

NEW YORK STATE
TEACHERS' RETIREMENT SYSTEM
MEMORANDUM

To: Retirement Board Date: October 30, 2019
From: R. Young
Subject: Lowering the System's Valuation Rate of Interest Assumption and
Updating of the Mortality Improvement Scale for the Actuarial Valuation
as of June 30, 2019
Cc: T. Lee, J. Indelicato, S. Pangburn

The Valuation Rate of Interest Assumption

The valuation rate of interest, or discount rate, is used to determine the present value of future benefit payments calculated within the actuarial valuation. It is the single most important actuarial assumption, and has a dramatic impact on the actuarial valuation results, including the employer contribution rate (ECR). Even a small change in the rate can lead to a meaningful change in the ECR. Lowering the interest rate assumption has the effect of increasing plan liabilities, and ultimately the ECR. Lowering this assumption implies the System expects to earn less money on its investments in the future and will therefore require higher contributions.

The history of NYSTRS valuation rate of interest assumption since 1980 is as follows:

<i>NYSTRS History of the Valuation Rate of Interest Assumption</i>	
<u>Fiscal Year</u>	<u>Return Assumption</u>
1980	4.50%
1981	6.75%
1982	6.75%
1983	6.75%
1984	6.75%
1985	7.25%
1986	7.25%
1987	7.25%
1988 – 2014	8.00%
2015 - 2016	7.50%
2017 - 2018	7.25%

The System's current valuation rate of interest assumption is 7.25% per annum.

A decrease in the valuation rate of interest assumption to 7.10% is recommended at this time.

Asset Allocation

The System’s current asset allocation, approved by the Retirement Board at its meeting on July 31, 2019, is provided below. This allocation is set by the Retirement Board and reviewed annually. Asset allocation changes, if any, are typically of an incremental nature and not large in scale.

<i>Asset Class</i>	<i>Allocation Target Percentage</i>	<i>Permitted Range</i>
Domestic Equity	33.0%	29.0% – 37.0%
International Equity	16.0%	12.0% – 20.0%
Global Equity	4.0%	0.0% - 8.0%
Real Estate	11.0%	6.0% – 16.0%
Private Equity	<u>8.0%</u>	3.0% – 13.0%
<i>Total Equity</i>	72.0%	
Domestic Fixed Income	16.0%	12.0% – 20.0%
Global Fixed Income	2.0%	0.0% – 3.0%
Real Estate Debt	7.0%	3.0% – 11.0%
High Yield Bonds	1.0%	0.0% - 3.0%
Private Debt	1.0%	0.0% - 5.0%
Cash Equivalents	<u>1.0%</u>	0.0% – 4.0%
<i>Total Fixed Income</i>	28.0%	

Historical Rates of Return

The System’s historical annualized rates of return, net of expenses, for periods ending on June 30, 2019, are provided in the table below.

<i>NYSTRS Historical Annualized Rates of Return through June 30, 2019</i>	
<u>Return Period</u>	<u>Annualized Rate of Return (net of expenses)</u>
1 year	7.1%
3 years	9.5
5 years	7.2
10 years	10.4
15 years	7.5
20 years	6.3
25 years	8.7
30 years	8.8

Expected Returns

The System's investment consultant, AON Hewitt, annually provides their long-term expected rates of return and standard deviations, by asset class and for the total fund. These projected returns represent their current expectations over a 30-year time horizon. Combined together, along with corresponding asset class correlations, the expected annual rate of return for the total portfolio as of the first quarter of 2019 was 7.2% on a geometric basis and 7.8% on an arithmetic basis. The expected annual rate of return for the total portfolio as of the second quarter of 2019 was 7.0% on a geometric basis and 7.6% on an arithmetic basis. The average of these two expected long-term geometric returns is 7.1%. AON Hewitt's exhibits illustrating these outcomes are attached to this memo as Attachments 1 and 2.

