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CANNEX RESEARCH

Comparing a Novel In-Plan Income Solution to Alternatives

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Comparing a Novel In-Plan Income Solution to Alternatives

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For more information about the research and analysis, please contact the research team at research@cannex.com, 416-926-0882.

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Contents

Executive Summary	1
Introduction and Motivation: Challenges and Opportunities in Today’s Retirement Income Landscape	2
Our Approach: Comparing Alternatives for Lifetime Income	4
Comparison 1: Lifetime Income Builder TDF And Traditional TDF	4
Comparison 2: Lifetime Income Builder TDF And Traditional Income Solutions	4
Product Overview: Lifetime Income Builder Target Date Fund	5
Analysis: How Does the Lifetime Income Builder TDF Compare to Available Alternatives?	7
Comparison 1: Lifetime Income Builder TDF And Traditional TDF	7
<i>Analysis of the Accumulation Stage</i>	7
<i>Analysis of the Distribution Stage</i>	9
<i>Analysis of Ruin Probabilities</i>	10
Comparison 2: Lifetime Income Builder TDF and Traditional Income Solutions.....	11
Conclusions: Analyzing the Lifetime Income Builder TDF Against Alternatives as a Retirement Income Solution	13
Comparison 1: Lifetime Income Builder TDF And Traditional TDF	13
Comparison 2: Lifetime Income Builder TDF And Traditional Income Solutions	14
Appendix I: Additional Results	15
Appendix II: Modeling Assumptions	19
Analytic Framework	19
<i>Income Value</i>	19
<i>Lifetime Ruin Probability</i>	19
Glide Path	20
Interest Rate Assumption	21
Capital Market Assumptions	22
Mortality Model	23
Lapse Model	24
Annuitant	24
Contribution Structure.....	24
Disclosures	25

Exhibits

- Exhibit 1** Key Percentiles of the Distribution of Accumulated Value at Age 65 [End of 15 Year Accumulation] in the Traditional TDF and LIB TDF8
- Exhibit 2** Key Percentiles of the Distribution of Difference in Accumulated Value of Traditional TDF Relative to LIB TDF at Age 65 [End of 15 Year Accumulation]8
- Exhibit 3** Key Percentiles of the Distribution of Improvement in Income Value in the LIB TDF Relative to the TDF with SWiP..... 10
- Exhibit 4** Lifetime Ruin Probabilities: TDF with SWiP and LIB TDF 11
- Exhibit 5** Key Percentiles of the Distribution of Annuitization Rate Required at Age 65 to Match Income Value of the LIB TDF..... 12
- Exhibit 6** Distribution of Accumulated Value at Age 65 (Retirement/Income Start Age) for the Two TDF Alternatives: Traditional TDF and LIB TDF..... 15
- Exhibit 7** Percentiles of the Distributions of Accumulated Value in Both TDF Options at Age 65 15
- Exhibit 8** Distribution of Difference in Accumulated Value of TDF Relative to LIB TDF at Age 65..... 16
- Exhibit 9** Percentiles of the Distribution of Difference in Accumulated Value of TDF Relative to LIB TDF at Age 65..... 16
- Exhibit 10** Distribution of Income Value for Both TDF Options (Traditional TDF with the Systematic Withdrawal Plan and the LIB TDF) 17
- Exhibit 11** Percentiles of the Distribution of Improvement in Income Value in the LIB TDF Relative to the TDF with SWiP..... 17
- Exhibit 12** Distribution of the Annuitization Rate Required at Age 65 to Match Income Value of the LIB TDF..... 18
- Exhibit 13** Percentiles of the Distribution of Annuitization Rate Required at Age 65 to Match Income Value of the LIB TDF 18

EXECUTIVE SUMMARY

In response to the growing need for lifetime income, the insurance and asset management industries continue to innovate to provide guaranteed income solutions. One example of retirement income innovation is Lifetime Income Builder from Annexus Retirement Solutions, a fixed indexed annuity with a daily market valuation like an investment and a guaranteed lifetime withdrawal benefit (GLWB). Lifetime Income Builder is incorporated into a target date series to create a Lifetime Income Builder Target Date Fund (LIB TDF).

This paper compares the LIB TDF first, to a traditional target date fund (TDF) with similar characteristics, and secondly, to a traditional guaranteed retirement income solution in the form of a single premium immediate annuity (SPIA). Our objective is to compare and clarify the performance of the LIB TDF relative to alternatives, aiding in the analysis and ultimately, the selection of retirement income options.

Our analysis concludes that compared to a traditional target date fund with similar characteristics, embedding the Lifetime Income Builder in the target date fund produces an in-plan solution which offers a fair trade-off in accumulated value for *Income Value*. Additionally, while the two options have roughly similar ruin probabilities, the implications of ruin for a retiree are quite different. With a traditional target date fund, portfolio ruin means that income will permanently stop; but with the LIB TDF option, lifetime payments will continue at the guaranteed rate. The LIB TDF also compares favorably to a traditional retirement income solution in the form of a single premium immediate annuity at market rates, without the requirement to forego liquidity.

INTRODUCTION AND MOTIVATION: Challenges and Opportunities in Today's Retirement Income Landscape

The shift from defined benefit to defined contribution pension plans has created a gap in guaranteed income for many retirees, as defined-benefit plans provide a guaranteed income in retirement while defined-contribution plans generally do not—and for most workers, Social Security falls short of filling the gap.

Today, only one in four private-sector workers has access to a pension, a decline of 64% from 1980.¹ Also, 51% of pre-retirees don't have a clear sense of how much they will receive in Social Security, which is facing long-term financing shortfalls under currently scheduled benefits and financing,² and more than half of Americans—56%—report they are concerned about achieving financial security in retirement.³ Increasingly, the problem of securing lifetime income in retirement is a burden shouldered by individuals, while the need for lifetime income continues to grow.

In response to this uncertain future, the insurance and asset management industries have been working towards a range of guaranteed income solutions, including as part of a plan sponsor's default investment alternative. These new approaches are designed to overcome the trade-offs and shortfalls of existing options, such as the reality that many plan participants fail to make active retirement income decisions and instead opt to remain with the plan default—making the qualified default investment alternative (QDIA) arguably the most important item in a plan's investment menu.

Today, the most-often-selected QDIA investment is a target date fund. The TDF is a broadly accepted and familiar vehicle for both plan sponsors and the advisors and consultants who support them, and thus the target date structure is an appropriate approach for income-oriented solutions that aim to qualify as a QDIA.

In recent years, plan innovation has gravitated towards the incorporation of annuities within TDFs, with the 2019 SECURE (Setting Every Community Up for Retirement Enhancement) Act opening up opportunities for annuity-based innovation within retirement plans. **Lifetime Income Builder Target Date Fund** (LIB TDF) from Annexus Retirement Solutions is one example of plan innovation. This product incorporates Annexus Retirement

More than half
of Americans—
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are concerned
about achieving
financial security
in retirement.

¹ U.S. Bureau of Labor Statistics, *Employee Benefits Survey*, March 2020.

² *The 2020 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds*, April 22, 2020.

³ *Retirement Insecurity 2021*, National Institute on Retirement Security, February 2021.

COMPARING A NOVEL IN-PLAN INCOME SOLUTION TO ALTERNATIVES

Solutions' Lifetime Income Builder, a fixed indexed annuity (FIA) with a guaranteed lifetime withdrawal benefit, into a target date series. The LIB TDF's innovative product design means it has daily valuations like other investments, allowing the investment manager to invest in the LIB TDF like any other holding, while the participant who owns the target date fund receives the growth and lifetime income benefits of the Lifetime Income Builder.

With the rise of plan innovation including the option for annuitization within TDFs, those seeking guaranteed income in retirement may wish to understand how a LIB TDF compares to available alternatives. The guaranteed lifetime income features of the LIB TDF, however, mean it is difficult to compare to TDFs both with and without a guaranteed lifetime income component.

In this paper, we overcome these difficulties by comparing a target date fund with Lifetime Income Builder first, to a Traditional TDF with similar characteristics, and secondly, to a traditional guaranteed retirement income solution (a single premium immediate annuity). The objective of our analysis is to compare and clarify the performance of the LIB TDF relative to alternatives, aiding in the analysis and ultimately, the selection of retirement income options.

