

ACHIEVE RETIREMENT GOALS THROUGH INNOVATIVE GLIDEPATH DESIGN

Defined Contribution (DC) plan design has come a long way over the past decade, with auto features and the use of target date funds (TDF) making it easier for participants to save and invest for retirement. At the same time, the amount of assets being invested in target date funds is urging plan sponsors and consultants to take a closer look at how they are built to ensure participants can meet their retirement goals. Our objective in target date design has always been to efficiently fund a participant's retirement liability while maintaining a diversified long-term strategic asset allocation that does not take undue risk.

Our glidepath design and construction process utilizes our asset allocation philosophy, which builds in the importance of financial asset diversification, global equity diversification and inflation sensitivity. Financial assets, which include both risk control and risk assets, are diversified to potentially reduce volatility and seek to protect against down-side market events. In particular, our capital market assumptions continue to highlight the importance of capturing corporate profitability from around the globe through the implementation of portfolios with a global equity market weight. Our focus on inflation sensitivity is fundamental to combating purchasing power erosion over a range of market cycles, with meaningful allocations to a diverse set of inflation sensitive asset classes across our target date glidepath.

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Building upon the components above, we incorporate the impact of human capital on asset allocation and integrate behavioral considerations into our glidepath construction. Additionally, our proprietary income replacement framework helps plan sponsors understand specific, expected liabilities participants need to fund in retirement, and how that translates to target date investing success.

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CAPITAL MARKET ASSUMPTIONS

The asset allocation process starts with the formulation of our capital market assumptions (CMA), which are developed to provide forward-looking, but historically aware, forecasts for global economic activity and financial market returns. These forecasts drive our five-year and longer-term asset class return expectations (We use a longer term horizon to forecast risk and return for the glidepath vintage years). Each year, the CMA group within the Investment Policy Committee (IPC) thoroughly evaluates political, economic and financial market conditions to refresh our five-year capital market assumptions.

From a quantitative lens, these evaluations help us arrive at base case market expectations while serving as a guide to the opportunities and risks our investment team manages. Additionally, we consider a qualitative lens where each year key themes emerge that we believe will affect the economic and financial market landscape. The forecasts of asset classes and understanding of market themes and trends are key elements that directly influence our glidepath design.

STRATEGIC ASSET ALLOCATION

Our strategic asset allocation process is used firm-wide, but distilled for use in specific business segments with unique needs, such as the DC space, where participant demographics and plan sponsor needs are considered in the creation of our target date glidepath. The goal of our strategic asset allocation process is to identify the optimal mix of risk control assets (those used for income and volatility protection) and risk assets (those used for growth) in portfolio construction, in this case a target date framework. The optimization is a critical step in verifying that a portfolio – especially one as dynamic as a target date glidepath – is addressing the right risk at the right time.

The first step in the portfolio optimization process is to categorize strategic asset classes into risk-control assets (term factor) and risk assets (market factor) based on their sensitivity (beta) to these risk factors. Risk-control assets include cash, investment grade bonds and inflation-protected bonds. Risk assets include high-yield bonds, developed global equity, emerging markets equity, natural resources,

listed infrastructure and global real estate. Since term and market factors are uncorrelated and offer different return and risk profiles (low return and risk vs. high return and risk, respectively), we maintain robust diversification across risk environments by relying on risk asset vs. risk control asset sub-portfolios to construct total portfolios.

The second step in the process is to identify the ideal combination of each of the risk-control assets and risk assets sub-portfolios. The optimal combination of risk-control assets is the mix of asset classes that offers the maximum Sharpe ratio (highest return-to-risk) in excess of the risk-free expected return. The optimal combination of risk assets is the mix that offers the maximum Sharpe ratio in excess of the expected return and risk of the risk-control asset sub-portfolio. The market-weighted portfolio of risky assets provides a theoretically sound benchmark to guide asset class constraints. This anchors portfolios to the market (equilibrium) portfolio as the opportunity cost benchmark, while expressing CMA views in the strategic portfolio weights.

