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MEMO

TO:	Connecticut Retirement Security Board
DATE:	November 30th, 2015
FROM:	Mercer
SUBJECT:	Income Replacement Ratio Analysis

Introduction

The legislation tasks the Connecticut Retirement Security Board (CRSB) to design the Retirement Security Program (the Program) to achieve the following goal:

"A reduced need for public assistance through a system of prefunded retirement income"

This memo will cover the issue of whether this Program can help achieve this goal. The key drivers behind reducing the need for public assistance depend on:

- Contributions to Social Security, which are largely dependent on length of covered employment prior to retirement
- The age at which a prospective participant begins (or ends) participating in the Program (accumulation period)
- Percentage of income that is saved for retirement (deferral rate)
- Choice of investments for retirement savings

Assumptions Used for the Income Replacement Ratio Analysis[1]

In determining the potential retirement readiness for various segments of the uncovered population of the State of Connecticut, Mercer adopted the following nine representative age/income cohorts:

EXHIBIT 1: AGE AND INCOME COHORTS OF UNCOVERED POPULATION IN THE STATE OF CONNECTICUT

		Age Cohort		
		Age 25	**Age 40**	**Age 55**
Income Level	**Low**	$20,000	$26,000	$30,750
	Mid	$24,000	$45,000	$55,000
	High	$31,000	$75,000	$99,000

*Source: US Census Connecticut data and Mercer's calculation of uncovered population*

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[1] The income replacement ratio in retirement was calculated assuming an annuity is purchased at retirement (age 65). The income replacement ratio is adjusted for inflation and economic environment at retirement and is inclusive of Social Security benefits, commencing at age 65.

In performing our analysis, we assumed the following:

- Retirement age of 65
- Annual wage growth of 2.2%, which is also our inflation assumption
- Participant deferral rates of 3% or 6%
- Savings in the Program are invested in either an age appropriate target-date fund or cash
- Starting retirement account balance of $0, meaning participants have access to no other retirement savings
- Social security coverage starting at age 25 through age 65

The Annual Wage growth of 2.2%, which is also our inflation assumption, is based on our analysis that historical US wage growth and inflation have had a similar trend (see Exhibit 2). Our analysis also shows that Connecticut specific wage inflation data is broadly in-line with the overall US data. In order to show an alternate scenario of high earnings growth, we have prepared additional analysis assuming 4% wage inflation (see Appendix 2).

EXHIBIT 2: TRENDS IN US INFLATION VERSUS US WAGE GROWTH 1990-2014
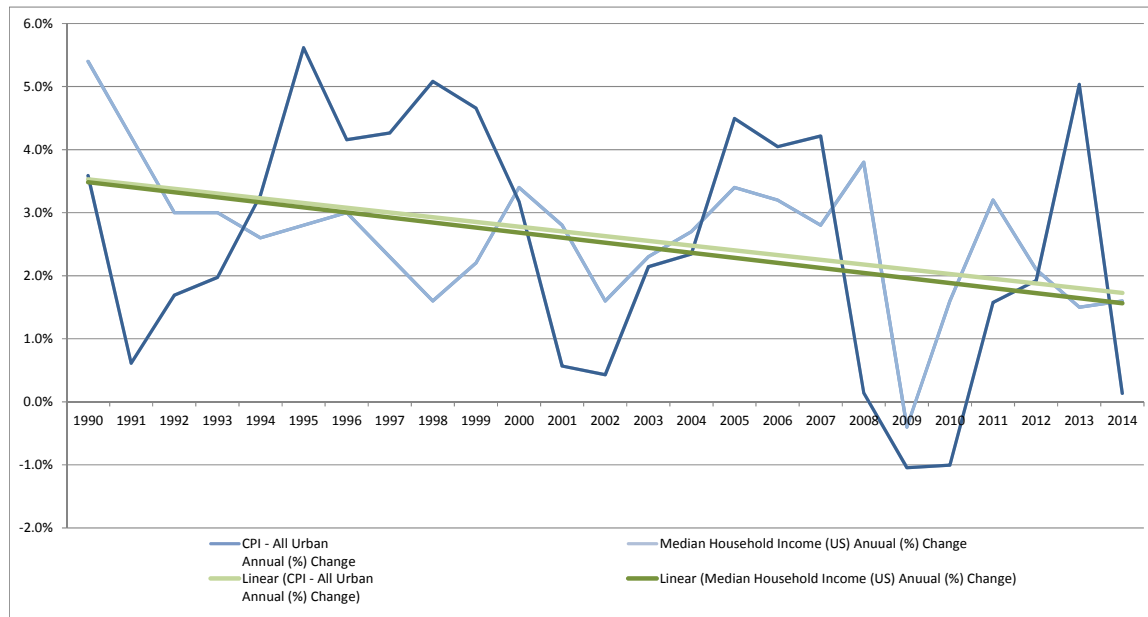
Mercer used the following target-date fund asset allocation to simulate the investment of prospective participants' savings in the Program:

EXHIBIT 3: DESCRIPTION OF THE TARGET DATE FUNDS USED TO MODEL INVESTMENT RETURNS IN THE PROGRAM

Assumptions	2055 Portfolio	2050 Portfolio	2045 Portfolio	2040 Portfolio	2035 Portfolio	2030 Portfolio	2025 Portfolio	2020 Portfolio	2015 Portfolio	2010 Portfolio	2005 Portfolio	Income Portfolio
Global Equity - All Cap	76.0	76.0	76.0	76.0	76.0	72.0	68.0	49.0	39.0	32.5	29.2	22.7
US Aggregate FI	5.0	5.0	5.0	5.0	5.0	10.0	15.0	30.0	32.0	30.0	22.0	26.0
Cash	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	10.0	16.5	19.5
TIPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	10.0	16.5	19.5
Real Assets (Excluding TIPS)	9.5	9.5	9.5	9.5	9.5	9.0	8.5	10.5	9.0	7.5	6.8	5.3
Opportunistic Fixed Income	9.5	9.5	9.5	9.5	9.5	9.0	8.5	10.5	12.0	10.0	9.0	7.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Asset Class Ratios												
Growth Assets	95.0	95.0	95.0	95.0	95.0	90.0	85.0	70.0	60.0	50.0	45.0	35.0
Defensive/Income Assets	5.0	5.0	5.0	5.0	5.0	10.0	15.0	30.0	40.0	50.0	55.0	65.0
Mean/Variance Statistics												
Geometric Return	6.22%	6.22%	6.22%	6.22%	6.22%	6.11%	5.99%	5.53%	5.11%	4.67%	4.37%	3.96%
Std Dev	16.90%	16.90%	16.90%	16.90%	16.90%	16.03%	15.17%	12.08%	10.13%	8.59%	7.77%	6.35%
Reward/Risk Ratio	0.37	0.37	0.37	0.37	0.37	0.38	0.39	0.46	0.50	0.54	0.56	0.62

We tried to anticipate the considerations a future board may apply in either selecting a glidepath from those available off-the-shelf, or working with a provider to develop a custom glidepath. In comparison to the average off-the-shelf glidepath, the allocations we are showing in this illustrative glidepath will tend to be at the high end of growth %. We believe the relatively high growth allocation is appropriate for this demographic because they have a significant portion of their retirement income provided by social security – effectively a form of fixed income. Further, our analysis shows that most cohorts fall short of a desired replacement ratio, so there is a need for higher growth.