OUR APPROACH: Comparing Alternatives for Lifetime Income

Our analysis focuses on income-related outcomes—for the LIB TDF, a Traditional TDF, and traditional income solutions—in both the accumulation and distribution stages. The hypothetical participant considered enters both LIB TDF and Traditional TDF at age 50, making 15 years of contributions and taking income starting at age 65. Our approach is twofold.

Comparison 1: Lifetime Income Builder TDF and Traditional TDF

In our first comparison, we carried out simulations to compare and summarize accumulated values and product cash flows from the LIB TDF and a Traditional TDF. In this initial analysis, we used a Monte Carlo simulation with products intended to mimic those available in the market, including all necessary capital markets, mortality, and interest-rate environment inputs, and with the same glide path. This set of comparisons focuses on both the accumulated value during the accumulation stage as well as the *Income Value* once distributions begin.

Comparison 2: Lifetime Income Builder TDF and Traditional Income Solutions

In our second comparison, we compared the LIB TDF and a traditional retirement income solution in the form of a single premium immediate annuity (SPIA).⁴ Specifically, we calculated the SPIA payout rate required at age 65 to produce equivalent *Income Value* from the LIB TDF. This comparison focuses on the distribution stage.

⁴Our analysis in this paper is based on the initial proposed design of the LIB TDF product. Other target date series that include a Lifetime Income Builder component may differ in design, and Lifetime Income Builder products may be offered by single insurers and by multiple carriers. In addition, changes in the economic environment may result in changes to target date series with a Lifetime Income Builder component. For example, an increase in interest rates may result in an increase in the income guarantee.

At a high level, the performance of Lifetime Income Builder-associated structures may remain similar so long as other solutions do not deviate significantly from the original implementation. Our analysis is limited to the initial instance of the LIB TDF product. CANNEX does not warrant results based on other partners and structures.

PRODUCT OVERVIEW: Lifetime Income Builder TDF

The LIB TDF provides an income guarantee within a target date structure, specifically a collective investment trust (CIT). Designed to optimize growth potential and deliver lifetime income, the LIB TDF includes the following features and components:

Fixed Indexed Annuity (FIA): The unique design of a LIB TDF is that it allocates to Lifetime Income Builder, a group FIA with a daily market valuation that allows complete transparency in terms of current value as well as a guaranteed lifetime withdrawal benefit.

Vintages and income start dates: Each LIB TDF is issued in three-year vintages based on the participant's age. The income start date is January 1 of the middle year of a given vintage for all participants invested in that vintage. Prior to the investment manager gliding into the FIA (Lifetime Income Builder), which starts around age 50, the TDF vintages have holdings similar to other accumulation-based target date funds.

Glide path: The glide path of the initial design of the LIB TDF product is traditional during the accumulation phase. Approximately 15 years prior to the target date, the glide path starts allocating a portion of the assets into the LIB TDF. Then, every quarter during the accumulation phase, the portfolio is rebalanced between the FIA (Lifetime Income Builder) and the target date portfolio of equities and fixed income according to the FIA Allocation Algorithm, a proprietary, rules-based method to determine the portfolio allocation. Here, by coupling the glide path with a unique purchasing structure in which the plan trustee is purchasing the annuity on behalf of the plan member, participant-level decisions—traditionally a significant barrier to product adoption—have been eliminated.

FIA Crediting Strategy: The interest crediting strategy used is point-to-point with a participation rate calculated dynamically. We examine a version of the FIA (Lifetime Income Builder) that uses a 5% volatility control excess return index with a term length of one year and a daily unitized value for the FIA (Lifetime Income Builder).⁵

Income guarantee: The FIA (Lifetime Income Builder) offers a minimum income guarantee of 4.5%.⁶ The FIA Allocation Algorithm adjusts the allocation to the FIA (Lifetime Income Builder) to maintain a single-life

The LIB TDF provides an income guarantee within a target date structure, specifically a collective investment trust (CIT).

⁵ The asset manager or insurer(s) may use other indices, and crediting terms may range from one to five years.

⁶ The LIB TDF payout is based on the weighted average LIB TDF reference rate; the reference rate in the analysis was the 10-year U.S. Treasury.

COMPARING A NOVEL IN-PLAN INCOME SOLUTION TO ALTERNATIVES

guarantee of 4.5%, based on a quarterly high-water mark (HWM) for the entire LIB TDF. (Participants may select joint-life payments for a 10% payout reduction.)

LIB TDF payout: At the target date, the fund automatically begins paying annual income into an in-plan retirement fund.⁷ In the initial design, the payout from the LIB TDF is 6% of the high-water mark: a 4.5% payout from the FIA (Lifetime Income Builder) plus 1.5% in systematic withdrawals from the remainder of the portfolio, which is allocated to traditional assets. If the equity portion of the investment is depleted, the annual income benefit adjusts from 6% to 4.5% of the high-water mark, and participants receive (only) the guaranteed payments from the FIA (Lifetime Income Builder).

⁷ The actual percentage will be based on the sum of the FIA payments and the supplemental income percentage, which is set at 1.5%.

ANALYSIS:

How Does the Lifetime Income Builder TDF Compare to Available Alternatives?

How does the LIB TDF compare to our two selected alternatives? This section presents the results of our comparisons.

Comparison 1: Lifetime Income Builder TDF and Traditional TDF

First, we modeled and compared the LIB TDF and a Traditional TDF in the **accumulation stage**. Given the setup of the analysis, the hypothesis was that the accumulated value at the end of the 15 year accumulation stage (when the annuitant is age 65) could be higher in the Traditional TDF than in the LIB TDF, due to the higher fees associated with managing the additional allocation of the FIA (Lifetime Income Builder) with the TDF portfolio of equities and fixed income. While the allocation to the FIA (Lifetime Income Builder) should align with or replace a piece of the fixed income portion of the TDF portfolio, the question is, how different are the accumulated values at the time when income would begin?

Our analysis resulted in the following observations of the accumulation and distribution stages:

Analysis of the Accumulation Stage

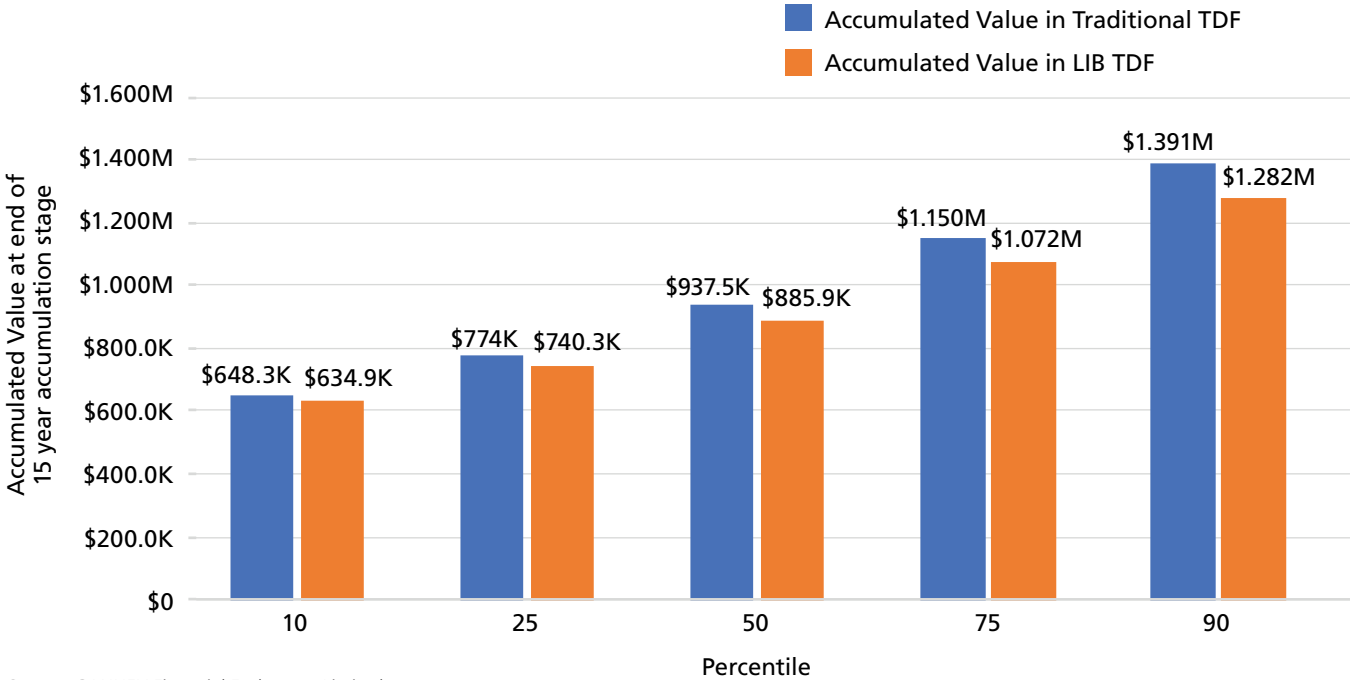
In the **accumulation stage**, the Traditional TDF and the LIB TDF have somewhat similar outcomes as is evidenced by their distributions of accumulated value at the end of the accumulation stage. Exhibit 1 shows that the key percentiles in accumulated value at age 65 of the LIB TDF are lower than that of the Traditional TDF, seemingly in line with the hypothesis above. In taking a deeper look at the relative difference in accumulated value in each of the simulated scenarios, we find that at the 50th percentile (see Exhibit 2), the Traditional TDF has outperformed the LIB TDF by just 5.5% at the end of the 15 year accumulation stage. This relative difference, which is as high as 15.4% at the 90th percentile, cannot be due only to the difference in fees but must also result from the replacement of the fixed income allocations with the FIA.