Finally, we optimize risk-control assets with risk assets to create a robust efficient frontier of risk-based portfolios comprising different combinations of the two optimally constructed risk factor sub-portfolios.

This strategic asset allocation process provides the foundation for general portfolio construction upon which we apply our goals driven framework. In the case of target date funds it is crucial to fund lifetime goals, i.e., the retirement liability, to produce strong retirement outcomes for participants. Therefore, our process further considers the importance of incorporating the I-CAPM, or intertemporal capital asset pricing model.

Leading financial economists¹ have proposed that an I-CAPM should be the benchmark for multi-period asset allocation, which a target date fund explicitly represents. The I-CAPM redefines the safe asset (which is risk-free in theory) as the one that most safely funds the investor's multi-period liability. The optimal portfolio is a combination of the multi-period safe asset (risk control asset as our proxy) and the market-weighted portfolio of risky assets (risk assets as our proxy), where the relative weighting depends on the investor's risk aversion. Since the I-CAPM incorporates liabilities (goals) and time, it provides a solid theoretical basis for goals based investing, which is designed to optimally fund lifetime goals. In the case of our target date fund, we address the retirement liability as the lifetime goal for the multitudes of DC plan participants we serve.

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¹ See for example Cochrane, "A Mean Variance Benchmark for Intertemporal Portfolio Theory," Journal of Finance (2014).

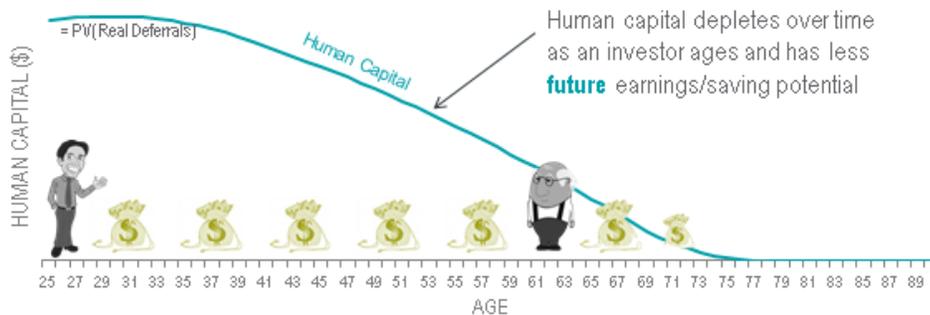
INCORPORATING HUMAN CAPITAL IN PORTFOLIO CONSTRUCTION

A key tenet of our framework is the importance of incorporating human capital in target date portfolio glidepath construction. Human capital is the value of an investor's future earnings potential. It can be considered a non-financial safe asset in terms of portfolio construction and should be taken into account when considering a full view of participants' assets. Human capital is central to the rationale for a dynamic glidepath, or an asset allocation that changes through time. Within the context of the DC market, we need not only consider the value of all future earnings, but also how much of those earnings will be contributed to savings to support future retirement liabilities. As such, we use a robust set of market studies and observations of our client base to determine assumptions for salary, growth of salary, and contribution rates. These assumptions serve as the basis for the human capital assumptions we include in our glidepath construction process.

How does human capital work? Exhibit 1 provides a visual illustration of this concept. At the beginning of a participant's career, human capital often has its greatest flexibility and time advantage, and therefore provides participants with the greatest exposure to non-financial safe assets. As an investor ages and has less future earnings in front of them, their amount of human capital depletes. Upon retirement, human capital is almost completely depleted, with a small amount remaining should the participant choose to re-enter the workforce. Human capital, in combination with the financial portfolio, is a key driver in considering how to fund the liability or goal of retirement.

