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The Nuveen pension de-risking solution

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Nuveen, in collaboration with Wilshire Analytics (Wilshire), the investment technology arm of Wilshire Associates, created a family of corporate pension indexes two years ago that seeks to provide an effective de-risking solution, customized for all plan sizes, with a simple implementation. In turn, Nuveen designed actively managed fixed income strategies that are benchmarked to these indexes. The following pages detail the structure of these indexes and how plan sponsors can use them.

THE BACKGROUND

A few years ago, Wilshire recognized that the bond market lacked an index that truly represented actively traded bonds in the United States. As a result, the business sought to build a fixed income index, the Wilshire Bond Index℠, which tracks bonds held in actively managed strategies on behalf of corporate, public and multi-employer pensions as well as endowments and foundations. These institutions collectively manage approximately $7 trillion of assets.

Around the same time, Nuveen recognized that the U.S. corporate pension market lacked a highly investable performance benchmark and economic measure of its liabilities. Furthermore, we lamented about the inefficiency of traditional de-risking techniques. If plan sponsors sought simplicity, they were forced to accept a significant duration and credit spread volatility mismatch on an asset/liability basis. If they sought precision, they were burdened with additional complexity and cost through the required use of derivatives. These solutions were only available to plans of sufficient size (e.g. able to commit $50 million+), closing the de-risking market to thousands of smaller and mid-sized pension plans facing the same challenges as their larger peers.

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In summary, while Wilshire sought to address bond market challenges, we leveraged their work to address these corporate pension market challenges:

- Traditional bond indexes do not represent the actively-managed bond market
- Standard long duration bond indexes provide a sub-optimal pension liability match
- Customized de-risking strategies are too complex and introduce additional risks
- Effective, customized solutions are not easily available to small and mid-sized plans

THE PROJECT

While Wilshire created a fixed income universe that truly represents the institutional bond market, we sought to leverage their efforts and apply our pension expertise to create a family of sub-indexes. These indexes, when combined, can precisely match U.S. corporate defined benefit pension liabilities.

Before creating the indexes, we established the following criteria for success:

- The indexes must close the gap between the asset-based benchmark and the liability benchmark
- The de-risking solution must be more effective than what already exists in the market
- The solution must be simple, with no derivatives or leverage required for implementation
- All plan sizes must have access to the solution

With these goals in mind, we took the following steps to develop what ultimately became the Nuveen Wilshire Pension Investment Indexes:

1. Based on the constituents of the Wilshire Bond Index, we created a sub-universe that closely represents the underlying characteristics of A to AAA corporate pension liability discount curves. For example, we eliminated bonds rated BBB or below, structured products (e.g. ABS, MBS) and variable-rate securities.
2. We made the strategic decision to structure the indexes by maturity range, rather than by duration target. Since pension obligations are *cash flows* that will be paid in the future, a maturity-based index hedges liability movements more effectively. While targeted duration strategies may intuitively align with pension liabilities at the time of initial investment, changes in interest rates – and therefore changes in duration in both the assets and liabilities – requires more frequent rebalancing. This may lead to higher costs and tracking error.
3. We tested various combinations of asset maturity buckets against three pension cash flow profiles with durations of approximately 10 years, 14 years and 18 years to determine the maturity ranges and breakpoints that would effectively match all of these liability profiles.
4. For longer duration pension liabilities, we added an ultra-long STRIPS index, consisting of zero coupon bonds with maturities greater than or equal to 20 years.
5. We initially concluded that three corporate-based indexes, with maturities of 5-10 years, 10-20 years and 20-30 years, as well as the ultra-long STRIPS index, would effectively match the overall and partial durations of each of our three sample pension plans. We then conducted a rigorous historical analysis to substantiate our conclusions.

THE RESULT

On April 1, 2016, both the Wilshire Bond Index (see Callout on page 3) and the Nuveen Wilshire Pension Investment Indexes (NWPI) went live, inspired by the challenge of finding a simple and effective pension de-risking solution for all corporate defined benefit plans. Table 1 summarizes the index family and Table 2 shows the key criteria.

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The NWPI platform consists of four indexes designed to provide maximum alignment with corporate pension liabilities. Of note, while traditional long bond indexes have a single allocation spanning 10 to 30 years, we split the long bond universe into two pieces – one with 10- to 20-year maturities and the other with 20- to 30-year maturities – providing more flexibility and a more precise match versus pension liabilities. We detail the impact of this structural decision later in the report.