Additionally useful in this regard are stochastic simulations that Cheiron Consulting performed for the System. In the stochastic simulation modeling over five thousand different future investment outcomes are generated based on the System's specific asset allocation. In one simulation set the AON Hewitt capital market assumption projections were used, while in another simulation set the Horizon Actuarial Survey capital market assumption projections were used. Horizon surveys investment consultants and provides data with respect to the average of their investment return expectations by asset class. For the 2019 Horizon survey 16 different investment consultants provided long-term (20-year) investment return forecasts. Cheiron Consulting's Report "2019 Stochastic Investment Return Projections – October 2019" is attached to the memo as Attachment 3.

- The stochastic simulation run using AON Hewitt's capital market assumptions produced a return set with a distribution that had a 50th percentile that settled around a return of 7.0% in 20 years. The returns' 25th to 75th percentile range was 5.1% to 8.8%.
- The stochastic simulation run using the Horizon survey capital market assumptions produced a return set with a distribution that had a 50th percentile that settled around a return of 7.4% in 20 years. The returns' 25th to 75th percentile range was 5.6% to 9.1%.

Valuation Interest Rate Conclusion

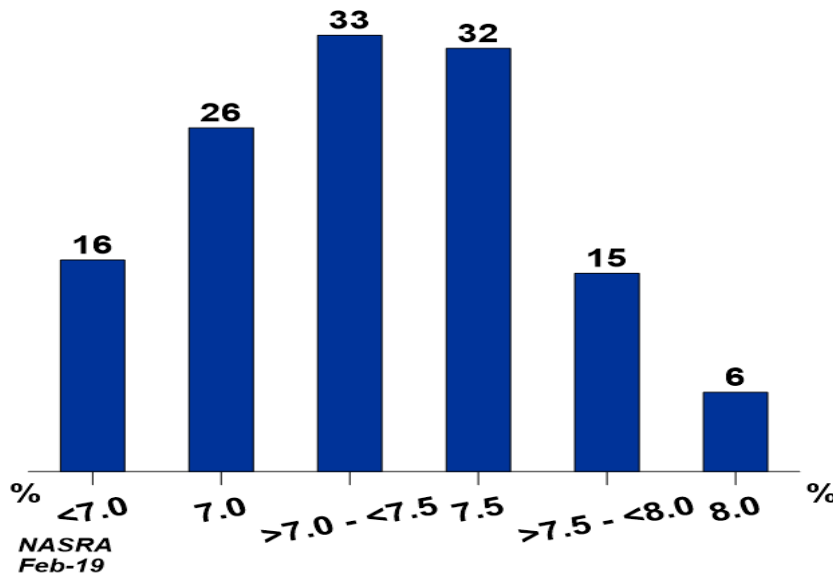
Based on this stochastic analysis as well as the static long-term projections I recommend a valuation interest rate assumption of 7.10%. This is between the two long-term 50th percentile returns discussed above, with a slight bend toward the conservative end of the range.

Other Retirement Systems

The trend across the country has been the lowering of investment return assumptions. The National Association of State Retirement Administrators (NASRA) maintains a public fund database providing data on 128 of the state (and some large municipal) retirement systems. According to the most recent NASRA Issue Brief on the subject (February 2019), more than

90% of survey participants have lowered their assumed rate of return since 2010. Additionally, more than 30% have lowered their assumed rate of return since February of 2018. The bar graph below from the NASRA Issue Brief shows the distribution of investment return assumptions used. The number of Systems using an investment return assumption of 8.0%, or in the 7.5% to 8.0% band, has fallen by more than half since February of 2017. The average investment return assumption has declined from 7.91% in 2010 to 7.28% as of the survey date. Some Systems have lowered their return assumptions since.

Distribution of Investment Return Assumptions – February 2019 (NASRA Issue Brief)



Large public funds CalPERS and CalSTRS have both lowered their assumed rates of return to 7.0% in recent years. Locally in New York State, the New York City Retirement Systems use an assumption of 7.0%, while the New York State and Local Retirement System has just recently lowered their return assumption to 6.8% (after the NASRA Survey).

Impact on other economic assumptions

There are several other economic assumptions that relate to the assumed investment rate of return and for completeness they have also been examined. The recommendation for each of these other economic assumptions is as follows:

- Assumption for Inflation – Inflation assumption is lowered from 2.25% to 2.20%.
- Salary Scale – no change is recommended at this time.
- Assumed COLA - the assumed rate of COLA increase is lowered from 1.5% to 1.3%.
- “Hurdle rate” for the actuarial value of assets method – this rate is equal to the assumed rate of return and will therefore change as appropriate.