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Exhibit 1 – Human Capital



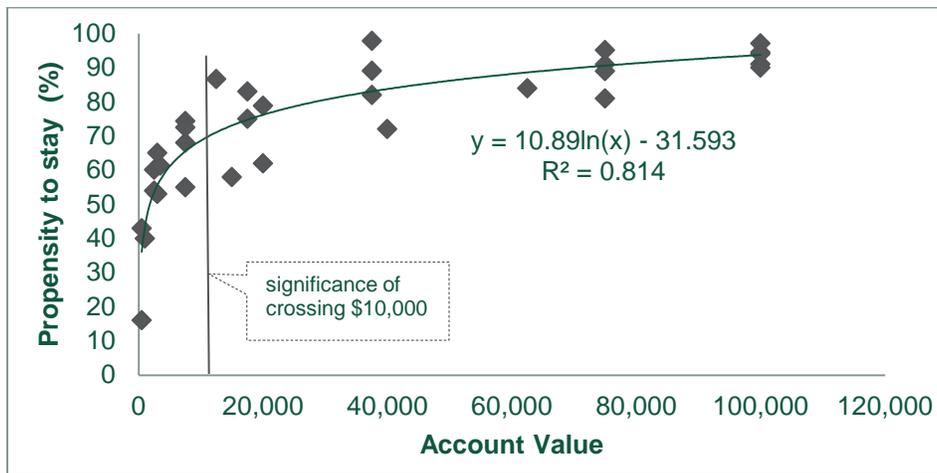
INCORPORATING INVESTOR BEHAVIOR IN PORTFOLIO CONSTRUCTION

Retirement preparation is a long journey. The ultimate success hinges on rational, disciplined efforts. Investors, however, often exhibit biases in reality and deviate from the optimality.

Building confidence and establishing a strong savings commitment from participants is a significant, and often overlooked, hurdle in a participant's retirement savings journey. Our analysis reveals an empirical pattern of participants dropping out of DC plans in reverse correlation with their account values.

Exhibit 2 plots workers' propensity to stay in a retirement plan. The fitted curvature shows remarkable sensitivity of participant action. At the initial stage of asset accumulation a small gain may strongly encourage participants to stay committed to their retirement savings journey, while conversely a small loss may disproportionately touch a nerve and trigger abandonment.

Exhibit 2: Propensity to Stay in a Retirement Plan



Source: The scatter plot is based on the data from academic and industry reports. A logarithmic regression is used to fit the curve. See Sabrina Bailey and Gaobo Pang, "The \$10,000 Hurdle," for details, updated in February 2019.

The peril of having as low as \$1,000 is that it is likely perceived as "play money" and spent upon job separation. Such leakage risk is reduced when participants have gathered \$5,000 in retirement savings, but still remains elevated. The leap to \$10,000 in retirement savings is a meaningful milestone for participants, slashing the drop-out rate by half.

The significance of crossing the \$10,000 hurdle is that it mentally triggers a stronger sense of accomplishment and thus incentivizes commitment to the retirement savings journey. As the research shows, the likelihood of remaining committed to retirement savings increases to 97% when a participant crosses \$100,000. Additionally, it forms a more solid economic basis to garner the tax deferral benefit. This self-reinforcing cycle will likely lead to better participant outcomes.

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1 + 2 + 3: FINANCIAL ASSETS + HUMAN CAPITAL + INVESTOR BEHAVIOR

Along the glidepath, the value of human capital and value of the retirement liability (a.k.a., target retirement income) drive the financial asset allocation of the participant's retirement portfolio. We determine the required level of total safe assets in line with both risk preference and the retirement liability, at each point on the glidepath. Safe assets are defined as human capital (non-financial asset) and risk-control assets (financial asset), each of which are "bond-like" in nature.

In the early part of the glidepath, all of a worker's assets can be considered "owned" in the form of future earnings potential, or human capital. With this framework, their savings or "financial" capital should typically be directed to a portfolio invested heavily in risk assets to provide the highest potential for portfolio growth. As a worker ages and their human capital declines, a shift from risk assets to risk-control assets is needed to meet the total safe asset requirement. It is this mechanism which drives the trade-off of the financial asset allocation between risk control assets and risk assets across the participant's investing lifecycle.

In other words, there is a steady reduction of assets owned in the form of risk assets, and this is how the "shape" of the financial assets glidepath is formed. Once there is no potential to re-enter the workforce and human capital is fully depleted, the asset allocation "lands" at a point where the risk preference is fully expressed through financial assets.