The CRSB also tasked Mercer with analyzing the impact of investing all retirements savings accumulated through the Program in cash, which the CRSB has determined as the investment solution that would meet the guarantee statute[2] while also meeting the requirement of the portability statute[3] set by the State of Connecticut legislature. Mercer's analysis estimates the impact on retirement readiness if cash is used as the investment vehicle instead of an age appropriate target-date fund to accumulate the retirement savings for the various age cohorts.

Mercer determined retirement readiness based on the amount of pre-retirement income that is replaced in retirement through savings in the Program as well as from Social Security. The income replacement ratio analysis was performed using stochastic simulations to project outcomes for participants over a range of capital market environments using an economic model with regime switching. This type of simulation allows for a range of results that have non-normal return distributions, which more closely reflect the reality of the capital markets as opposed to the more commonly used pure mean-variance model. For more details about the model, please see Appendix 1.

The income replacement ratio in retirement was calculated assuming an annuity is purchased at retirement (age 65). The income replacement ratio is adjusted for inflation and economic environment at retirement and is inclusive of Social Security benefits, commencing at age 65. Actual Social Security benefits may be higher or lower depending on the age at which Social Security benefits

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[2] Section 185 (9) "An annually predetermined guaranteed rate of return and the procurement of insurance, as necessary, to guarantee the stated rate of return;"
[3] Section 185 (6) "Plan portability through maintenance of individual retirement accounts for each plan participant;"

commence and the on-going viability of Social Security, which could result in different income replacement ratios than the ones modeled. Concerns about future declines in Social Security benefits can be addressed by increasing prospective participants' savings rates, either in the Program or in other participant-directed retirement accounts compared to the rates used in this analysis. Rising healthcare cost and concerns about on-going viability of Medicare can lead prospective participants to need high income replacement ratios in retirement. An additional consideration is the impact of family members. For example, if a worker is no longer supporting children, income needs decrease. However, retired individuals are more commonly called upon to help support their adult children, and/or aged parents, which can increase the need for retirement income.

Complications with Calculating Income Replacement Ratio

Purcell describes a number of issues to consider when calculating income replacement ratios (Purcell, 2012). Purcell highlights:

> *Lower-income workers typically need a higher [income] replacement ratio than average-income workers because they spend higher proportion of their income on necessities such as food, clothing, housing, transportation, and medical care…For some households, a replacement ratio of 65 percent maybe adequate, while others may require a replacement ratio of 90 percent or more to maintain their desired standard of living.*

Several other factors contribute to the need for higher income replacement levels for lower-income workers. Lower-income workers tend to experience lower tax rates while employed, and thus experience less reduction in tax rates in retirement than higher-income workers. Finally, lower-income workers tend to save less for retirement, and thus the cessation of saving for retirement has less impact than for higher-income workers. These factors are of particular importance given the high likelihood that prospective participants in the Program are lower income than the broader State of Connecticut population.

Additional considerations include:
- Should pre-retirement income be defined as the average income over a set number of years prior to retirement or simply the income during the last year of employment?
- What consideration should be given to the possibility of part-time work for a number of years during retirement?
- Should retirement income and pre-retirement income be determined on a pre-tax basis or on a post-tax basis, given the high likelihood of changes in tax rates in retirement versus pre-retirement, depending on the source of retirement income?
- Should income replacement ratios reflect household income or individual income?
- Should income replacement ratios reflect real or nominal income?

Clearly there are a range of issues that are individual in nature, and cannot be resolved at a population level, which is the goal of this analysis. They have been highlighted here to illustrate that, while Mercer sought to address these issues to the extent possible within the confines of this analysis, scenario modeling cannot address all of the real-life issues that each individual or household must consider in determining what is an adequate income in retirement.
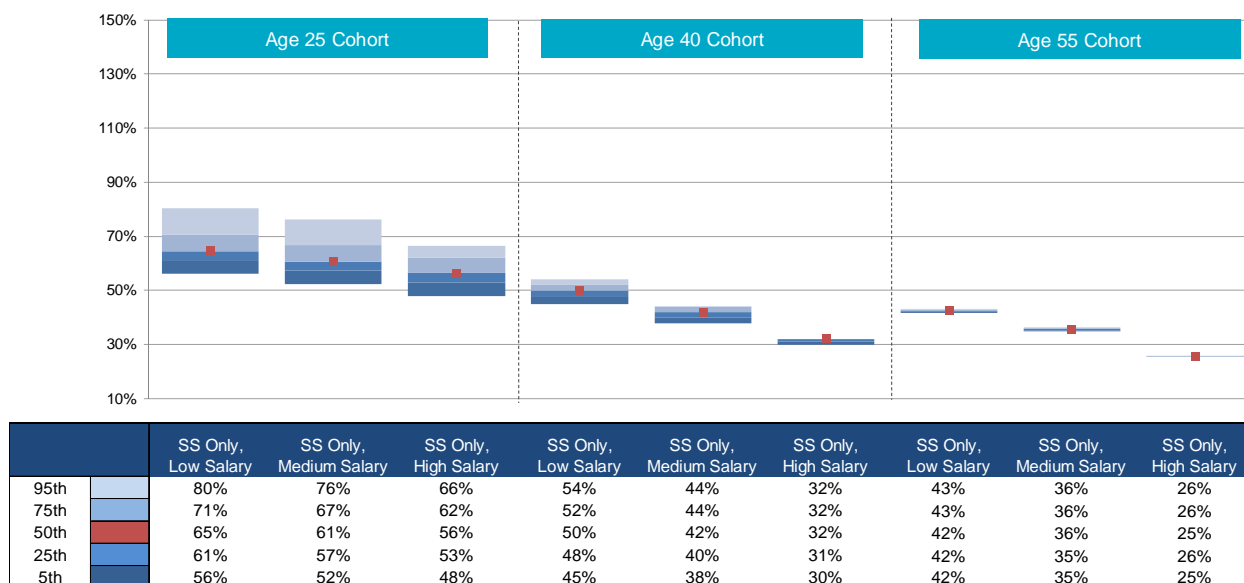
In our analysis, we assumed that an individual would work full-time for the entire period of the accumulation phase and then retire the following year. Considering that some prospective participants in the Program will experience periodic unemployment or underemployment there may be a need to defer a greater percentage of salary during periods of full employment than our model suggests is

sufficient. As a conservative estimate, we used end of the last year of employment as a basis to calculate income replacement ratios in retirement. Given the lack of information on household size for the Program's target population, we simplified the model by assuming all participants in the Program are single throughout both accumulation and decumulation phases. Uncertainty around future tax rates led us to use pre-tax income to calculate income replacement ratios.