In summary, in just over half of the simulations (53%), the Traditional TDF outperforms the LIB TDF by 5% or more, in just less than half of the simulations (41%) both TDF options perform comparably and in some scenarios (6%) the LIB TDF outperforms by 5% or more. So now, how does this difference in performance impact the expected income benefit?

At the 50th percentile, the Traditional TDF has outperformed the LIB TDF by just 5.5% at the end of the 15 year accumulation stage.

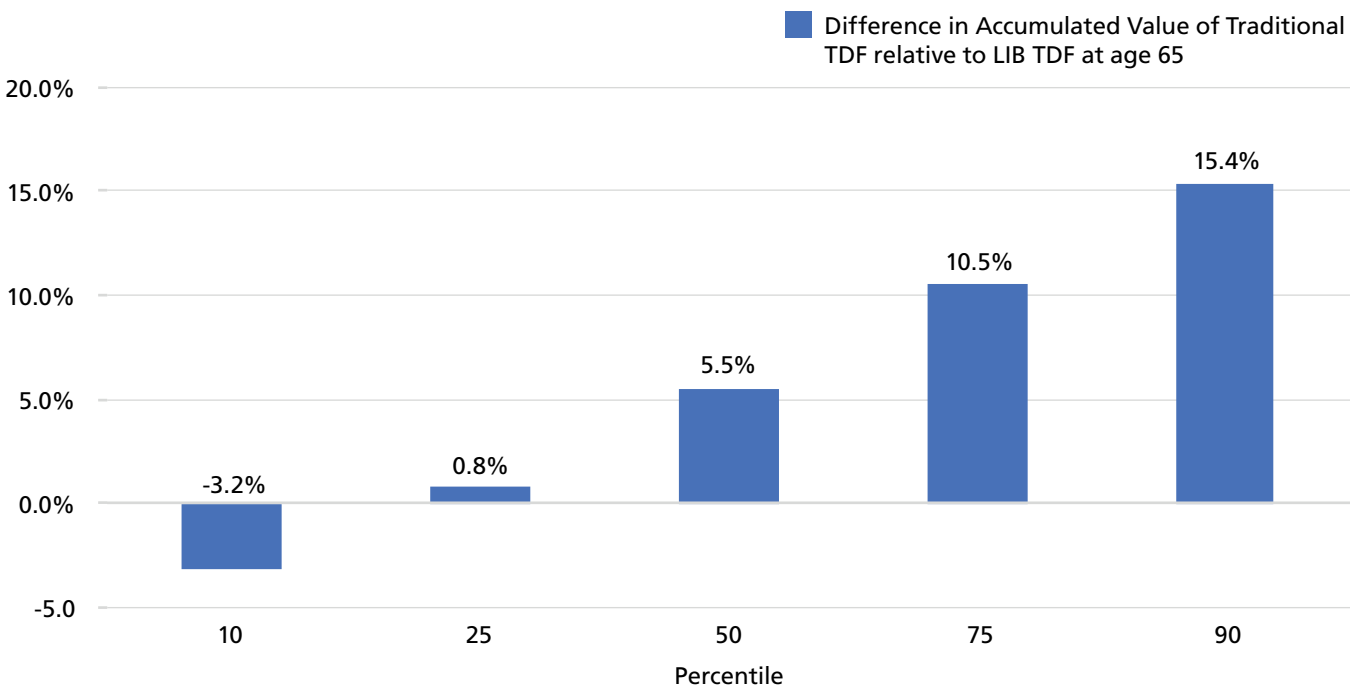
COMPARING A NOVEL IN-PLAN INCOME SOLUTION TO ALTERNATIVES

Exhibit 1: Key Percentiles of the Distribution of Accumulated Value at Age 65 [End of 15 Year Accumulation Stage] in the Traditional TDF and LIB TDF



Source: CANNEX Financial Exchanges Limited

Exhibit 2: Key Percentiles of the Distribution of Difference in Accumulated Value of Traditional TDF Relative to LIB TDF at Age 65 [End of 15 Year Accumulation Stage]



Source: CANNEX Financial Exchanges Limited

Analysis of the Distribution Stage

Next, we modeled the distribution or income stage of the two alternatives.

To establish a fair comparison between the two alternatives, we set up the following income strategies:

- With the LIB TDF, an age-65 retiree will withdraw the maximum amount allowed which starts at 6% and reduces to 4.5% of the LIB TDF high-water mark upon the ruin of the non-Lifetime Income Builder portfolio (note that these are the minimum percentages, but the exact withdrawal percentages will depend on the market scenario—see LIB TDF Guaranteed Payout Factor (Single Life Payout)).
- With the Traditional TDF, an age-65 retiree will take the same income withdrawals as in the LIB TDF in each market scenario until the portfolio is ruined. This option is referred to as the TDF with Systematic Withdrawal Plan (SWiP).

Here we emphasize that we are modelling nominal income amounts to match the income from the LIB TDF.

We note that although these may be seen as “high” withdrawal rates, our starting hypothesis was that the Traditional TDF would have accumulated enough to sustain them, but that the LIB TDF would provide a higher *Income Value* due to the income guarantee.

To assess the difference in the income benefit from the two options, we need a framework to quantify and compare different retirement income streams. For this we employ the *Income Value* metric. Given the income stream from a retirement strategy, each income payment is discounted to the present by the time value of money and the probability that the retiree will survive to receive that payment, and then summed to arrive at the *Income Value* of that retirement strategy. A higher *Income Value* indicates a better income benefit. For each simulated market scenario, we compute the *Income Value* of the two income strategies and then compare.

