volatility is required in order to match liability returns on average. (And the extra tracking error induced would be much larger if the extra returns were generated by allocations to equities.)