Importance of Social Security

As discussed under the assumptions, our analysis assumes that prospective participants in the Program have been contributing to Social Security and working full-time since age 25, regardless of the age at which they begin participating in the Program. However, if prospective participants in the Program have experienced significant periods of unemployment or underemployment prior to their participation in the Program, then it is possible that they will have accrued significantly lower benefits than assumed in our analysis. As the analysis shows, Social Security is a very important source of income in retirement. It will replace anywhere from 25% to 65% of pre-retirement income in retirement, depending on income level. Individuals at the lower end of the income range are likely to have a larger share of their pre-retirement income replaced through Social Security, versus those at the higher end of income range, based on the benefit formula for Social Security.
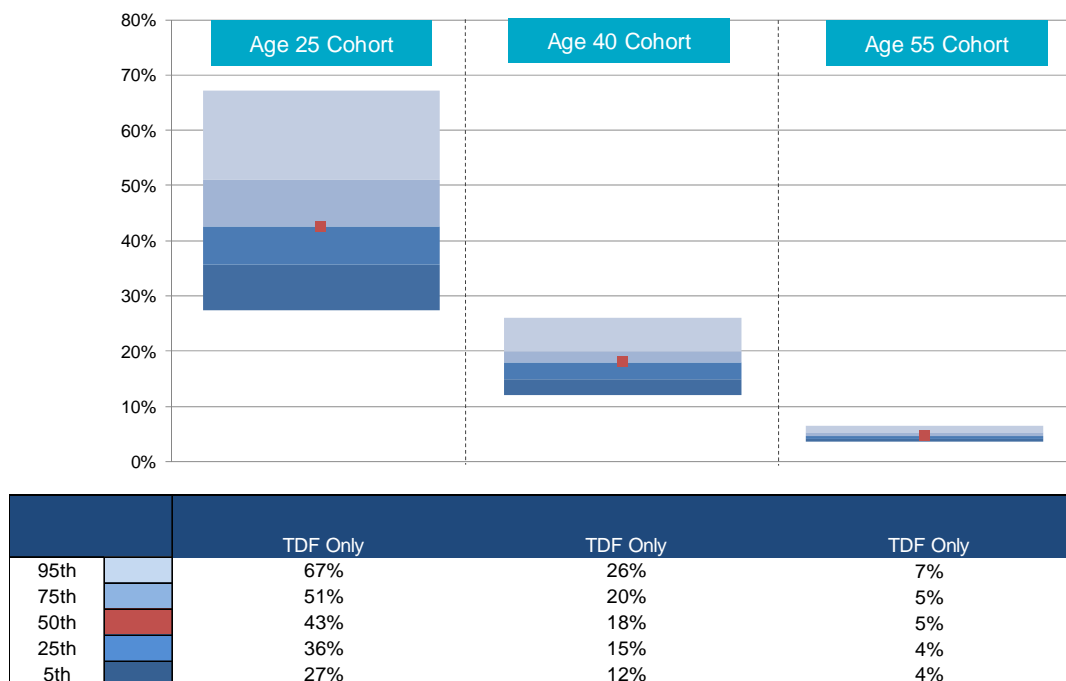
EXHIBIT 4: SUMMARY OF SOCIAL SECURITY (SS) INCOME REPLACEMENT RATIO FOR ALL INCOME LEVELS WITH 6% DEFERRAL RATE

	SS Only, Low Salary	SS Only, Medium Salary	SS Only, High Salary	SS Only, Low Salary	SS Only, Medium Salary	SS Only, High Salary	SS Only, Low Salary	SS Only, Medium Salary	SS Only, High Salary
95th	80%	76%	66%	54%	44%	32%	43%	36%	26%
75th	71%	67%	62%	52%	44%	32%	43%	36%	26%
50th	65%	61%	56%	50%	42%	32%	42%	36%	25%
25th	61%	57%	53%	48%	40%	31%	42%	35%	26%
5th	56%	52%	48%	45%	38%	30%	42%	35%	25%

Length of Accumulation Phase

All else being equal, an individual who is 25 years old at the inception of the Program is more likely to benefit from the Program than an individual who is 50 years old. This is due to longer period over which a younger prospective participant would contribute to the Program. Nevertheless, our analysis shows even older prospective participants would see some improvement in their income replacement ratio compared to if they didn't save for retirement at all.

EXHIBIT 5: SUMMARY OF TARGET DATE FUNDS' (TDF) INCOME REPLACEMENT RATIO FOR ALL INCOME LEVELS WITH 6% DEFERRAL RATE

|		TDF Only	TDF Only	TDF Only
95th		67%	26%	7%
75th		51%	20%	5%
50th		43%	18%	5%
25th		36%	15%	4%
5th		27%	12%	4%

Deferral Rate

Deferral rates (percentage of salary contributed into the Program) is one of the biggest factors towards accumulation of retirement savings. A deferral rate of 6% compared to 3% improves income replacement ratio by more than 20%, on average, for a participant entering the Program at age 25. The improvement drops to less than 10% on average for a 40 year-old entrant, and less than 5% for a 55 year-old entrant, largely due to the shorter accumulation phase. All of the calculations mentioned here assume contributions are invested in an age appropriate investment solution such as a target-date fund (TDF). We have also performed the analysis assuming all the retirement savings are invested in cash, which show smaller improvements in income replacement ratio than if the savings were invested in TDF. This is largely due to lower return assumptions for cash than TDF.

Our modeling assumes that participants in the Program continue contributing until retirement. We acknowledge that this assumption is not true for all participants, given the possibility that participants may experience periods of unemployment, underemployment, or employment at a workplace that provides an employer sponsored retirement plan. Given the uncertainty associated with future employment, it may be appropriate to adopt a higher default deferral rate to ensure that participants save sufficient retirement income. With a broad range of age groups initially participating in the Program, particularly older participants who may not have existing retirement savings, there may be a need to adopt a higher default rates, perhaps specifically for older age groups. However, this perspective needs to be balanced with participants' ability to contribute at higher levels at the outset of the Program as opposed to slowly increasing deferral rates over time.