Our analysis of the **distribution stage** resulted in several observations. Firstly, we note that *Income Value* from the LIB TDF must always be as good as or better than the *Income Value* from the TDF with SWiP, and this is a direct consequence of the lifetime income guarantee in the LIB TDF. Exhibit 3 shows this distribution of the improvement in *Income Value* in the LIB TDF relative to the TDF with SWiP. Secondly, the 40th percentile of improvement in *Income Value* is 5% and, if we take 5% as an appropriate significance threshold, this means that in at least 60% of the simulated scenarios, *Income Value* from the LIB TDF was significantly higher than

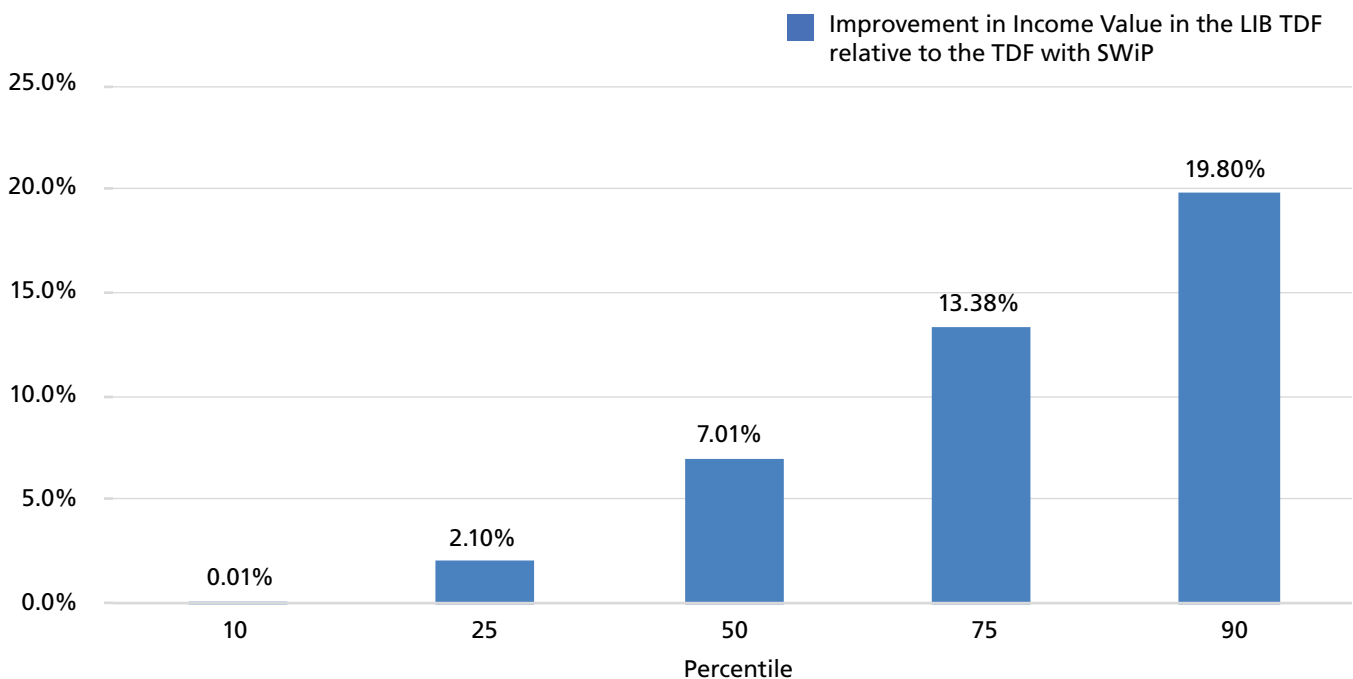
In at least 60% of the simulated scenarios, *Income Value* from the LIB TDF was significantly higher than that from the TDF with SWiP.

COMPARING A NOVEL IN-PLAN INCOME SOLUTION TO ALTERNATIVES

that from the TDF with SWiP. Thirdly, improvements indicated by the 25th and higher percentiles are very much in line with the difference in accumulated value shown in Exhibit 2, suggesting a fair trade-off in accumulated value for *Income Value*.

A natural next question to ask is, just how important is the lifetime income guarantee to the income benefit of the LIB TDF? The next part of the analysis attempts to answer this question for our hypothetical annuitant.

Exhibit 3: Key Percentiles of the Distribution of Improvement in Income Value in the LIB TDF Relative to the TDF with SWiP



Source: CANNEX Financial Exchanges Limited

Analysis of Ruin Probabilities

In our final comparison of the Traditional TDF and the LIB TDF, we calculated the “ruin probabilities” of both options. For our metric of comparison, we used *Lifetime Ruin Probability (LRP)*, defined as the probability of running out of funds in the investment account while the retiree is still alive.

Our analysis found that the ruin probabilities for both options are roughly in the same ballpark: With the Traditional TDF with SWiP, we observe that our hypothetical annuitant and his female counterpart end up with no income (that is, they outlive the TDF income stream) with a probability of 33% and 41%, respectively. The LIB TDF option presents slightly lower lifetime ruin probabilities, at 31% and 36% for males and females respectively, see Exhibit 4.

Here, a key distinction arises. While the “ruin probability” results for these two options are numerically similar, **the implications for a retiree are quite different**. With a Traditional TDF, portfolio ruin means that payments will permanently stop, while with the LIB TDF only the portfolio adjacent to the FIA (Lifetime Income Builder) is subject to ruin—and, if and when that portfolio is ruined, income payments will drop to the guaranteed level, **not to zero**. With the LIB TDF option, a retiree’s income cannot fall below the guaranteed rate (of 4.5% in this example) for life.

What this means is that while the retiree with a LIB TDF may be exposed to roughly the same portfolio lifetime ruin probabilities as the retiree with a Traditional TDF, they do not face the same risk of income loss. Instead, they are protected from the income loss that would occur with the ruin of a Traditional TDF by the features of the LIB TDF, which provides guaranteed income for as long as the retiree is alive.

While the “ruin probability” results for these two options are numerically similar, **the implications for a retiree are quite different**. ...[Participants with the LIB TDF] do not face the same risk of income loss.

Exhibit 4: Lifetime Ruin Probabilities: TDF with SWiP and LIB TDF

		Male	Female
TDF with SWiP	Probability that the retiree survives to experience the ruin of the portfolio (assets in the TDF go to \$0) and therefore the income stream from the TDF ceases.	33.3%	41.3%
LIB TDF	Probability that the retiree survives to experience the ruin of the non-Lifetime Income Builder portfolio, the supplemental income ceases and the income from the LIB TDF falls to the guaranteed level for the remainder of life. <i>Note that in the LIB TDF there is no possibility that the retiree experiences the income stream falling to \$0.</i>	30.8%	36.0%

Source: CANNEX Financial Exchanges Limited

Comparison 2: Lifetime Income Builder TDF and Traditional Income Solutions

Within the defined contribution market, other income guarantees are available, warranting a comparison of the LIB TDF against these other options.

Today, some retirement plans offer participants the opportunity to purchase a SPIA with some or all of their savings at retirement. Variable annuities with a guaranteed lifetime withdrawal have also been available for some time from a range of different insurers. Similar to the LIB TDF, these provide the accumulation of a future income guarantee during working years. (In this paper, we focus on the SPIA comparison and leave other income solutions as a topic of further research).