Table 1: The Nuveen Wilshire Pension Investment Indexes

Index Name	Maturity Range (years)	Effective duration (years)[1]	Rationale
Intermediate (5-10) Corporate Bond	5 – 10	6.4	Enhances match for mature plans
Long (10-20) Corporate Bond	10 – 20	11.1	Split long corporate structure to enhance liability match
Long (20-30) Corporate Bond	20 – 30	15.1	Split long corporate structure to enhance liability match and increase yield
Ultra-Long (20+) STRIPS	20 – 30	24.7	Minimizes duration mismatch with payments beyond 30 years; diversifies corporate exposure

1 Source: Nuveen Asset Management, FactSet, 30 Sep 2017.

Table 2: Summary of Key Criteria

Index Criteria	Intermediate (5-10) Corporate Bond	Long (10-20) Corporate Bond	Long (20-30) Corporate Bond	Ultra-Long (20+) STRIPS
Maturity range (years)	5 – 10	10 – 20	20 - 30	>= 20
Quality range (S&P)	AAA to A	AAA to A	AAA to A	Treasury/ Agency
Bond sectors	Corporate Taxable Municipal	Corporate Taxable Municipal	Corporate Taxable Municipal	Government
Coupon type	Fixed	Fixed	Fixed	Zero
Rebalancing frequency	Quarterly	Quarterly	Quarterly	Quarterly
Source weighting	Market Value	Market Value	Market Value	Market Value

The Wilshire Bond Index

The Wilshire Bond Index includes more than 13,000 bonds held in actively-managed institutional investor strategies. This construction, as opposed to a hypothetical portfolio based on decisions made by an index committee, delivers a performance and risk profile consistent with the taxable fixed income opportunity set, as chosen by institutional investors. This makes it a more accurate reflection of the true U.S. bond market. The accompanying table contrasts characteristics of the Bloomberg Barclays U.S. Aggregate Bond Index with the Wilshire Bond Index.

	Bloomberg Barclays U.S. Aggregate Bond Index	Wilshire Bond Index
Purpose	Originally designed to represent U.S. investment grade bonds outstanding	Designed to represent bonds held in actively managed accounts
Composition	Approximately three-quarters of holdings are government-backed securities	Use of manager holdings creates a self-adjusting index that more truly represents the bond market
Weighting	Based on bonds outstanding	Based on institutional manager holdings
Liquidity	Nearly one-third of holdings are not tradeable on a given day	Constituents are held in actively managed strategies

The Wilshire Bond Index provided an ideal universe from which to create the NWPI Indexes since it represents assets in actively-managed institutional accounts. Bonds that have effectively been removed from the market by hold-to-maturity investors do not distort the index. For more information on the Wilshire Bond Index, visit http://wilshire.com/indexinfo/Wilshire-Bond-Index.html.

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AN EFFECTIVE DE-RISKING SOLUTION FOR PENSION PLANS

No bond investment can exactly match a pension liability for a variety of reasons, but an NWPI solution may minimize mismatches. Our allocation process against a pension liability considers the overall duration match, partial ("key rate") duration match, basis risk, downgrades and yield. Following is a summary of the key de-risking issues addressed by our approach.

Duration. A corporate pension investor's initial concern with regard to risk reduction is typically duration. It is possible to match the overall duration of some pension liabilities with standard, market-based bond strategies, but they often require derivatives to complete the match. An allocation among the NWPI Indexes allows a plan sponsor to match the liability's overall duration precisely without the need for derivatives or leverage. This is because we split up the long bond universe into two components and added the Ultra-Long STRIPS Index.

Yield curve. Aligning asset duration with liability duration along the yield curve (i.e., matching partial ("key rate") durations) will ensure the value of assets change in the same way as the pension liability when the shape of the yield curve changes. Since market-based bond strategies were not designed to match pension liabilities, investors often ignore the yield curve mismatch or use derivatives to fill any partial duration gaps. A hypothetical allocation among the NWPI Indexes allows a plan sponsor to match the liability partial durations effectively without the need for derivatives or leverage. The three corporate-based indexes are organized by maturity range and align well with pension cash flows while the STRIPS Index may provide the necessary duration for cash flows beyond 30 years.

Basis risk. Basis risk exists to the extent an LDI portfolio contains Treasuries or corporate bonds that exhibit more credit spread volatility than the liability discount curve. No investable solution will eliminate this risk, but the Nuveen approach seeks to minimize it. For example, splitting the long bond universe into two maturity ranges, 10-20 years and 20-30 years, enables the LDI manager to maximize corporate bond exposure and minimize the use of Treasury STRIPS. Further, since the indexes include corporate bonds with ratings from A to AAA, they provide a good match from a credit spread volatility perspective.

Downgrades. Bond downgrades negatively impact the investment portfolio but positively impact the liability discount curve, creating another form of basis risk. There is also no investable solution to eliminate this risk, which is significant. For instance, we estimate that bond downgrades result in average annual underperformance of approximately 70 basis points versus popular A to AAA liability discount curves. The NWPI Indexes contain similarly rated bonds as corporate pension discount curves and can serve as an "economic" liability benchmark, but we recommend actively managed strategies with modest alpha targets (e.g. 40 to 50 basis points) to help compensate for this risk.