EXHIBIT 6: SUMMARY OF CASH INCOME REPLACEMENT RATIO FOR ALL INCOME LEVELS (3% AND 6% DEFERRAL RATE)
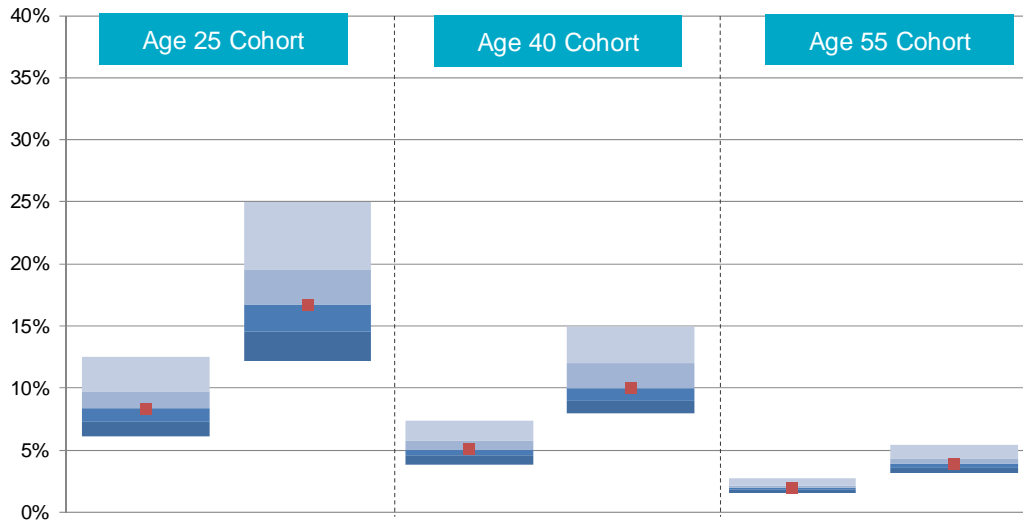
		Cash Only, 3% Deferal Rate	Cash Only, 6% Deferal Rate	Cash Only, 3% Deferal Rate	Cash Only, 6% Deferal Rate	Cash Only, 3% Deferal Rate	Cash Only, 6% Deferal Rate
95th		12%	25%	7%	15%	3%	5%
75th		10%	20%	6%	12%	2%	4%
50th		8%	17%	5%	10%	2%	4%
25th		7%	15%	5%	9%	2%	4%
5th		6%	12%	4%	8%	2%	3%

EXHIBIT 7: SUMMARY OF TARGET DATE FUNDS' (TDF) INCOME REPLACEMENT RATIO FOR ALL INCOME LEVELS (3% AND 6% DEFERRAL RATE)
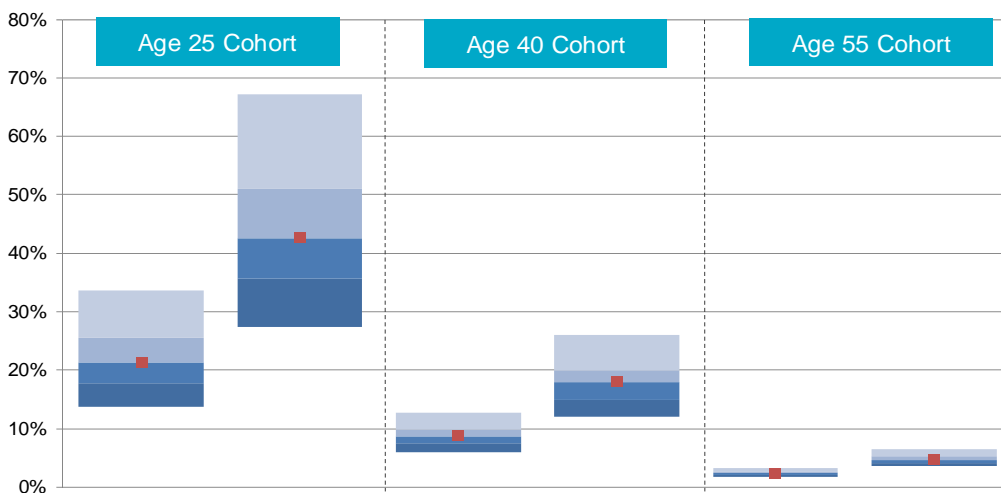
		TDF Only, 3% Deferal Rate	TDF Only, 6% Deferal Rate	TDF Only, 3% Deferal Rate	TDF Only, 6% Deferal Rate	TDF Only, 3% Deferal Rate	TDF Only, 6% Deferal Rate
95th		34%	67%	13%	26%	3%	7%
75th		26%	51%	10%	20%	3%	5%
50th		21%	43%	9%	18%	2%	5%
25th		18%	36%	8%	15%	2%	4%
5th		14%	27%	6%	12%	2%	4%

Investment Strategy

The CRSB also tasked Mercer with analyzing the impact of investing all retirement savings accumulated through the Program in cash versus a target-date fund (TDF). As such, our analysis presents the impact on income replacement ratio if cash (money market fund) is used to accumulate the retirement savings for the various age cohorts. On average, prospective participants age 25 and 40 are expected to see a 26% to 8% improvement in their income replacement ratio, respectively, if their retirement savings are invested in a TDF compared to a money market fund. The difference in income replacement ratio between investing in a TDF versus a money market fund for the 55 year old is not significant, largely due to short accumulation period and investment horizon for this age cohort.

EXHIBIT 8: SUMMARY OF CASH AND TARGET DATE FUNDS' (TDF) INCOME REPLACEMENT RATIO FOR ALL INCOME LEVELS WITH 6% DEFERRAL RATE
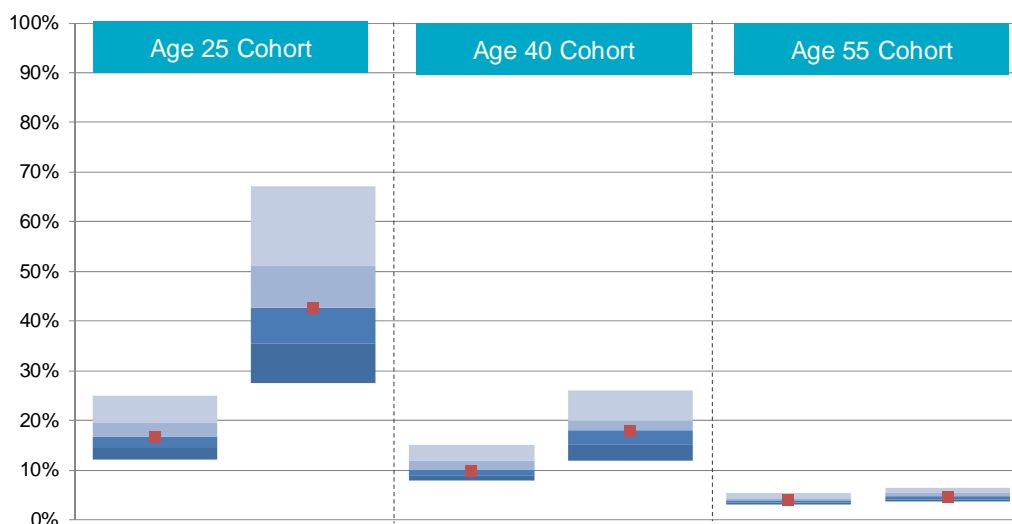
		Cash Only	TDF Only	Cash Only	TDF Only	Cash Only	TDF Only
95th		25%	67%	15%	26%	5%	7%
75th		20%	51%	12%	20%	4%	5%
50th		17%	43%	10%	18%	4%	5%
25th		15%	36%	9%	15%	4%	4%
5th		12%	27%	8%	12%	3%	4%

Conclusion

Social Security, which replaces between 25%-65% of income, dependent on pay level, is not sufficient on its own to meet retirement needs. A deferral rate of 3% or 6% into the Program combined with Social Security leads to an improved income replacement in retirement. Increasing the deferral rate from 3% to 6% improves the income replacement ratio by more than 20% on average for a participant entering the Program at age 25. The improvement is less than 10% on average for a 40 year old and less than 5% for a 55 year old, largely due to shorter accumulation phase. These calculations assume contributions are invested in an age appropriate investment solution such as a TDF.