COMPARING A NOVEL IN-PLAN INCOME SOLUTION TO ALTERNATIVES

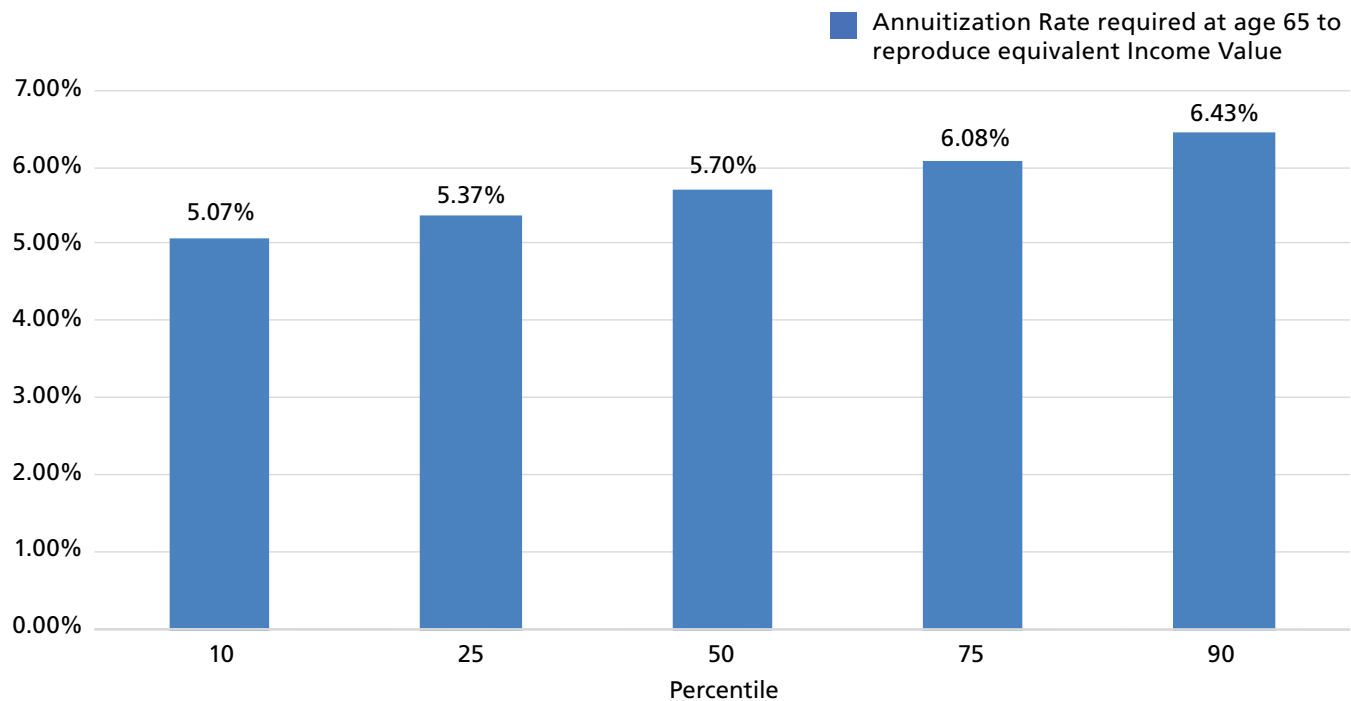
In this comparison, our starting hypothesis was that the greater savings accumulated with a Traditional TDF would mean that a lower-than-market SPIA rate would be needed for equivalent income from the SPIA solution. In other words, we theorized that a plan member might not need to annuitize all of their accumulated value to get the same *Income Value* as provided by the LIB TDF.

To compare the LIB TDF with a solution in which plan members may roll their accumulated savings into a SPIA from a Traditional TDF, we take the inverse approach from our previous comparisons and seek to model the guaranteed payout a retiree would need to match the *Income Value* of the LIB TDF solution.

Here, our analysis resulted in the following observations: First, we observe SPIA rates that are in line with present and past rates available in the market (refer to the [CANNEX Pay Index](#) for information on available rates.⁸) For example: Exhibit 5, below, shows that at the 50th percentile, the required SPIA rate at age 65 is 5.70% while it is 5.07% at the 10th percentile and 6.43% at the 90th percentile. Secondly, we note that to meet the *Income Value* of the LIB TDF, one must forgo liquidity through full annuitization. In contrast,

To meet the *Income Value* of the LIB TDF, one must forgo liquidity through full annuitization. In contrast, the LIB TDF retains liquidity for the accumulated value throughout the participant's lifetime.

Exhibit 5: Key Percentiles of the Distribution of Annuitization Rate Required at Age 65 to Match Income Value of the LIB TDF



Source: CANNEX Financial Exchanges Limited

⁸The CANNEX Payout Annuity Yield (PAY) Index is a baseline measurement of the lifetime yield that a retiree can expect from an immediate income annuity. The CANNEX PAY Index can be used to compare the performance of cash flow strategies with or without the use of an immediate income annuity.
See <https://www.cannex.com/index.php/services/united-state/benchmarks-indices/pay-index/>

the LIB TDF retains liquidity for the accumulated value throughout the participant's lifetime—providing another key distinction between the LIB TDF and available alternatives.

CONCLUSIONS: **Analyzing the Lifetime Income Builder TDF Against Alternatives as a Retirement Income Solution**

In this paper, we provide the results of our comparison of the LIB TDF to retirement income alternatives—a Traditional TDF and a traditional retirement income solution in the form of a SPIA.

Comparison 1: Lifetime Income Builder TDF and Traditional TDF

Our initial hypothesis was that the accumulated value would be higher in the Traditional TDF than in the LIB TDF. The analysis into the performance of both TDF options revealed that while this hypothesis turned out to be true in about half of the simulations, there isn't much of a significant difference in about 41% of simulations and the LIB TDF actually outperforms in about 6% of simulations. A reverse relationship was found in comparing the income benefit between the two options. In 60% of the simulations, the income benefit from the LIB TDF was significantly better than the Traditional TDF with the Systematic Withdrawal Plan, while being comparable in the remaining 40% of simulations.

We emphasized the importance of the lifetime income guarantee by measuring the lifetime ruin probability of the LIB TDF and an alternative, traditional retirement income source in the form of a Systematic Withdrawal Plan from the Traditional TDF. While the risk of lifetime ruin is similar for both options, the implications are starkly different for retirees. With the LIB TDF option, a retiree's income cannot fall below the guaranteed rate of 4.5% for life. In contrast, with the Traditional TDF with SWiP, a retiree's income could fall to zero.

These results ultimately speak to the strength of the LIB TDF solution from an income benefit perspective and suggest that it offers a trade-off of accumulated value for *Income Value* and the peace of mind that comes with the lifetime income guarantee.

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Comparison 2: Lifetime Income Builder TDF and Traditional Income Solutions

In our second comparison, we hypothesized that the greater savings accumulated within a Traditional TDF would mean that a lower SPIA rate would be needed for equivalent income from the SPIA solution, and therefore less than full annuitization of the account value.

Our results show that a retiree would need to annuitize at SPIA rates that are generally in line with rates available in the marketplace. This finding is indicative that while both products—the LIB TDF and the traditional retirement income solution in the form of a SPIA—find a way to access the mortality credits associated with risk pooling with similar efficiency for the insurance company, the LIB TDF, unlike the traditional SPIA solution, does not require the retiree to give up liquidity.

It is important to note that the high-water mark feature offered with the LIB TDF eliminates sequence of returns risk presented by market volatility as a participant nears retirement; protection which could not be provided with the combination of a Traditional TDF and a SPIA. In certain economic environments, the elimination of sequence of returns risk would have dramatic positive impacts for participants with the LIB TDF.