Simultaneously, we consider the impact of investor behavior. While the consideration of human capital could potentially lead to a glidepath that has the highest concentration of risk assets for the youngest participants, the empirical evidence we provided for participant behavior implies a rush to highly aggressive portfolios may be counterproductive. We have to ask ourselves if we are taking the right risk at the right time to lead to the highest likelihood of successful retirement outcomes for participants. Remember that a participants' retirement outcome is not only based on the prospect of their retirement portfolio to generate growth, but their willingness to stay committed to the retirement savings journey over time.

Consider for a moment times of financial stress. During these times large negative swings in account values could project the \$10,000 hurdle as insurmountable for workers just beginning their retirement savings journey.

A conservative asset allocation at the front end of the glidepath, provides a smoother path and encourages participants to stay calm and remain committed to their journey. Our glidepath starts with a lower risk

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asset exposure and ramps up towards workers' mid-career (from 91% to 94%) when they tend to have greater capacity and willingness to take risks in the pursuit of wealth accumulation. The gradual increase intends to strike a balance to accommodate investors' sense of opportunities and perceived risks in the markets.

What is the "cost," or forgone wealth accumulation, of a conservative glidepath on retirement outcomes? Our research shows that the notional cost of a more conservative glidepath for younger participants is minor. It does not mean much sacrifice of growth or missed opportunity because salaries, and therefore contributions, and account balances are typically at the lowest levels in a personal savings journey at this point of time. The encouragement to stay in the plan is a precondition for the powerful compounding impact of savings growth to materialize in later years when the forthcoming contributions and balances are much greater.

RETIREMENT INCOME FRAMEWORK

Throughout this paper we have mentioned our incorporation of retirement liabilities as part of our glidepath construction. We determine the appropriate retirement liability by asking what level of retirement income workers should aim for.

Our asset allocation provides a predicted value of the portfolio at the time of retirement that is expected to be sufficient to fund the liability, or income needed during retirement.

Most target date glidepath designs focus on growth of participant assets in the accumulation phase. They largely defer the question regarding what is a meaningful retirement – consumption needs or desired income – to a separate discussion. To address this dichotomy, Northern Trust incorporates participants' anticipated consumption needs into the glidepath construction and calibrates investments in an asset-liability matching fashion.

In order to accomplish this we developed a proprietary framework to estimate required savings and a target replacement rate (retirement income as a percentage of pre-retirement earnings) for workers while maintaining standards of living before and after retirement. To make this benchmark sufficiently close to reality, our framework takes into account salient features of law, regulations, and lifecycle spending patterns. Among other specifics, the following institutional components are carefully coded in the framework.

Taxes. Our framework incorporates the details of federal income tax (i.e., income brackets, tax rates, and standard deductions under the Tax Cut and Jobs Act of 2017) and payroll taxes for Social Security and Medicare. Payroll taxes cease to apply in retirement and income taxes

Northern Trust incorporates participants' anticipated consumption needs into the glidepath construction and calibrates investments in an asset-liability matching fashion

may experience a significant drop upon retirement depending on the income levels.

Social Security. Most U.S. workers count on Social Security (SS) as the first pillar of retirement. Benefits vary with the covered workers' lifetime earnings level, birth cohort, and retirement age. Social Security has a progressive benefit formula so that the relatively lower paid workers receive a greater replacement rate from SS. The monthly benefit is higher if a worker delays retirement (up to age 70) because of the actuarial adjustment.

Lifecycle Expenses. Our framework captures the hump shape of expenses over one's lifecycle and the noticeable reductions upon retirement, particularly in food, clothes, and transportation spending.

Health Care Costs. Insurance premiums and out-of-pocket expenses are based on the most recent data. Various subsidies under the Affordable Care Act (ACA) are coded in the framework and linked to incomes relative to federal poverty line.