Investing in TDFs improves average income replacement ratio for a 25 year old today by 43% compared to just depending on Social Security, due to this age cohort's long savings and investment

horizon. For 40 and 55 year old cohorts, the average improvement in income replacement ratio were 18% and 5%, respectively, due to their relatively short savings and investment horizon. This calculation assumes a 6% deferral rate; the improvements in income replacement ratio are smaller for a 3% deferral rate.

On average, prospective participants aged 25 and 40 are expected to see a 26% to 8% improvement in their income replacement ratio, respectively, if their retirement savings are invested in a TDF compared to a money market fund. The difference between investing in a TDF versus a money market for the 55 year old is not significant, largely due to short accumulation period and investment horizon.

Mercer believes that mandating this Program on an opt-out basis will tap into the power of inertia to help uncovered workers save for retirement and meaningfully improve their retirement readiness. While setting a high deferral rate may be prudent in order to improve retirement readiness of prospective participants in the Program, we acknowledge that some participants may not be able to contribute at a 6% level. As such, it may be more palatable to default new participants at a 3% contribution level and slowly escalate the contribution over a set period of time.

Works Cited

Purcell, P. J. (2012). *Income Replacement Ratios in the Health and Retirement Study.* Social Security
Administration.

Appendix 1

Capital Market Models

Many models of the capital markets are mean-variance models. Efficient frontier modeling, for example, is a mean-variance approach. Surplus optimization is another type of mean-variance analysis. Mean-variance approaches are quite acceptable for certain situations, but they fail to provide satisfactory results in modeling interest rates, inflation, or multi-factor risk approaches. Most significantly, they fail to capture the extreme events that occur in markets.

The Mercer Capital Markets Simulator (CMS) is not a mean-variance model. Rather, it relies on a set of mean-reverting, serially correlated equations to create multiple time series, or trials, of economic variables such as inflation, economic growth, and interest rates. From these variables, we can directly compute returns to bonds, equities, changes in exchange rates, etc. The returns are calculated using the fundamental drivers of asset returns for each asset type, such as equity return = starting dividend yield + P/E change + earnings growth. Bond returns are equal to starting yield + price change due to yield change (including roll-down yield) - defaults, etc. Although more complex than a mean-variance approach, the model permits great flexibility and encompasses in a more realistic manner the multifaceted, dynamic nature of capital markets.

CMS provides four main strengths in terms of capital market simulations:
- Precise analytics by employing an economic model, not a mean/variance model. The model is based upon economic fundamentals: growth, inflation, and interest rates that determine returns.
- It is a global model. By specifying several countries and/or regions, inflation, economic growth, and interest rates are generated simultaneously across all regions. This allows for consistency in determination of exchange rates as well as correlations between regions.
- Consistency between calculation of asset class returns and valuation of liabilities: By generating bond yields directly, these yields can be used to calculate bond returns and liability discount rates.
- Inclusion of non-normal distributions through a regime switching model that allows, in effect, correlations between assets to vary over time.
- Equity returns are determined by earnings growth, dividend yields, and changes in P/E ratios. This approach is consistent with an economic approach to equity valuation: the dividend discount model.

An Outline of the Model

The flowchart below presents a general schematic for understanding how the model works

Step 1.
Generate
- Inflation
- Economic growth

Step 2.
Generate
- Nominal yield curve
- Real yield curve
- Equity yields, dividend yields
- Corporate bond spreads

Step 3.
Determine change in exchange rates

Step 4.
Compute
- Bond returns
- Equity returns

Step 5.
Determine Int'l returns
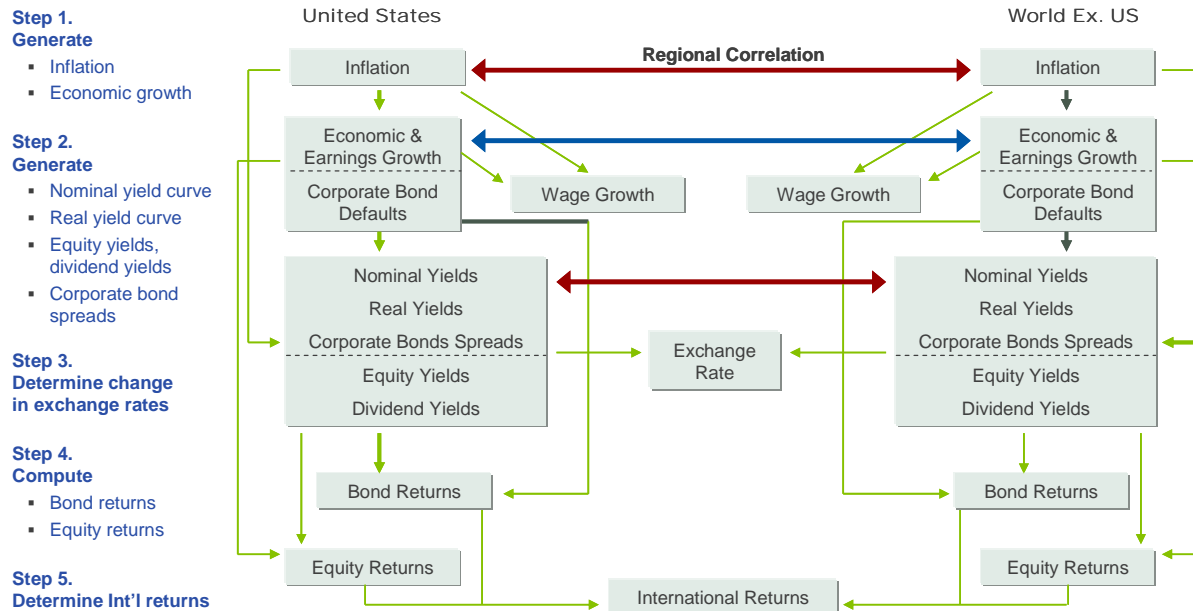
Description of the Scenarios and Regime Switching Modeling

Our methodology for stochastic modeling uses Regime-Switching. This model does not have a static state of the world—rather, the underlying assumptions can vary, permitting the possibility of extreme events.
We define seven possible states of the world:

- Base Case: Inflation, growth, and equity returns hover around their long term expected values. (Inflation is 2.2%, growth is 2.4%, and equity returns are in the 8% range.) Bond yields adjust from their current conditions to their long run values over a period of three to five years. This path of interest rates then determines bond returns.

- Recession: This is a "classical recession", not a severe credit crunch or depression. In the recession scenario, inflation is quite low, but not negative, while growth dips below zero. Treasury yields decline sharply, but T-Bills do not approach zero. Credit spreads widen and the equity returns are low because of a decline in earnings and drop in the P/E level.