The assumed investment rate of return as well as other economic assumptions were determined in accordance with Actuarial Standard of Practice (ASOP) No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*. ASOP No. 27 provides guidance on the selection of appropriate economic assumptions.

Change in Mortality Improvement Scale

I am recommending a change in the mortality improvement scale from MP-2014 to MP-2018. The healthy annuitant and disabled annuitant mortality assumptions consist of two parts, a base table, which is constructed based upon the experience of the System's membership, and a mortality improvement scale. The job of the mortality improvement scale is to estimate the impact of incremental improvements in mortality that are expected to take place over future decades. This scale is developed by the Society of Actuaries.

The effect of this change is actually to lower plan liabilities as MP-2018 represents a dialing back of mortality improvement. The actual rate of mortality improvement in recent years has been lower than that projected back in 2014.

Impact on the Employer Contribution Rate (ECR)

The current ECR is **8.86%** of pay (the result of the June 30, 2018 actuarial valuation, applicable to fiscal year '19-'20 salaries). At this time our estimate of the next ECR (the result of the June 30, 2019 actuarial valuation) using the 7.10% return assumption as well as the other assumptions mentioned, is between **9.25% and 10.25%** of pay.

Unless specifically stated herein, all other assumptions (rates of mortality, withdrawal, disability and salary increase) remain unchanged from the "Report on the 2015 Recommended Actuarial Assumptions" issued October 15, 2015.

30-Year Return Update: Geometric and Arithmetic Averages

Asset Class	Target	1Q19 Return Assumptions		Risk Assumptions
		Geometric	Arithmetic	1Q19
U.S. Equity ¹	33%	7.2%	8.7%	18.4%
Non-U.S. Equity ²	16%	8.4%	10.3%	20.6%
Global Equity	4%	8.0%	9.6%	19.0%
Real Estate Equity ³	11%	6.2%	7.0%	12.5%
Private Equity	8%	9.6%	12.2%	24.5%
Private Debt	1%	7.9%	9.2%	17.0%
Core U.S. Fixed Income	16%	3.6%	3.7%	5.0%
Global Fixed Income ⁴	2%	3.3%	3.3%	3.9%
Real Estate Debt ⁵	7%	5.1%	5.3%	5.5%
High Yield Bonds	1%	5.7%	6.4%	12.0%
Cash Equivalents	1%	2.7%	2.7%	2.0%
Total NYSTRS	100%	7.2%	7.8%	12.3%

1 Modeled as 80% large cap / 20% small cap

2 Modeled as 75% non-US developed markets / 25% emerging markets

3 Modeled as 55% core private real estate / 30% non-core private real estate / 15% REITs

4 Modeled as 60% non-US developed bonds (hedged) / 40% core US fixed income

5 Modeled as 80% commercial mortgages / 20% private mezzanine debt

30-Year Return Update: Geometric and Arithmetic Averages

Asset Class	Target	2Q19 Return Assumptions		Risk Assumptions
		Geometric	Arithmetic	2Q19
U.S. Equity ¹	33%	7.0%	8.5%	18.4%
Non-U.S. Equity ²	16%	8.1%	10.0%	20.7%
Global Equity	4%	7.8%	9.4%	19.0%
Real Estate Equity ³	11%	6.1%	6.8%	12.5%
Private Equity	8%	9.5%	12.1%	24.5%
Private Debt	1%	7.4%	8.7%	17.0%
Core U.S. Fixed Income	16%	3.4%	3.5%	5.0%
Global Fixed Income ⁴	2%	3.1%	3.1%	4.0%
Real Estate Debt ⁵	7%	4.9%	5.1%	5.6%
High Yield Bonds	1%	5.1%	5.8%	12.0%
Cash Equivalents	1%	2.5%	2.5%	1.5%
Total NYSTRS⁶	100%	7.0%	7.6%	12.3%