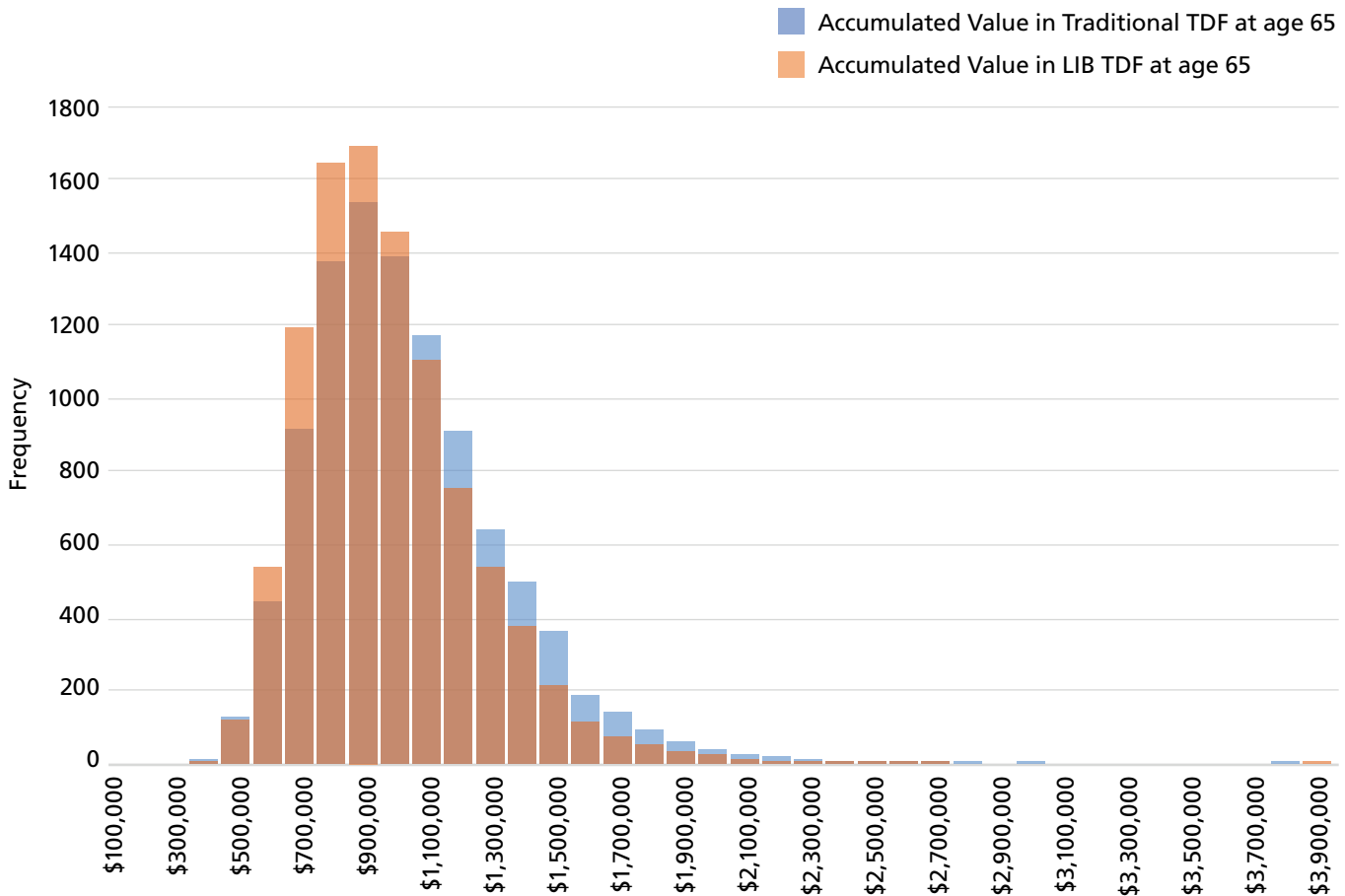
In understanding the landscape of lifetime income solutions within 401(k) plans, we have come to appreciate that some operational and structural considerations are important for employers weighing implementation of these solutions but that is not part of our analytics. Instead, our analysis focuses on the relative strength of the income guarantee embedded within the LIB TDF.

Our analysis highlights some of the important similarities and differences between the LIB TDF and available retirement income alternatives, across both the accumulation and distribution stages. We identify some key distinctions between the LIB TDF and alternatives with respect to income benefit, lifetime income guarantee and liquidity features. For plan members, an understanding of how the LIB TDF compares to other solutions available in the marketplace should aid in identifying and selecting appropriate approaches to securing guaranteed lifetime income in retirement.

In certain economic environments, the elimination of sequence of returns risk would have dramatic positive impacts for participants with the LIB TDF.

APPENDIX I: Additional Results

Exhibit 6: Distribution of Accumulated Value at Age 65 (Retirement/Income Start Age) for the Two TDF Alternatives: Traditional TDF and LIB TDF



Source: CANNEX Financial Exchanges Limited

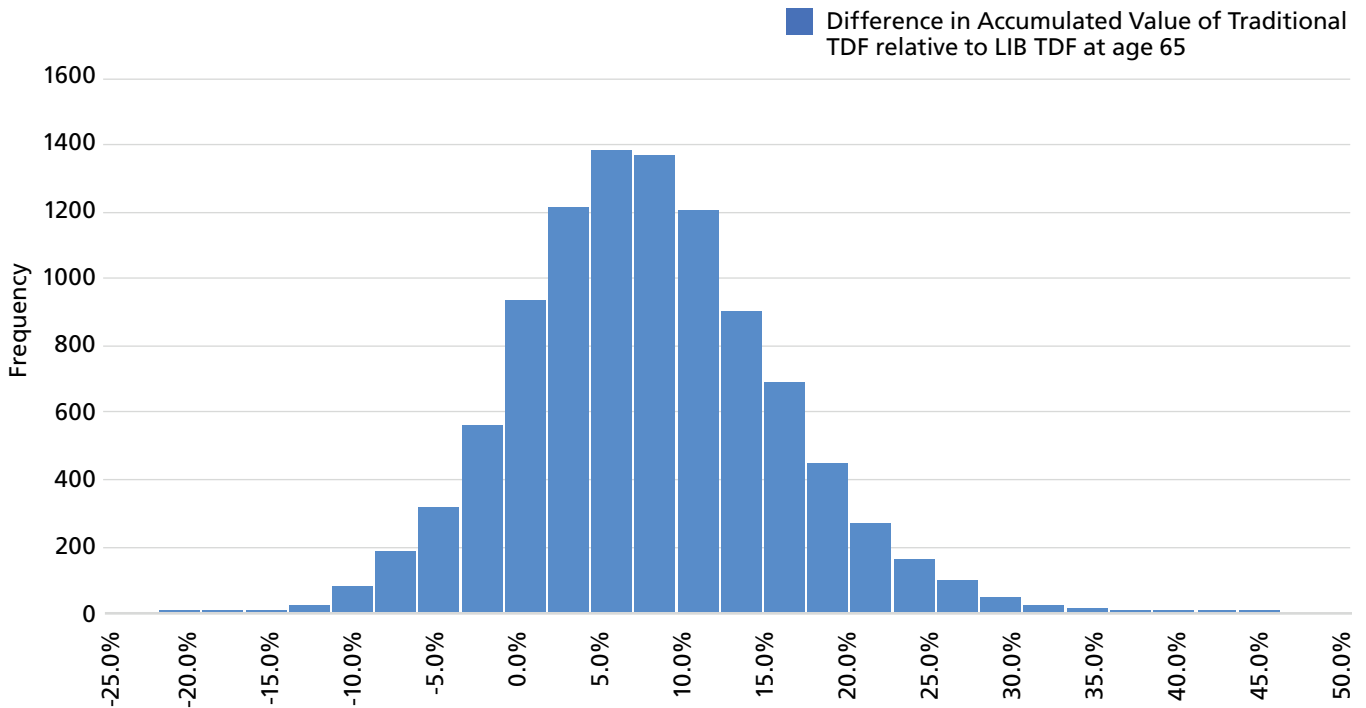
Exhibit 7: Percentiles of the Distributions of Accumulated Value in Both TDF Options at Age 65

Percentile	Accumulated Value in Traditional TDF at age 65	Accumulated Value in LIB TDF at age 65
0	\$326,264	\$379,805
10	\$648,292	\$634,851
25	\$773,966	\$740,284
50	\$937,489	\$885,855
75	\$1,150,021	\$1,072,181
90	\$1,391,045	\$1,282,253
100	\$3,787,053	\$3,885,841

Source: CANNEX Financial Exchanges Limited

COMPARING A NOVEL IN-PLAN INCOME SOLUTION TO ALTERNATIVES

Exhibit 8: Distribution of Difference in Accumulated Value of TDF Relative to LIB TDF at Age 65