- Depression/Credit Crunch: This is modeled after the events of 2008. Inflation and economic growth are both negative (around -1.5% to -2.0%). Credit spreads soar, treasury yields decline sharply and T-Bill yields approach zero. The P/E level of the market declines sharply.

- 10% Inflation: Inflation rises to 10%, economic growth is below average at 2.5%. Treasury yields rise to 10% - 11%, credit spreads widen slightly. Equity returns are depressed as the P/E level falls.

- Stagflation: Inflation rises to around 6.0% and growth stalls to 1.0% (but is not necessarily negative). The Treasury yield curve flattens at about 7.0% to 7.5%. Equity returns are weak, because the P/E level drops. Credit spreads widen, but not to recession levels.

- Inflationary growth: Inflation rises to 6.0% and economic growth is very strong at 4.5%. Treasury yields rise to an 8.0% level. The P/E level of the market rises slightly, producing returns consistently in the 10% range.
- Ideal Growth: Inflation falls to 0.5%, economic growth booms at 6%. Treasury yields stay near our long run projected curve, producing very high real yields. P/E level soars, producing equity returns in the teens. If this regime persists for a few years, equity returns drop back down to the 8.0% level, which means that real returns are still quite high, in the 7.5% range.

We can model additional scenarios, as well, but we believe that these seven scenarios cover the range of events that the market has seen over the last 140 years (which is about as far back as decent data about growth, inflation, yields, and equity returns are available.)
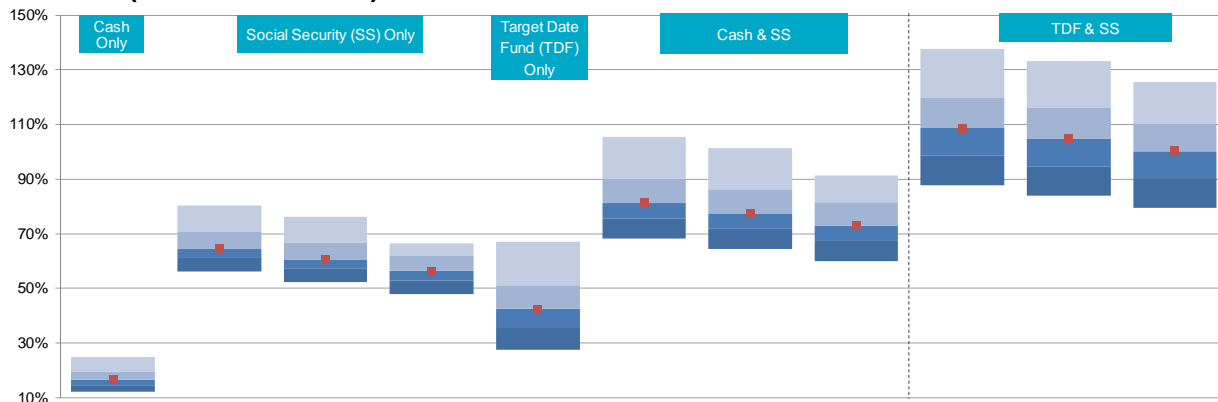
Appendix 2

Summary of Income Replacement Ratios
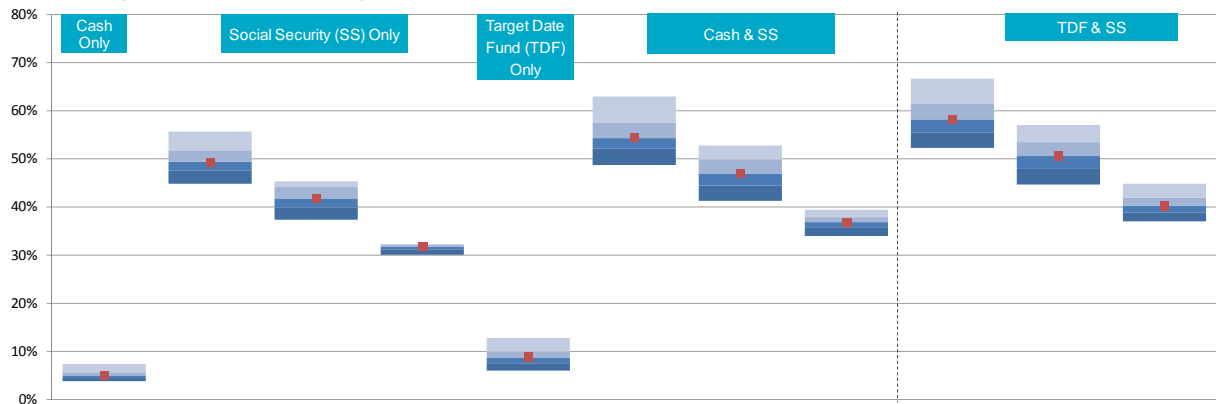
Age 25 Cohort (3% Deferral Rate)
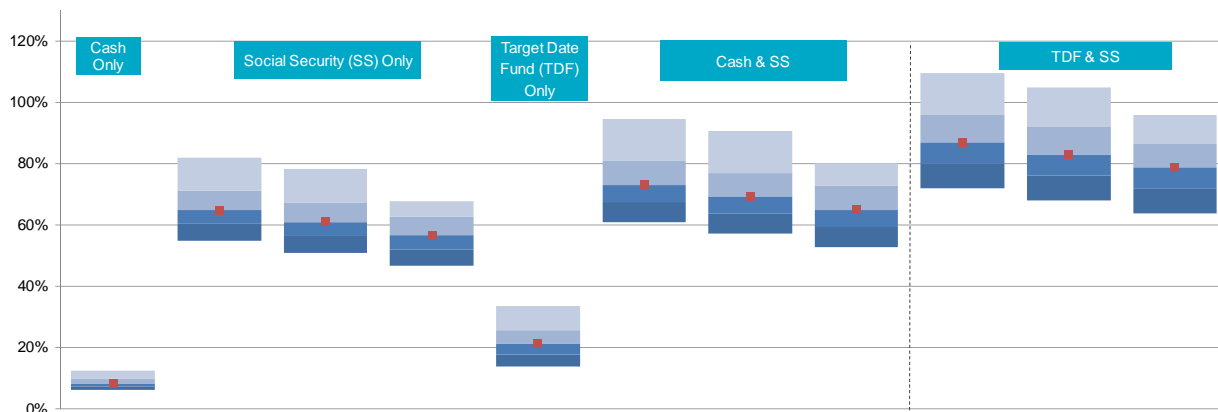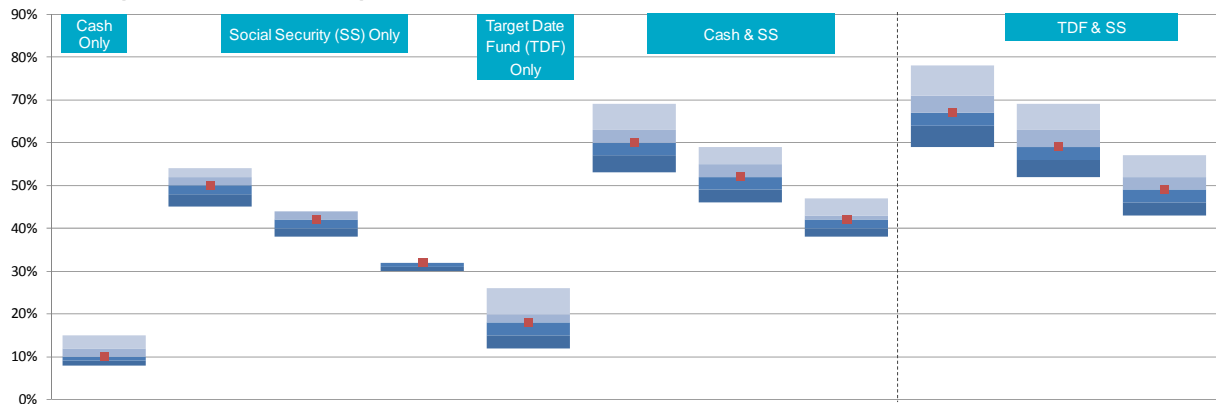