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6 Inflation is 2.2%

New York State Teachers' Retirement System

2019 Stochastic Investment Return Projections

October 2019

Capital Market Assumptions (CMAs)



- This analysis is based on CMAs from
 - Aon Hewitt CMAs for 2Q19
 - Horizon Actuarial Services 2019 Survey of CMAs
- The study also uses the target asset allocation resulting from AON's April 2019 asset allocation study, as follows:

Asset Class	Target Allocation
U.S. Equity	33%
Non-U.S. Equity	16%
Global Equity	4%
Real Estate Equity	11%
Private Equity	8%
Private Debt	1%
Core U.S. Fixed Income	16%
Global Fixed Income	2%
Real Estate Debt	7%
High Yield Bonds	1%
Cash Equivalents	1%

Assumed Rate of Investment Return



- The table below shows the probability of meeting or exceeding a given investment return based on Aon Hewitt's 30-year horizon CMAs with a 30-year measurement period

Probabilities of Meeting Alternative Investment Return Assumptions

Investment Return Assumption	6.97%	7.00%	7.10%	7.25%	7.50%	7.75%
Probability of Meeting or Exceeding the Assumption	50%	49%	48%	45%	41%	36%

- The table below shows the probability of meeting or exceeding a given investment return based on Horizon's 20-year horizon CMAs with a 30-year measurement period

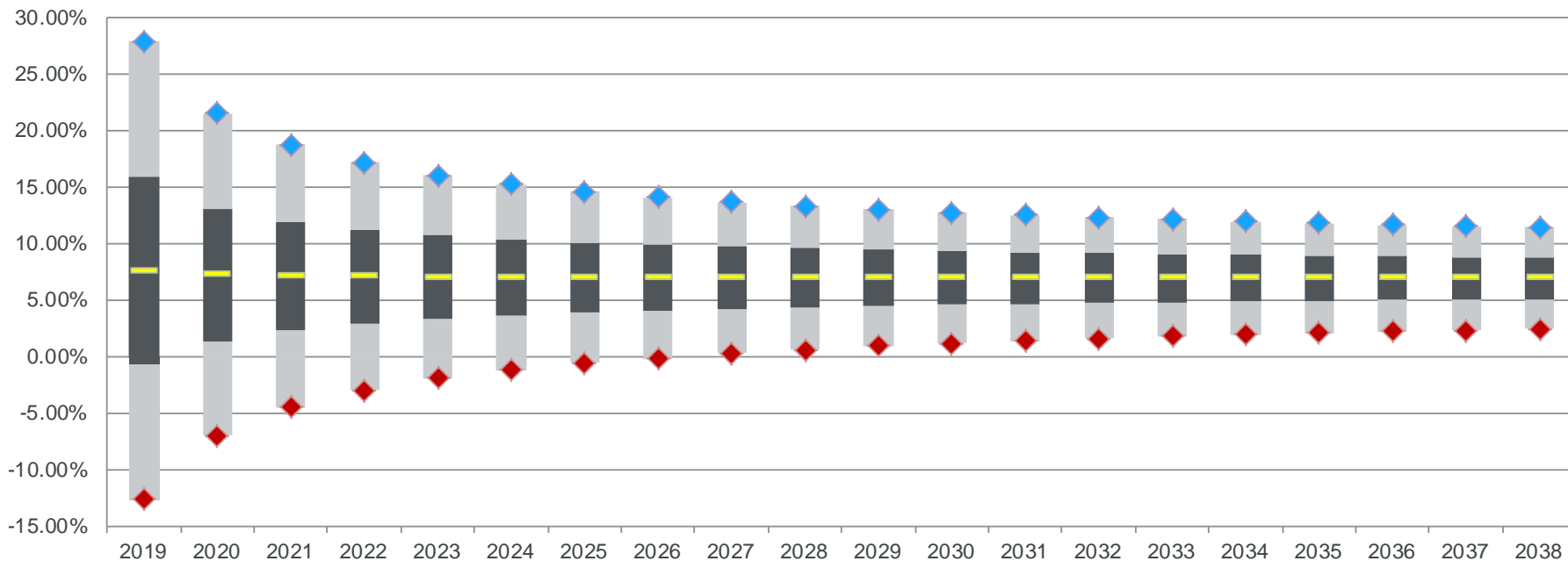
Probabilities of Meeting Alternative Investment Return Assumptions