Source: CANNEX Financial Exchanges Limited

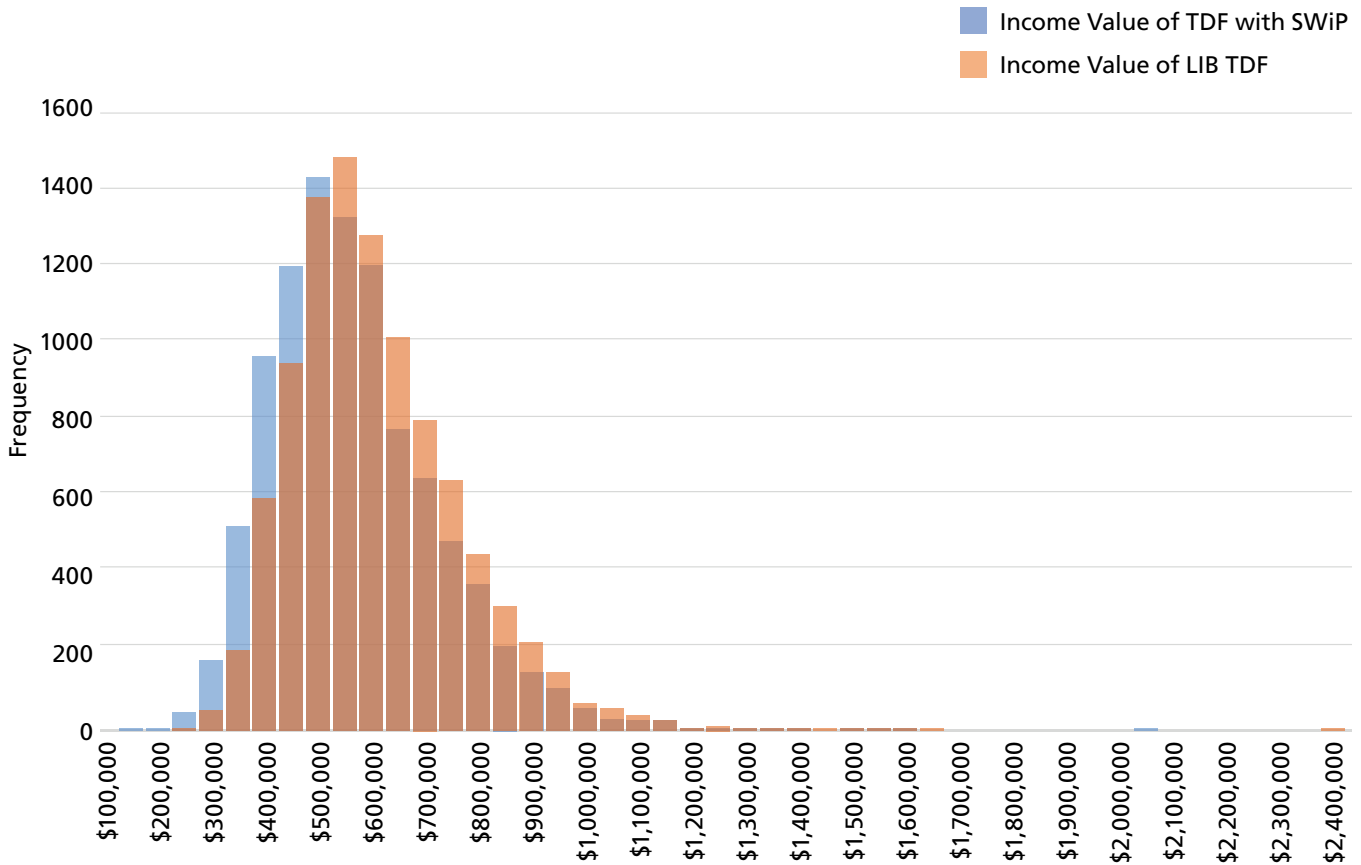
Exhibit 9: Percentiles of the Distribution of Difference in Accumulated Value of TDF Relative to LIB TDF at Age 65

Percentile	Difference in Accumulated Value of TDF relative to LIB TDF at Age 65
0	-21.9%
10	-3.2%
25	0.8%
50	5.5%
75	10.5%
90	15.4%
100	41.3%

Source: CANNEX Financial Exchanges Limited

COMPARING A NOVEL IN-PLAN INCOME SOLUTION TO ALTERNATIVES

Exhibit 10: Distribution of Income Value for Both TDF Options (Traditional TDF with the Systematic Withdrawal Plan and the LIB TDF)



Source: CANNEX Financial Exchanges Limited

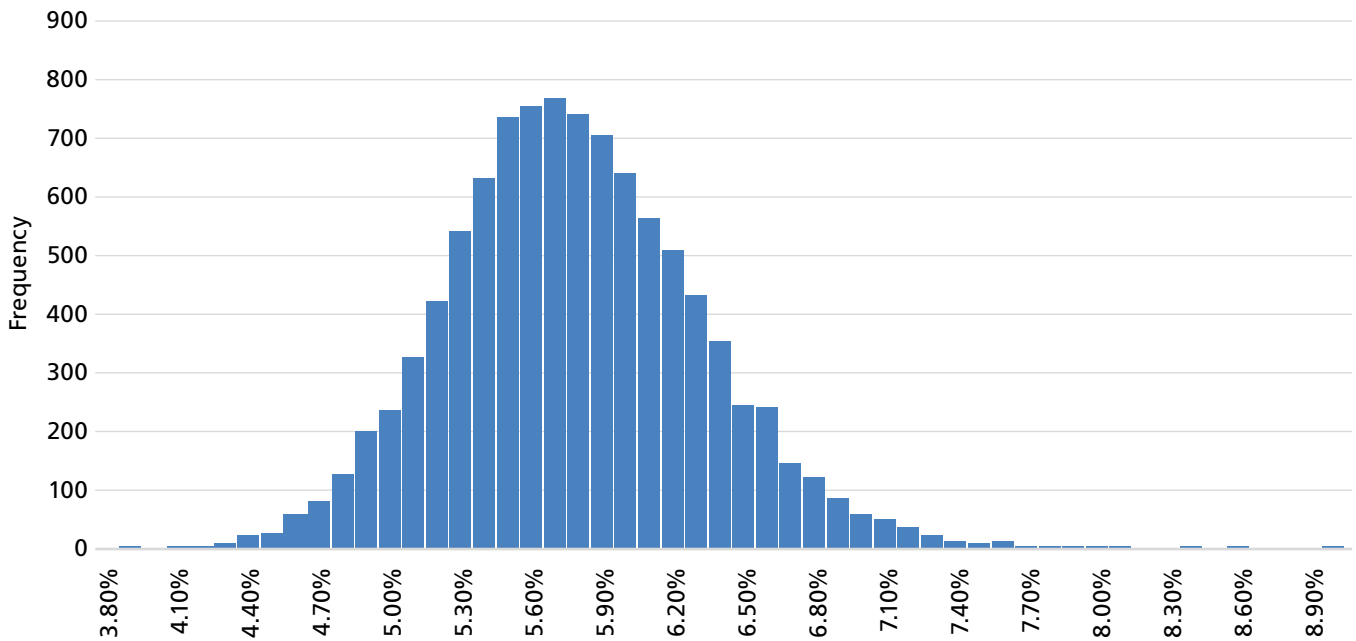
Exhibit 11: Percentiles of the Distribution of Improvement in Income Value in the LIB TDF Relative to the TDF with SWiP

Percentile	Improvement in Income Value in the LIB TDF relative to the TDF with SWiP
0	0.00%
10	0.01%
25	2.10%
50	7.01%
75	13.38%
90	19.80%
100	61.06%

Source: CANNEX Financial Exchanges Limited

COMPARING A NOVEL IN-PLAN INCOME SOLUTION TO ALTERNATIVES

Exhibit 12: Distribution of the Annuitization Rate Required at Age 65 to Match Income Value of the LIB TDF



Source: CANNEX Financial Exchanges Limited

Exhibit 13: Percentiles of the Distribution of Annuitization Rate Required at Age 65 to Match Income Value of the LIB TDF

Percentile	Annuitization Rate required at age 65 to reproduce equivalent Income Value
0	3.86%
10	5.07%
25	5.37%
50	5.70%
75	6.08%
90	6.43%
100	8.91%

Source: CANNEX Financial Exchanges Limited

APPENDIX II: Modeling Assumptions

This section provides some detail into the analytic framework and the assumptions that were used to generate the results illustrated in this report.

Analytic Framework

The accumulation of and distribution (income) from the LIB TDF and Traditional TDF are simulated for a large number (10,000) of scenarios. In each scenario, the interest rate and capital markets are simulated based on the model and parameters described below. The outcomes from the simulated scenarios are aggregated to produce the distributions and key percentiles of those distributions that are presented in the report.

Income Value

Income Value is the actuarial present value of the future income stream from a retirement strategy. Each income payment is discounted to the present by the time value of money and the probability that the retiree will survive to receive that payment, and then summed to arrive at the *Income Value* of that income stream.

- In the analysis of the distribution stage in Comparison 1, *Income Value* is used as the metric to quantify the income stream from the two retirement income strategies in order to compare them.
- In the analysis for Comparison 2, for each simulated market scenario, we calculated the annuitization rate that is required at age 65 so that the *Income Value* of the SPIA with level payments (as a result of a full annuitization of the Traditional TDF) would match the *Income Value* of the LIB TDF. See Exhibit 12 for the distribution of annuitization rates.