The above tax obligations are mainly mandatory and most of the lifecycle expenses are largely for subsistence. Thus, the equilibrium criterion in the framework for maintaining the same lifestyle is defined by the discretionary consumption, which is financed by the remainder of income after workers have paid for those indispensables and carved out retirement savings.

Our framework can accommodate specific situations for plan sponsors and participants, such as retirement plan provisions, worker earnings and demographics, and expected investment returns. It computes required savings rate and target replacement rate for a plan or an individual.

Exhibit 3 illustrates the retirement planning guidelines for a representative worker with assumptions listed in the notes below.

Exhibit 3 - Illustrative Savings and Replacement Rates

Retirement age	Savings rate (%)#	Replacement rate (% of final pay)		
		SS	DC	Total
Baseline scenarios				
62	12.1	33.1	42.8	75.9
65	8.8	37.9	41.7	79.6
67	7.2	41.6	40.3	81.9
Alternative scenarios, relative to the baseline				
Employer 50% match, up to 6% of pay				
67	7.6	41.6	42.3	83.8
Lower expected return 5.5%				
67	8.8	41.6	38.9	80.5
Initial earnings \$75,000				
67	7.7	35.1	42.9	77.9

Notes: # Combined employer and employee contributions. Baseline assumptions: CPI inflation 2.5%, National Average Wage Index (NAWI) growth = CPI+1%; Single worker, \$45,000 initial earnings at age 25, annual pay raise = NAWI growth until age 55, then CPI+0.25% until retirement; Constant 6.5% nominal asset return for simplicity; Annuity pricing: 5% interest rate, 10% load, annuitant RP-2014 life table, indexed to inflation; Health care cost inflation: CPI+1.5%. Source: Northern Trust Asset Management.

A few observations are worth highlighting. If the worker planned to work until age 67, the normal retirement age for Social Security, she would get full SS benefits and be able to reach a higher replacement rate than otherwise. The longer career gives her the potential to garner investment returns over time. Conversely, if she planned to retire earlier, she would have to save noticeably more; and her target replacement rate would be lower because:

- SS benefits would be reduced by the actuarial formula,
- Wealth would be spread over a few more years in retirement, and
- She would have a shorter time period to save and accumulate assets

If the plan sponsor provided matching contributions, that would help share the worker's duty to save and at the same time boost the worker's aspiration (a higher replacement rate). If a lower investment return were assumed, thus less power of return compounding, the worker would have to save more and lower her income expectation. If the worker were better paid, she would face a greater personal responsibility for retirement finance, given that her SS benefits would replace a smaller portion of pre-retirement earnings.

Our proprietary retirement income framework provides us with robust guidelines that we incorporate into our target date glidepath. It serves as a differentiator from the market as participants' replacement rates are no longer defined as an industry rule of thumb, rather they are developed based on the goal of helping participants maintain their standard of living to and through retirement. This framework, which forms the bases for using participant

demographics to truly customize desired outcomes, offers confidence for plan sponsors that we have constructed our target date funds to work for participants.

Target Date Funds Oversight: Investment Management Process

Overseeing this activity is Northern Trust's Investment Policy Committee (IPC), where the CMAs and Strategic Asset Allocation frameworks are set. These components flow down to the Multi-Asset Oversight Committee (MAOC), (formerly the Investment Model Oversight Committee), which has responsibility for monitoring and managing all multi-asset class strategies at Northern Trust, most specifically, our Focus Funds glidepath. The MOAC is comprised of senior investment professionals, such as our chief investment officer, chief administrative officer, senior investment strategists, the head of investment solutions and the head of investment strategy for retirement solutions, among others. The MOAC is responsible for managing the glidepath in four distinct areas: Monitoring, Evaluation, Validation and Communication.