Investment Return Assumption	7.37%	7.00%	7.10%	7.25%	7.50%	7.75%
Probability of Meeting or Exceeding the Assumption	50%	57%	55%	52%	48%	43%

Investment Return – Aon Hewitt CMAs



Projected Cumulative Investment Return for Plan Years Ending June 30

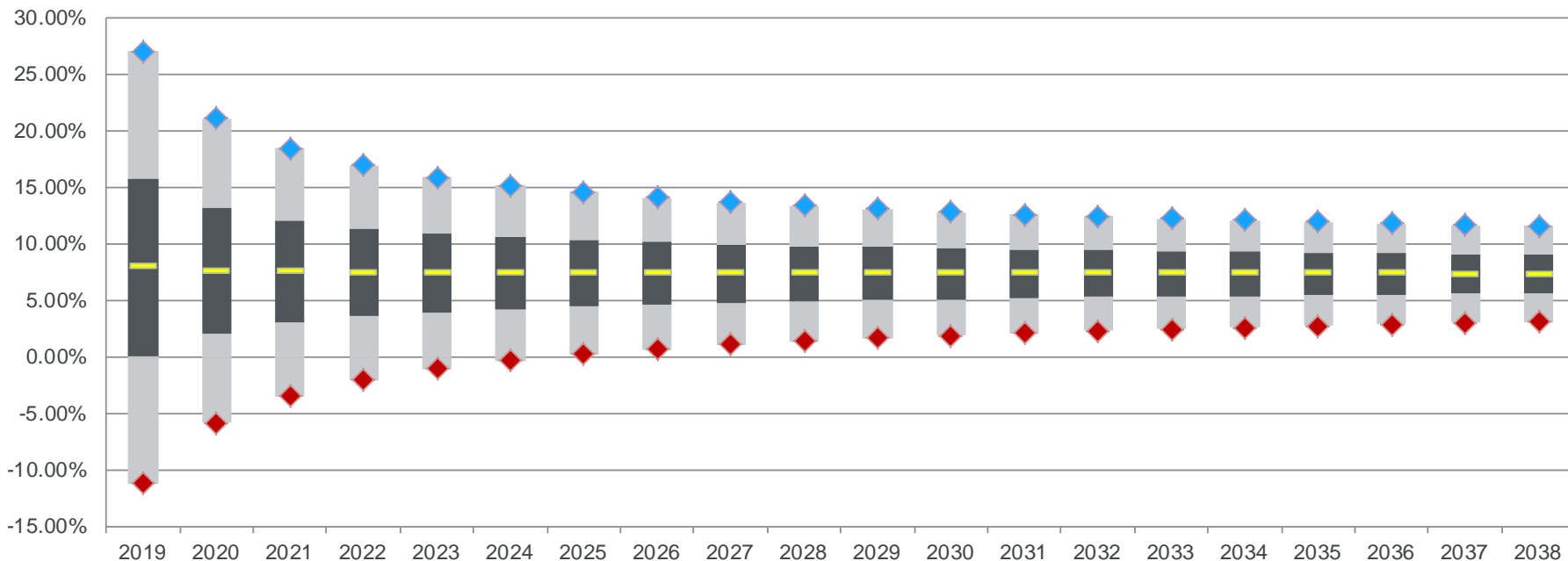


	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
95%	27.9%	21.6%	18.8%	17.2%	16.1%	15.3%	14.6%	14.1%	13.7%	13.4%	13.1%	12.8%	12.6%	12.4%	12.2%	12.0%	11.9%	11.7%	11.6%	11.5%
75%	16.0%	13.1%	11.9%	11.2%	10.8%	10.4%	10.2%	9.9%	9.8%	9.6%	9.5%	9.4%	9.3%	9.2%	9.1%	9.0%	9.0%	8.9%	8.9%	8.8%
50%	7.6%	7.3%	7.2%	7.1%	7.1%	7.1%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
25%	-0.7%	1.5%	2.4%	3.0%	3.4%	3.7%	3.9%	4.1%	4.3%	4.4%	4.5%	4.6%	4.7%	4.8%	4.9%	4.9%	5.0%	5.0%	5.1%	5.1%
5%	-12.6%	-7.0%	-4.4%	-2.9%	-1.9%	-1.1%	-0.5%	-0.1%	0.3%	0.7%	1.0%	1.2%	1.4%	1.6%	1.8%	2.0%	2.1%	2.3%	2.4%	2.5%