Lifetime Ruin Probability

Lifetime Ruin Probability (LRP) is the probability that a retiree outlives the assets in their retirement portfolio. This metric is used to quantify the effectiveness of a retirement income strategy in reducing the lifetime ruin risk associated with the strategy and, therefore, allows for apples to apples comparison of various retirement income strategies. This metric is used in Comparison 1.

COMPARING A NOVEL IN-PLAN INCOME SOLUTION TO ALTERNATIVES

Glide Path

Age	US Large Caps	US Small Caps	International Equity	Emerging Markets Equity	US Aggregate Bonds	Inflation Protected Securities
50	36.00%	11.25%	22.50%	5.25%	25.00%	0.00%
51	35.28%	11.03%	22.05%	5.15%	26.50%	0.00%
52	34.56%	10.80%	21.60%	5.04%	28.00%	0.00%
53	33.84%	10.58%	21.15%	4.94%	29.50%	0.00%
54	33.12%	10.35%	20.70%	4.83%	31.00%	0.00%
55	32.40%	10.13%	20.25%	4.73%	32.50%	0.00%
56	31.68%	9.90%	19.80%	4.62%	34.00%	0.00%
57	30.96%	9.68%	19.35%	4.52%	35.50%	0.00%
58	30.24%	9.45%	18.90%	4.41%	37.00%	0.00%
59	29.52%	9.23%	18.45%	4.31%	38.50%	0.00%
60	28.80%	9.00%	18.00%	4.20%	40.00%	0.00%
61	27.84%	8.70%	17.40%	4.06%	40.40%	1.60%
62	26.88%	8.40%	16.80%	3.92%	40.80%	3.20%
63	25.92%	8.10%	16.20%	3.78%	41.20%	4.80%
64	24.96%	7.80%	15.60%	3.64%	41.60%	6.40%
65	24.00%	7.50%	15.00%	3.50%	42.00%	8.00%
66	22.63%	7.07%	14.14%	3.30%	43.60%	9.26%
67	21.26%	6.64%	13.29%	3.10%	45.20%	10.51%
68	19.89%	6.21%	12.43%	2.90%	46.80%	11.77%
69	18.51%	5.79%	11.57%	2.70%	48.40%	13.03%
70	17.14%	5.36%	10.71%	2.50%	50.00%	14.29%
71	15.77%	4.93%	9.86%	2.30%	51.60%	15.54%
72+	14.40%	4.50%	9.00%	2.10%	53.20%	16.80%

Source: CANNEX Financial Exchanges Limited

Interest Rate Assumption

Interest rate, specifically the 10-year U.S. Treasury, is simulated using a Vasicek model. The Vasicek model is a stochastic interest rate model that is appropriate for this analysis, because of its mean-reversion feature and its simplicity to calibrate and simulate. One of the limitations of the model is that it allows for rates to be negative; while this is entirely possible in the current environment, we have imposed a floor of 0% on simulated interest rates.

The model was fitted to the monthly values of the 10-year U.S. Treasury over the historical period December 2008 to July 2021 and had the following characteristics:

- The long-term mean level of the rate was 2.14%
- Changes in the interest rate over time had a standard deviation of 0.77%
- The speed at which the rate returns to the long-term mean level was 0.4901

This interest rate simulation ultimately impacts the movement of the Participation Rate as well as the Payout Factors of the solution.

Capital Market Assumptions

Six asset classes representative of the investments available in retirement savings portfolio are considered for this analysis. Each asset class is simulated using a Geometric Brownian Motion (GBM) model.

GBM is a widely used model for asset prices, as it is simple and straightforward to implement. It relies on the assumption that price returns follow a normal distribution with constant expected return and constant volatility. In reality, price return distributions have fatter tails compared to a normal distribution and volatility is not constant but changes over time and may also change based on price level. In this analysis, we are not concerned with any application that could suffer from these simple assumptions such as replicating market prices of options or assessing tail risks; we are concerned with the long-term price behavior of assets, as well as capturing the dynamics in price return between different assets and so the GBM model is appropriate.

Parameter values for each asset class are taken from the JP Morgan Long-Term Capital Market Assumptions 2021, 25th edition (U.S. Dollar Assumption Matrix page 118).

Asset Class	Average Annualized Return	Annualized Volatility
US Large Caps	5.13%	14.80%
US Small Caps	6.33%	19.44%
International Equity	7.80%	16.92%
Emerging Markets Equity	9.19%	21.14%
US Aggregate Bonds	2.16%	3.43%
Inflation Protected Securities	1.64%	5.29%

Source: CANNEX Financial Exchanges Limited

COMPARING A NOVEL IN-PLAN INCOME SOLUTION TO ALTERNATIVES

Asset correlations, among the assets in the table above, are also taken from the JP Morgan Long-Term Capital Market Assumptions 2021, 25th edition; correlations between the 10-year U.S. Treasury and asset classes were estimated using the historical data.

Asset Class	10-Year Treasury	US Large Caps	US Small Caps	International Equity	Emerging Markets Equity	US Aggregate Bonds	Inflation Protected Securities
10-Year Treasury	1.00						
US Large Caps	0.29	1.00					
US Small Caps	0.37	0.91	1.00				
International Equity	0.30	0.88	0.79	1.00			
Emerging Markets Equity	0.25	0.77	0.69	0.88	1.00		
US Aggregate Bonds	-0.84	0.00	-0.07	0.07	0.12	1.00	
Inflation Protected Securities	-0.62	0.09	0.03	0.16	0.25	0.74	1.00

Source: CANNEX Financial Exchanges Limited

Mortality Model

Annuitant mortality is simulated by the Gompertz-Makeham mortality model, which states that the death rate for humans can be attributed to two categories of causes:

1. Age-dependent causes of death that increases with age, and
2. Age-independent causes, which are attributable to accidents

This model has been widely used to create mortality tables within the insurance industry over the last century. For this study, the model has been calibrated to the Retirement Plan Mortality Tables of 2014 which have been projected to the year 2017 using a 2014 improvement scale, which is widely used in the pension industry.

Gompertz-Makeham Parameter	Male	Female
Accidental death rate	0.003148	0.001982
Modal value of life	89.50	91.60
Dispersion coefficient	8.60	8.50

Source: CANNEX Financial Exchanges Limited

Lapse Model

Lapses are not modelled in the analysis for this report; i.e., it is assumed that the retiree will stay with the retirement strategy until death.

Annuitant

The hypothetical annuitant considered is a male entering both LIB TDF and Traditional TDF at age 50, making 15 years of contributions and taking income starting at age 65.

- Note that for Exhibit 4, the ruin probabilities are calculated for a 50-year old male and a 50-year old female, both with income start age of 65.

Contribution Structure

We assume an initial deposit of \$250,000 at age 50, with nominal annual deposits of \$19,500 for 15 years of contribution that is subjected to an annual salary increase rate of 2%. These numbers are assumed to be representative of the typical plan participant.

DISCLOSURES

- 1. The results presented in this report are based on the set of assumptions used for the analysis and documented herein. CANNEX retains the discretion to update these assumptions in the future.*
- 2. All product specifications are based on the information provided to CANNEX by Annexus Retirement Solutions, the sponsor of this report.*
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- 5. The effect of taxes (if any) has not been taken into account.*
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ABOUT CANNEX

CANNEX supports the exchange of **pricing information** for annuity and bank products across North America. We provide financial institutions with the ability to evaluate and compare various guarantees associated with retirement savings and retirement income products.

Our **quantitative research** team provides methodologies that help optimize the selection and allocation of annuity and insurance guarantees in support of retirement programs and practices.

Our pricing and analytic services can be deployed to support a variety of processes, including:

- Research & Market Intelligence
- Financial Planning & Education
- Sales & Compliance
- Transaction Processing
- Product Service & Administration

Contact Information

CANNEX Financial Exchanges Limited
1200 Bay Street, Suite 1001
Toronto, Ontario
Canada
M5R 2A5

Phone: (416) 926-0882
Toll Free: (800) 387-1269
Fax: (416) 926-0706

Email: cannex@cannex.com
Web: cannex.com