The monitoring phase is ongoing, analyzing the quarterly performance of the Focus Funds and the underlying components in order to review adherence to tracking error guidelines. The Evaluation phase is where the MOAC spends most of its time on an annual basis, taking input from the annual CMA process. The CMA process refreshes Northern Trust's view on our market outlook, from a quantitative, qualitative and thematic viewpoint. This information gets distilled down into the strategic asset allocation of the glidepath, where enhancements may or may not be made on an annual basis, always taking into consideration the long term nature of a participant who must save and invest over a 40+ year working and retirement timeframe. Once any glidepath changes have been introduced, we verify the impact these changes may have on participant outcomes through our third phase, validation. We use a Monte Carlo simulation, running over 10,000 scenarios, to determine a range of potential accumulated retirement account balances as a result of investing in the Focus Funds. This helps us in determining the probability that the asset allocation set forth in the Focus Funds will potentially be sufficient to help participants replace required amounts of pre-retirement income in retirement. Finally, our process would not be complete without communicating effectively to our plan sponsor and consultant clients so that they are prepared for any

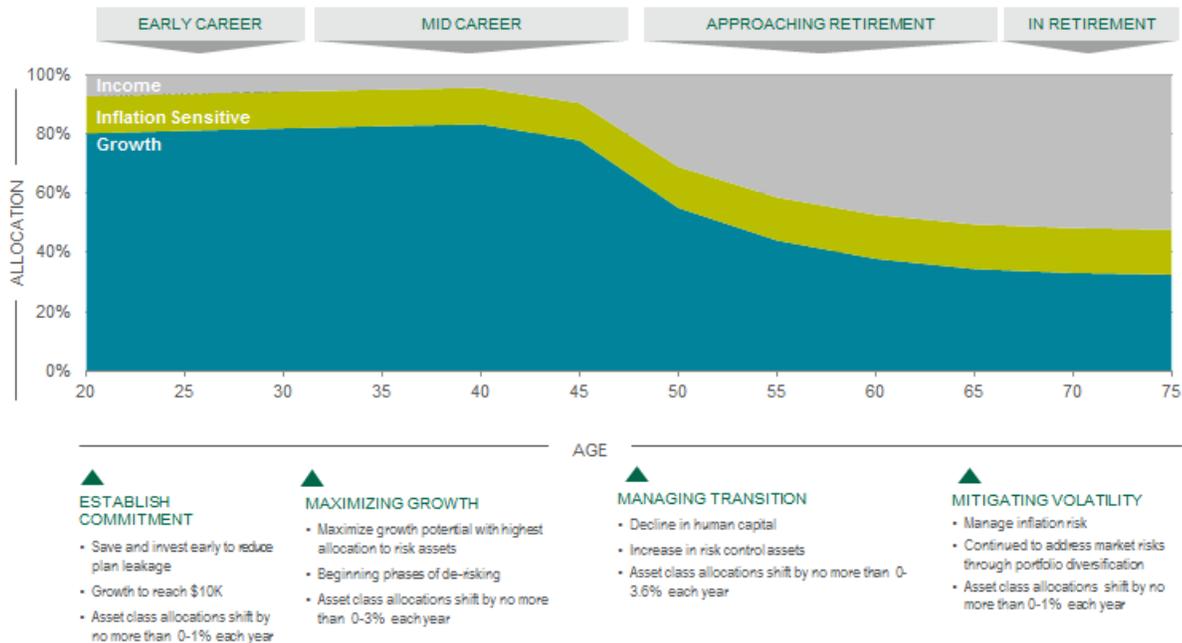
NORTHERN TRUST GLIDEPATH

The shape of our glidepath, shown in Figure 4 begins with the foundation of our asset allocation philosophy, emphasizes the importance of financial asset diversification, and incorporates the interplay of human capital, investor behavior and retirement income targets in its construction. It is differentiated and non-linear, driven by these elements and in particular, lifecycle theory.

Lifecycle theory posits that human capital starts high, declines with age, and is generally bond-like. This supports the use of risk assets (e.g., equities) in pursuit of growth over the long term and calls for a shift to risk control assets that provide downside protection when human capital is diminishing. The theory forms the backbone for investing in a dynamic glidepath. One could aggressively seek growth at the onset of career, but the gain is likely immaterial given the typically low account balance. The perceived high risk, however, could stir sensitivity among younger participants, triggering drop-out if their account value sank significantly. Maximizing asset accumulation around mid-career is likely

a smart strategy. Labor earnings and contributions serve as cushions for potential loss, and there is still time for the market to recover. Seeking growth towards the end of a career is risky, whereas the expected gain could be substantial but the cushion of labor earnings ceases to apply, unless the worker has capacity and flexibility to rearrange retirement.