Yield. All else being equal, the higher the yield the better. Matching the liability's duration may decrease yield in a portfolio because corporate credit spreads must be sacrificed in favor of Treasuries to match longer-term payments. Traditional approaches take on additional credit risk (i.e. BBB exposure) to increase yield. By splitting the long end of the bond universe into two maturity buckets (i.e. 10 to 20 years and 20 to 30 years), the Nuveen solution enables maximizing long corporate exposure and minimizing Treasury exposure, resulting in more yield. For example, a typical long duration credit index has roughly 75% of its bonds maturing between 20 and 30 years, with the remaining 25% maturing between 10 and 20 years. This allocation reflects bond issuance patterns, but creates a problem for corporate pension plans

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because expected benefit payments do not match the maturity profile of market-based indexes.

Realistic performance measurement. In a traditional LDI strategy, there is a disconnect between the asset-based benchmark and the liability benchmark. For example, a common market-based benchmark, such as the Bloomberg Barclays U.S. Long Credit Index, generally represents credit-based bonds outstanding in the 10- to 30-year segment of the yield curve. However, the liability cash flow profile is unique to the pension plan itself and may differ significantly from the market-based benchmark. The NWPI Indexes unify LDI benchmarking in that the asset-based benchmark is also the liability benchmark, allowing a plan sponsor to evaluate both the skill of the manager and the effectiveness of the LDI program.

THE NUVEEN SOLUTION

We view corporate pension de-risking as an evolutionary process, where a plan initially seeks to extend the duration of the fixed income portfolio and, as the funded ratio increases, ultimately seeks to immunize a significant portion of the liability. Corporate plans often use a glide path to guide this process. At a high-level, we generally group corporate pension plans that seek to match their liabilities into two broad categories: early-stage and late-stage de-riskers.

At Nuveen, we have actively managed strategies that use each of the four indexes as benchmarks and seek to facilitate the evolution from early-stage to late-stage de-risking. Consider Example 1 to illustrate a potential approach that a corporate plan sponsor may employ:

Example 1: Hypothetical glide path strategy

Early-stage de-risking. When the plan is underfunded (80%) and a significant allocation to return-seeking assets exists (60%), the plan sponsor seeks to extend the duration of the fixed income allocation. In this case, the Nuveen Long (20-30) Corporate Bond Index provides more duration than traditional market-based indexes. For example, the Long (20-30) Corporate Bond Index duration was 15.7 years, compared to the Bloomberg Barclays Long Credit Index duration of 13.9 years, as of 30 Sep 2017.

Late-stage de-risking. As the funded ratio approaches its end state of 105%, the plan sponsor will seek to match the interest rate and credit spread duration of the liability using an immunization approach. In this case, the plan may invest in the Nuveen Intermediate (5-10) Corporate Bond Strategy (35%), the Nuveen Long (10-20) Corporate Bond Strategy (30%) and the Nuveen Long (20-30) Corporate Bond Strategy (25%) with the goal of matching the liability's overall and partial durations. A small allocation to return-seeking assets (10%) remains in this example.

Funded status	80%	85%	90%	95%	100%	105%
Return-seeking assets	60%	50%	40%	30%	20%	10%
Intermediate (5-10) Corporate	0%	0%	10%	15%	25%	35%
Long (10-20) Corporate	0%	10%	10%	20%	25%	30%
Long (20-30) Corporate	40%	40%	40%	35%	30%	25%
Tracking error	8.0%	7.0%	6.0%	5.0%	4.0%	3.0%
Hedge ratio	40%	50%	55%	70%	80%	95%
	Early-stage: extend duration				**Late-stage: seek precise match**	

The sample glide path is hypothetical and presented for illustrative purposes only. See more information on Hypotheticals on the last page of this report.

It is important to reiterate that we recommend actively-managed bond strategies within de-risking programs. As previously described, we believe the manager's alpha target should be modest (e.g. approximately 40-50 basis points) and consistent with the goal of recouping underperformance due to downgrades against the liability discount curve. Therefore, a small allocation to BBB bonds (e.g. 10% to 15%) in the active strategy may be prudent, depending on market conditions.