		Cash Only	SS Only, Low Salary	SS Only, Medium Salary	SS Only, High Salary	TDF Only	Cash & SS, Low Salary	Cash & SS, Medium Salary	Cash & SS, High Salary	TDF & SS, Low Salary	TDF & SS, Medium Salary	TDF & SS, High Salary
95th		12%	82%	78%	68%	34%	94%	91%	80%	109%	105%	96%
75th		10%	71%	67%	63%	26%	81%	77%	73%	96%	92%	87%
50th		8%	65%	61%	57%	21%	73%	69%	65%	87%	83%	79%
25th		7%	60%	56%	52%	18%	68%	64%	59%	80%	76%	72%
5th		6%	55%	51%	47%	14%	61%	57%	53%	72%	68%	64%

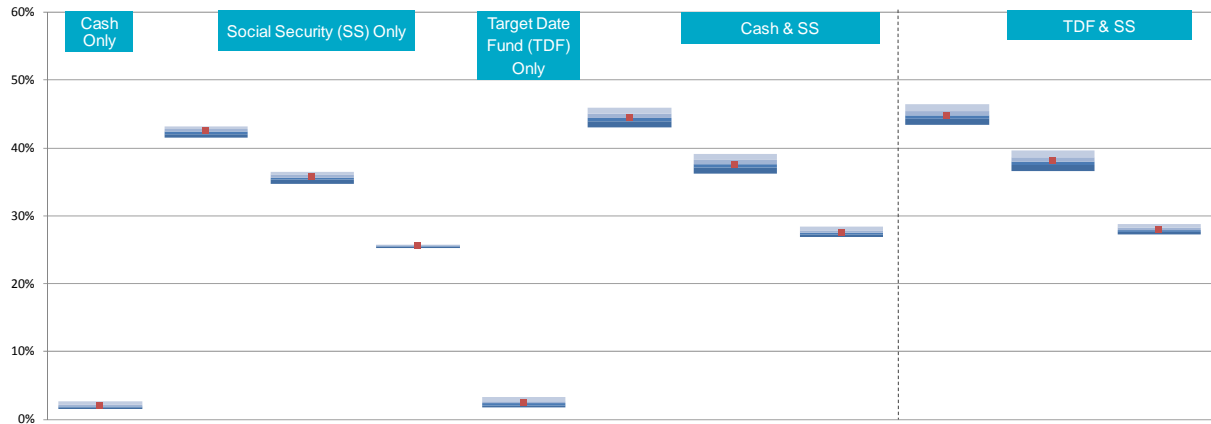### Age 25 Cohort (6% Deferral Rate)

		Cash Only	SS Only, Low Salary	SS Only, Medium Salary	SS Only, High Salary	TDF Only	Cash & SS, Low Salary	Cash & SS, Medium Salary	Cash & SS, High Salary	TDF & SS, Low Salary	TDF & SS, Medium Salary	TDF & SS, High Salary
95th		25%	80%	76%	66%	67%	105%	101%	91%	138%	133%	126%
75th		20%	71%	67%	62%	51%	90%	86%	82%	120%	116%	110%
50th		17%	65%	61%	56%	43%	81%	77%	73%	109%	105%	100%
25th		15%	61%	57%	53%	36%	76%	72%	68%	99%	95%	90%
5th		12%	56%	52%	48%	27%	68%	64%	60%	88%	84%	79%

Age 40 Cohort (3% Deferral Rate)
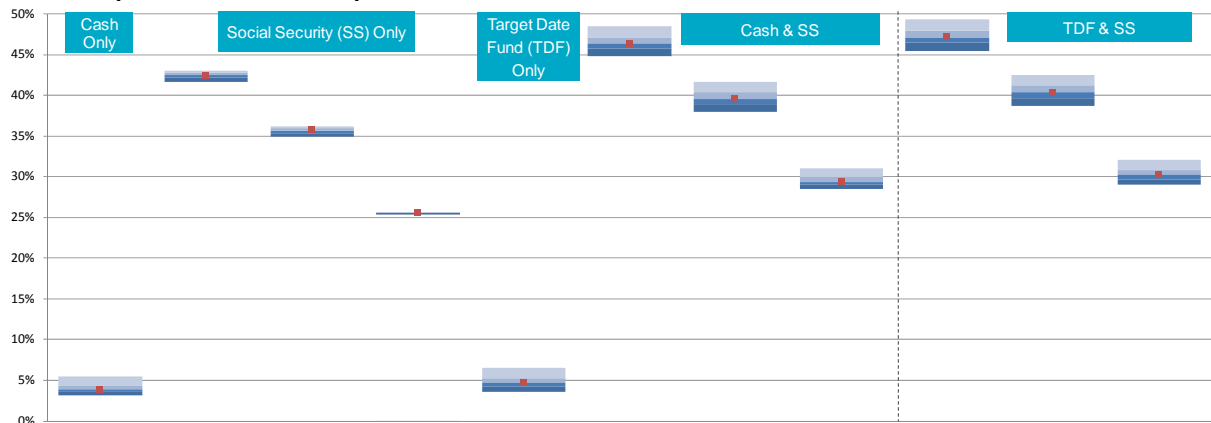

	Cash Only	SS Only, Low Salary	SS Only, Medium Salary	SS Only, High Salary	TDF Only	Cash & SS, Low Salary	Cash & SS, Medium Salary	Cash & SS, High Salary	TDF & SS, Low Salary	TDF & SS, Medium Salary	TDF & SS, High Salary
95th	7%	56%	45%	32%	13%	63%	53%	39%	67%	57%	45%
75th	6%	52%	44%	32%	10%	58%	50%	38%	61%	53%	42%
50th	5%	49%	42%	32%	9%	54%	47%	37%	58%	51%	40%
25th	5%	47%	40%	31%	8%	52%	44%	36%	55%	48%	39%
5th	4%	45%	37%	30%	6%	49%	41%	34%	52%	45%	37%