Investment Return – Horizon CMAs



Projected Cumulative Investment Return for Plan Years Ending June 30



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
95%	27.1%	21.1%	18.5%	17.0%	16.0%	15.2%	14.6%	14.1%	13.7%	13.4%	13.1%	12.9%	12.7%	12.5%	12.3%	12.1%	12.0%	11.8%	11.7%	11.6%
75%	15.8%	13.2%	12.1%	11.4%	11.0%	10.6%	10.4%	10.2%	10.0%	9.9%	9.7%	9.6%	9.6%	9.5%	9.4%	9.3%	9.3%	9.2%	9.2%	9.1%
50%	8.0%	7.7%	7.6%	7.5%	7.5%	7.5%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%
25%	0.1%	2.1%	3.1%	3.6%	4.0%	4.3%	4.5%	4.7%	4.8%	5.0%	5.1%	5.2%	5.2%	5.3%	5.4%	5.4%	5.5%	5.6%	5.6%	5.6%
5%	-11.1%	-5.8%	-3.4%	-2.0%	-1.0%	-0.3%	0.3%	0.7%	1.1%	1.4%	1.7%	1.9%	2.1%	2.3%	2.5%	2.7%	2.8%	2.9%	3.0%	3.1%

2019 Aon Hewitt CMAs and Target Allocation



Aon Hewitt Asset Class (30 year Horizon)	Target Allocation	Arithmetic Return	Geometric Return	Standard Deviation
US Equity ¹	33.0%	8.50%	7.00%	18.40%
Non-US Equity ²	16.0%	10.00%	8.10%	20.70%
Global Equity	4.0%	9.40%	7.80%	19.00%
Real Estate Equity ³	11.0%	6.80%	6.10%	12.50%
Private Equity	8.0%	12.10%	9.50%	24.50%
Private Debt	1.0%	8.70%	7.40%	17.00%
Core US Fixed Income	16.0%	3.50%	3.40%	5.00%
Global Fixed Income ⁴	2.0%	3.10%	3.10%	4.00%
Real Estate Debt ⁵	7.0%	5.10%	4.90%	5.60%
High Yield Bonds	1.0%	5.80%	5.10%	12.00%
Cash ⁶	1.0%	2.50%	2.50%	1.50%

1 Modeled as 80% large cap / 20% small cap

2 Modeled as 75% non-US developed markets / 25% emerging markets

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4 Modeled as 60% non-US developed bonds (hedged) / 40% core US fixed income

5 Modeled as 80% commercial mortgages / 20% private mezzanine debt

6 Inflation is 2.2%

Source: Aon Hewitt Investment Consulting, Inc, an Aon Company

2019 Aon Hewitt CMAs – Correlations



Aon Hewitt Asset Class	US EQ	Non US EQ	GL EQ	RE EQ	PE	PD	Core US FI	GL FI	RE Debt	HY	Cash
US Equity	1.00										
Non-US Equity	0.80	1.00									
Global Equity	1.00	0.90	1.00								
Real Estate Equity	0.50	0.50	0.50	1.00							
Private Equity	0.70	0.60	0.70	0.40	1.00						
Private Debt	0.30	0.30	0.30	0.20	0.20	1.00					
Core US Fixed Income	0.00	0.00	0.00	0.10	0.00	0.10	1.00				
Global Fixed Income	0.00	0.00	0.00	0.10	0.00	0.10	0.90	1.00			
Real Estate Debt	0.40	0.40	0.40	0.30	0.30	0.40	0.70	0.60	1.00		
High Yield Bonds	0.60	0.60	0.70	0.30	0.50	0.70	0.30	0.20	0.70	1.00	
Cash	0.10	0.10	0.10	0.20	0.10	0.00	0.20	0.60	0.40	0.20	1.00