Exhibit 4: Target Date Glidepath



SUMMARY

In addition to higher participation rates and auto features, innovative glidepath construction is critical to achieve strong retirement outcomes for defined contribution plan participants. Our thoughtful, deliberate approach estimates consumption needs for representative workers, factors them into the glidepath construction, and calibrates investments in an asset-liability matching fashion. This is facilitated by the integration of our retirement income framework and goals-based investing approach, which sets a lifelong financial plan with well-defined objectives and a great chance of success.

APPENDIX:

Exhibit 8: Glidepath Allocations by Vintage Year as of January 2019

TARGET DATE VINTAGE YEAR		2060	2055	2050	2045	2040	2035	2030	2025	2020	2015	Income
GROWTH	US Equity – MSCI US IMI	39.8%	40.2%	40.6%	41.0%	41.3%	38.6%	27.3%	21.9%	18.8%	17.1%	16.2%
	Non US Equity – MSCI ACWI ex-US	34.9%	35.2%	35.6%	35.9%	36.2%	33.8%	23.9%	19.2%	16.5%	15.0%	14.2%
	U.S. High Yield	5.5%	5.5%	5.6%	5.6%	5.7%	5.3%	3.8%	3.0%	2.6%	2.3%	2.2%
	TOTAL GROWTH	80.1%	81.0%	81.8%	82.5%	83.2%	77.8%	55.0%	44.1%	37.9%	34.4%	32.6%
INFLATION SENSITIVE	Global Real Estate	1.8%	1.8%	1.9%	1.9%	1.9%	1.8%	1.3%	1.0%	0.9%	0.8%	0.7%
	Global Infrastructure	1.8%	1.8%	1.9%	1.9%	1.9%	1.8%	1.3%	1.0%	0.9%	0.8%	0.7%
	Global Natural Resources	7.3%	7.4%	7.4%	7.5%	7.6%	7.1%	5.0%	4.0%	3.4%	3.1%	3.0%
	US TIPS 1-10 Year	1.5%	1.4%	1.2%	1.1%	0.9%	2.0%	6.4%	8.5%	9.7%	10.3%	10.7%
	TOTAL INFLATION SENSITIVE	12.4%	12.4%	12.4%	12.3%	12.3%	12.6%	13.9%	14.5%	14.8%	15.0%	15.2%
INCOME	US Aggregate Bond	7.5%	6.6%	5.8%	5.2%	4.5%	9.7%	31.1%	41.4%	47.3%	50.5%	52.3%
	TOTAL INCOME	7.5%	6.6%	5.8%	5.2%	4.5%	9.7%	31.1%	41.4%	47.3%	50.5%	52.3%
TOTAL		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

NORTHERN TRUST RETIREMENT SOLUTIONS

As one of the largest managers of DC assets in the United States, our team has deep expertise in developing innovative answers to challenges faced by many of the world's largest DC plan sponsors. Collectively, these sponsors have entrusted us to manage more than \$191 billion and to provide custody and administrative services for more than \$514 billion in DC assets as of June 30, 2019. We take a consultative approach to addressing the needs of plan sponsors and participants while offering a suite of solutions – including an inflation-sensitive asset fund and target date funds – aimed at improving retirement outcomes.

NORTHERN TRUST ASSET MANAGEMENT

As a leading global asset management firm, our investment expertise, strength and innovation have earned the trust and confidence of the world's most sophisticated institutional and individual investors.

With \$975 billion in total assets under management,² and a long standing history of solving complex challenges, we believe our strength and stability drive opportunities for our clients. Our comprehensive asset class offering includes passive, factor-based, fundamental active and multi-asset class solutions that are available in a variety of investment vehicles. Learn more at northerntrust.com/strength.

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² As of June 30, 2019

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