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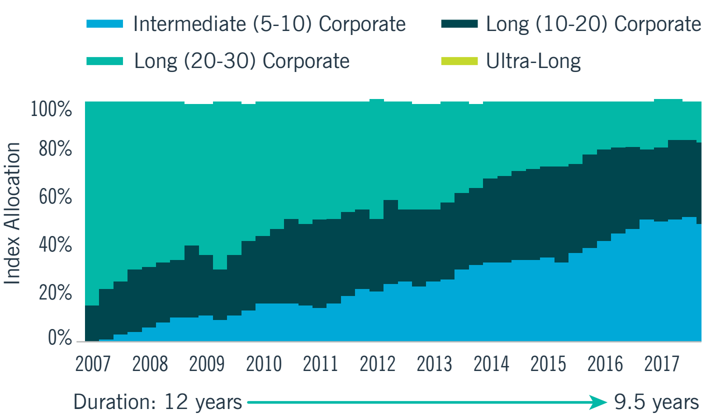
EVOLUTION OF THE INVESTMENT SOLUTION

The investment allocation should evolve along with the pension liability as benefits are paid and future expected payments come closer to being due. Part of a closely-matched immunization strategy using the Nuveen strategies is a process that we believe will help align the bond maturity profile and the pension payment profile. In the hypothetical example below, we show how the Nuveen Wilshire Pension Indexes evolved over a 10-year time period for a hypothetical frozen plan with quarterly rebalancing.

In this hypothetical example, the frozen plan, which was fully immunized and fully funded at the end of 2006, had a liability duration of just under 12 years. As time passed and benefits were paid, the liability duration shortened, ultimately to 9.4 years at the middle of 2017. The allocations among the Intermediate (5-10) Corporate, Long (10-20) Corporate and Long (20-30) Corporate Indexes adjusted with the changes to the liability, maintaining a tight overall and partial duration match.

Example 2: Hypothetical Evolution of Hedging Allocation



Source: Nuveen Asset Management, Wilshire Associates, 30 Sep 2006 —30 Jun 2017. The sample portfolio is hypothetical and presented for illustrative purposes only, involve backtested data, and does not reflect a strategy or product currently or previously managed by Nuveen Asset Management, LLC (NAM). See more information on Hypotheticals on the last page of this report.

Example 3 shows hypothetical performance metrics for customized allocations of the NWPI Indexes and corresponding Bloomberg Barclays indexes for a hypothetical frozen pension plan over the 10-year period between 30 Sep 2006 to 30 Jun 2017. The NWPI solution produced a slightly higher return (6.52% versus 5.92%) and a lower asset/liability tracking error (1.55% versus 1.72%).

Example 3: Hypothetical return and tracking error comparison

Time Horizon	Return		Tracking Error	
	Nuveen Wilshire Pension Investment Indexes	Bloomberg Barclays Blended	Nuveen Wilshire Pension Investment Indexes	Bloomberg Barclays Blended
1 Year	0.93	0.77	0.46	0.56
3 Years	4.84	4.47	0.66	0.52
5 Years	4.81	4.14	0.73	0.71
10 Years	7.00	6.39	1.59	1.77
Since 30 Sep 06	6.52	5.92	1.55	1.72

Source: Nuveen Asset Management, Bloomberg L..P. The comparison is hypothetical and presented for illustrative purposes only, involve backtested data, and does not reflect a strategy or product currently or previously managed by Nuveen Asset Management, LLC (NAM). See more information on Hypotheticals on the last page of this report.

CREATING EFFECTIVE INVESTMENT SOLUTIONS

The Nuveen Wilshire Pension Investment Indexes were designed to facilitate straightforward and effective investment solutions for pension investors. They also serve as benchmarks for Nuveen's actively managed strategies for U.S. corporate pension plans. The flexibility to use specific portions of the long bond universe enables better liability matches with the potential for more yield than solutions with standard market -based benchmarks.

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For more information, please consult with our Institutional Solutions Team at 312.917.6826 or visit nuveen.com.

Index definitions

Bloomberg Barclays U.S. Aggregate Bond Index represents securities that are SEC-registered, taxable and dollar denominated. The index covers the U.S. investment grade fixed rate bond market, with index components for government and corporate securities, mortgage pass-through securities, and asset-backed securities.

Bloomberg Barclays U.S. Long Credit Index measures the performance of the long-term sector of the U.S. investment bond market, which includes investment grade corporate debt and sovereign, supranational, local authority and non-U.S. agency bonds that are dollar denominated and have a remaining maturity of greater than or equal to 10 years.

Nuveen Wilshire Intermediate (5-10) Corporate Bond Index, Nuveen Wilshire Long (10-20) Corporate Bond Index, Nuveen Wilshire Long (20-30) Corporate Bond Index and the Nuveen Wilshire Ultra Long (20+) STRIPS Index, have been designed with pension liability-matching in mind, but also for simplicity and cost-effectiveness. Returns for the indexes can be accessed at http://wilshire.com/indexcalculator/poweredbywilshire.htm.

AAA, AA, A, and BBB are investment grade ratings given by one of the following national rating agencies; S & P, Moody's, or Fitch; BB, B, CCC/CC/C and D are below-investment grade ratings. Bonds backed by U.S. Government or agency securities are given an implied rating equal to the rating of such securities. Credit ratings are subject to change.

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