Source: Aon Hewitt Investment Consulting, Inc, an Aon Company

2019 Horizon CMAs and Target Allocation



Horizon Asset Class (20 year Horizon)	Target Allocation*	Arithmetic Return	Geometric Return	Standard Deviation
US Equity - Large Cap	28.0%	8.34%	7.15%	16.17%
US Equity - Small/Mid Cap	7.0%	9.52%	7.71%	20.15%
Non-US Equity – Developed	13.5%	9.30%	7.81%	18.23%
Non-US Equity – Emerging	4.5%	11.67%	9.03%	24.73%
US Corp Bonds – Core	23.8%	4.46%	4.32%	5.47%
US Corp Bonds - High Yield	1.0%	6.38%	5.91%	10.06%
Non-US Debt – Developed	1.2%	3.81%	3.53%	7.61%
Cash Equivalents	1.0%	3.07%	3.04%	2.31%
Real Estate	11.0%	7.94%	6.91%	15.03%
Private Equity	8.0%	12.82%	10.73%	22.05%
Private Debt	1.0%	8.57%	7.95%	11.62%

* When possible, the target allocation in AON's presentation was mapped to Horizon's asset classes following the notes to AON's asset classes. E.g. AON's 33% U.S. Equity is noted as 80% Large Cap (26.4%) and 20% Small Cap (6.6%). AON's Non-US Equity is noted 75% Developed and 25% Emerging. AON's Global Fixed Income is noted as 60% non-US Developed and 40% US Core. Additionally, AON's Global Equity was mapped to 50% US Equity and 50% Non-US Equity based on available information in the latest CAFR, and AON's Real Estate Debt was mapped to US Corp Bonds - Core.

Source: Horizon Actuarial Services, LLC 2019 Survey of Capital Market Assumptions

2019 Horizon CMAs – Correlations



Horizon Asset Class	US LC	US SC	Non US Dev	Non US Emg	FI	HY	FI Dev	FI Emg	Cash	RE	PE	P FI
US Eq – LC	1.00											
US Eq – SMC	0.86	1.00										
Non-US Eq – Developed	0.83	0.74	1.00									
Non-US Eq – Emerging	0.72	0.67	0.78	1.00								
US Core Bonds	0.15	0.07	0.17	0.17	1.00							
US High Yield	0.60	0.58	0.61	0.61	0.41	1.00						
Non-US Debt – Developed	0.20	0.12	0.32	0.29	0.53	0.23	1.00					
Non-US Debt – Emerging	0.51	0.47	0.54	0.64	0.45	0.59	0.42	1.00				
Cash Equivalents	-0.06	-0.07	-0.05	-0.03	0.23	-0.01	0.20	0.07	1.00			
Real Estate	0.48	0.49	0.46	0.41	0.16	0.42	0.15	0.33	0.03	1.00		
Private Equity	0.75	0.70	0.70	0.63	0.05	0.50	0.11	0.39	-0.06	0.43	1.00	
Private Debt	0.40	0.39	0.41	0.41	0.21	0.55	0.19	0.43	0.01	0.30	0.47	1.00

Source: Horizon Actuarial Services, LLC 2019 Survey of Capital Market Assumptions



The purpose of this presentation is to present stochastic projections of investment returns for evaluating the valuation interest rate to the New York State Teachers' Retirement System (NYSTRS).

Future results may differ significantly from the current results presented in this presentation due to such factors as the following: changes in capital market assumptions; and changes in asset allocation.

In preparing this presentation, we relied on information (some oral and some written) supplied by NYSTRS. This information includes, but is not limited to, the asset allocation and the capital market assumptions.

This presentation and its contents have been prepared in accordance with generally recognized and accepted actuarial principles and practices and our understanding of the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board as well as applicable laws and regulations. Furthermore, as credentialed actuaries, we meet the Qualification Standards of the American Academy of Actuaries to render the opinion contained herein. This presentation does not address any contractual or legal issues. We are not attorneys and our firm does not provide any legal services or advice.

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