Age 40 Cohort (6% Deferral Rate)

|	Cash Only	SS Only, Low Salary	SS Only, Medium Salary	SS Only, High Salary	TDF Only	Cash & SS, Low Salary	Cash & SS, Medium Salary	Cash & SS, High Salary	TDF & SS, Low Salary	TDF & SS, Medium Salary	TDF & SS, High Salary
95th	15%	54%	44%	32%	26%	69%	59%	47%	78%	69%	57%
75th	12%	52%	44%	32%	20%	63%	55%	43%	71%	63%	52%
50th	10%	50%	42%	32%	18%	60%	52%	42%	67%	59%	49%
25th	9%	48%	40%	31%	15%	57%	49%	40%	64%	56%	46%
5th	8%	45%	38%	30%	12%	53%	46%	38%	59%	52%	43%

Age 55 Cohort (3% Deferral Rate)

		Cash Only	SS Only, Low Salary	SS Only, Medium Salary	SS Only, High Salary	TDF Only	Cash & SS, Low Salary	Cash & SS, Medium Salary	Cash & SS, High Salary	TDF & SS, Low Salary	TDF & SS, Medium Salary	TDF & SS, High Salary
95th		3%	43%	36%	26%	3%	46%	39%	28%	46%	40%	29%
75th		2%	43%	36%	26%	3%	45%	38%	28%	45%	39%	28%
50th		2%	42%	36%	26%	2%	44%	38%	27%	45%	38%	28%
25th		2%	42%	35%	25%	2%	44%	37%	27%	44%	37%	28%
5th		2%	41%	35%	25%	2%	43%	36%	27%	43%	37%	27%

Age 55 Cohort (6% Deferral Rate)

		Cash Only	SS Only, Low Salary	SS Only, Medium Salary	SS Only, High Salary	TDF Only	Cash & SS, Low Salary	Cash & SS, Medium Salary	Cash & SS, High Salary	TDF & SS, Low Salary	TDF & SS, Medium Salary	TDF & SS, High Salary
95th		5%	43%	36%	26%	7%	48%	42%	31%	49%	42%	32%
75th		4%	43%	36%	26%	5%	47%	40%	30%	48%	41%	31%
50th		4%	42%	36%	25%	5%	46%	40%	29%	47%	40%	30%
25th		4%	42%	35%	26%	4%	46%	39%	29%	46%	40%	30%
5th		3%	42%	35%	25%	4%	45%	38%	29%	45%	39%	29%

Age 25 Cohort- High Earning Growth

3% Deferral Rate
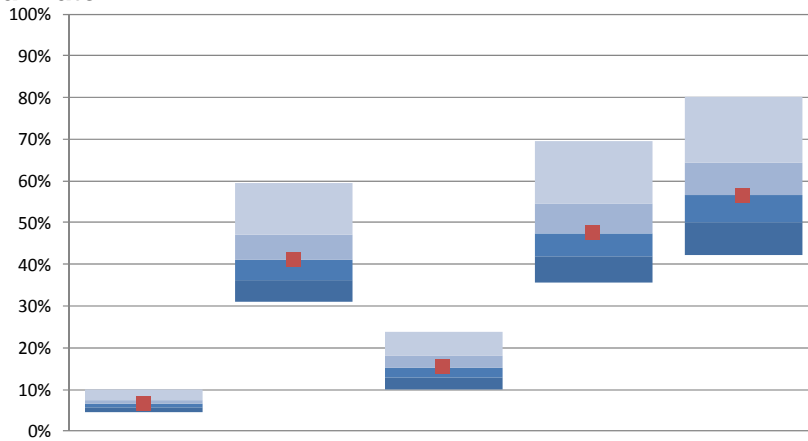
		Cash Only	SS Only	TDF Only	Cash & SS	TDF & SS
95th		10%	59%	24%	69%	80%
75th		8%	47%	18%	55%	64%
50th		7%	41%	15%	47%	57%
25th		6%	36%	13%	42%	50%
5th		5%	31%	10%	36%	42%

6% Deferral Rate
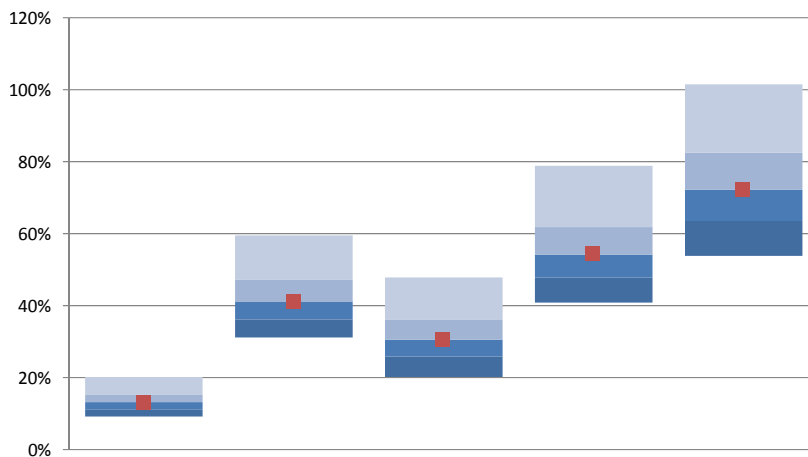
		Cash Only	SS Only	TDF Only	Cash & SS	TDF & SS
95th		20%	59%	48%	79%	101%
75th		15%	47%	36%	62%	83%
50th		13%	41%	30%	54%	72%
25th		11%	36%	26%	48%	64%
5th		9%	31%	20%	41%	54%

Appendix 3

Assumptions reflect August 2015 conditions. Returns shown are based on a 20-year horizon; fixed income returns are significantly below long-term equilibrium due to current low yield environment and expectation of rising rates. Results were adjusted to account for administrative and investment fees consistent with the financial feasibility analysis.

Mean Variance Characteristics										
	Geom Ret	Std Dev	Correlation Matrix							
Asset Class			1	2	3	4	5	6	7	8
Global AC All Cap Equity Unhedged	8.1%	19.5%	1.0	0.0	0.1	0.7	0.6	0.7	0.7	0.0
US Aggregate FI	3.0%	5.3%	0.0	1.0	0.6	0.3	0.0	0.3	0.1	0.1
US Inflation Indexed FI	2.2%	5.4%	0.1	0.6	1.0	0.2	0.1	0.2	0.1	0.1
US High Yield FI	4.9%	9.7%	0.7	0.3	0.2	1.0	0.4	0.5	0.5	0.0
US Natural Resources Stocks	7.3%	22.8%	0.6	0.0	0.1	0.4	1.0	0.4	0.4	0.0
Global Real Estate - REITS	7.3%	21.2%	0.7	0.3	0.2	0.5	0.4	1.0	0.5	0.0
Emerging Markets FI - Local Currency	6.1%	10.4%	0.7	0.1	0.1	0.5	0.4	0.5	1.0	0.0
US Cash	1.7%	2.0%	0.0	0.1	0.1	0.0	0.0	0.0	0.0	1.0

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