ASSET-LIABILITY ANALYSIS AND ASSET ALLOCATION RECOMMENDATION

NORTH DAKOTA STATE INVESTMENT BOARD – TFFR

SEPTEMBER 2025

PLAN AND ASSET ALLOCATION PROFILES

OVERVIEW

- **Today's discussion covers the Asset-Liability analysis for TFFR.**
- **The plans' liability structure, funded status and discount rate (i.e., long-term return assumption) vary and are reviewed later in the deck; these factors were considered in the final recommendation**
- **Return expectations across the plans range from 6.50% to 7.25%; based on the NEPC March 31, 2025 capital market assumptions, it seems reasonable to expect that the long-term (30-year) return expectations could meet or exceed the current assumptions**
- **In addition to the Current policy, we have presented in this deck two specific implementable allocations (one lower risk and one similar risk) as an alternative to the current policy**

WORK PLAN / ROADMAP

North Dakota State Investment Board
2025 Pension Asset/Liability Project Plan

Step/Milestone	Estimated Timing
Collect all data relative to plan liabilities and structure	December 2024
Review of NEPC capital market assumptions, current policy expectations and plan objectives (with NDRIO Staff)	January 2025
Review, discuss, and consider revisions to portfolio/plan objectives (with NDRIO Staff)	February 2025
Discuss and identify potential alternatives to the current policy	May 2025
Scenario modeling for Current and Alternative Policies	May 2025
Review modeling results (with NDRIO Staff)	June 2025
Prepare draft of Board materials	July 2025
Board Materials and Recommendations Finalized	August 2025
Study Presented to Board and Decision Finalized	September Board Meeting

TFFR PENSION PLAN: CURRENT STATE

Plan	TFFR
Plan Year	7/1 - 6/30
Actuary	GRS
Participants (Total)	25,663
Actives	11,945
Terminated Vesteds	4,025
Retirees & Beneficiaries	9,693
Payroll	879,276,401
Actuarial Accrued Liability	4,758,417,607
Market Value of Assets	3,351,007,841
Actuarial Value of Assets	3,408,483,045
Unfunded Actuarial Liability	1,349,934,562
Funded Status (AVA)	71.6%
Discount Rate	7.25%
Payroll Growth Rate	3.25%
Normal Cost Rate	12.3%
Remaining Amortization Period	19
Asset Valuation Method	5-Year Smoothing
COLA	Ad-hoc, but none assumed
Open/Closed	Open
Funding Policy	ER: Fixed Rate EE: Fixed Rate Contribution sufficiency measured against normal cost plus closed 30-yr amortization of unfunded liabilities ending 2043 (19 yrs left as of ‘24)

CORE ASSET CLASS RETURN ASSUMPTIONS

	Asset Class	3/31/2025 10-Year Return	3/31/2024 10-Year Return	Delta
	Cash	3.9%	4.1%	-0.2%
	U.S. Inflation	2.6%	2.6%	-
Equity	U.S. Large-Cap Equity	6.4%	4.1%	+2.3%
	Non-U.S. Developed Equity	5.1%	4.3%	+0.8%
	Emerging Market Equity	7.7%	8.3%	-0.6%
	Global Equity*	6.5%	5.1%	+1.4%
	Private Equity*	8.8%	8.8%	-
Fixed Income	U.S. Treasury Bond	4.4%	4.4%	-
	U.S. Municipal Bond	4.0%	3.7%	+0.3%
	U.S. Aggregate Bond*	4.8%	4.8%	-
	U.S. TIPS	4.5%	4.7%	-0.2%
	U.S. High Yield Corporate Bond	6.5%	6.1%	+0.4%
	Private Debt*	8.3%	8.3%	-
Real Assets	Commodity Futures	4.4%	4.3%	+0.1%
	REIT	5.3%	6.1%	-0.8%
	Gold	4.5%	4.8%	-0.3%
	Real Estate - Core	5.6%	5.8%	-0.2%
	Private Real Assets - Infrastructure	5.8%	6.7%	-0.9%
Multi-Asset	60% S&P 500 & 40% U.S. Aggregate	6.1%	4.7%	+1.4%
	60% MSCI ACWI & 40% U.S. Agg.	6.1%	5.3%	+0.8%
	Hedge Fund*	6.5%	6.1%	+0.4%

*Calculated as a blend of other asset classes. NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.

NDRIO ASSET ALLOCATION
LONG-TERM (30-YEAR) RETURN EXPECTATIONS ABOVE 7.25%

	TFFR	PERS	Bismarck Police	Bismarck Employees	Grand Forks Employees	Grand Forks Parks
Cash	1.0%	0.0%	0.0%	0.0%	1.0%	0.0%
Total Cash	**1.0%**	**0.0%**	**0.0%**	**0.0%**	**1.0%**	**0.0%**
Global Equity	45.0%	51.0%	46.0%	42.0%	55.0%	47.0%
Private Equity	10.0%	7.0%	5.0%	4.0%	5.0%	7.5%
Total Equity	**55.0%**	**58.0%**	**51.0%**	**46.0%**	**60.0%**	**54.5%**
US Aggregate Bond	18.0%	16.0%	22.0%	27.0%	17.0%	18.0%
US High Yield Corporate Bond	4.0%	3.5%	3.5%	3.5%	3.5%	3.8%
Private Debt - Direct Lending	4.0%	3.5%	3.5%	3.5%	3.5%	3.8%
Total Fixed Income	**26.0%**	**23.0%**	**29.0%**	**34.0%**	**24.0%**	**25.5%**
Real Estate - Core	6.8%	8.3%	9.0%	8.6%	5.3%	7.5%
Real Estate - Non-Core	2.3%	2.7%	3.0%	3.4%	1.8%	2.5%
Private Real Assets - Natural Resources	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Private Real Assets - Infrastructure	8.0%	7.0%	7.0%	7.0%	7.0%	9.0%
Total Real Assets	**18.0%**	**19.0%**	**20.0%**	**20.0%**	**15.0%**	**20.0%**

Expected Return 10 yrs (Geometric)	**6.8%**	**6.7%**	**6.6%**	**6.5%**	**6.6%**	**6.7%**
Expected Return 30 yrs (Geometric)	**7.7%**	**7.7%**	**7.5%**	**7.5%**	**7.6%**	**7.7%**
Standard Deviation	**13.2%**	**13.6%**	**12.4%**	**11.6%**	**13.4%**	**13.1%**
Sharpe Ratio (10 years)	**0.22**	**0.20**	**0.21**	**0.22**	**0.20**	**0.21**
Sharpe Ratio (30 years)	**0.32**	**0.31**	**0.32**	**0.34**	**0.31**	**0.32**

ALTERNATIVE ASSET ALLOCATION PROFILES

NORTH DAKOTA TEACHERS' FUND FOR RETIREMENT

	Mix 1	Mix 2	10-Year Return	Volatility	Income Yield	Net Alpha
Global Equity	40%	40%	6.5%	18.2%	2.8%	0.5%
Private Equity	15%	10%	8.8%	25.8%	0.0%	1.0%
Total Equity	**55%**	**50%**				
US Aggregate Bond	16%	21%	4.8%	5.8%	4.9%	0.3%
US High Yield Corporate Bond	2.5%	2.5%	6.5%	11.3%	8.1%	0.3%
Private Debt - Direct Lending	7.5%	7.5%	8.2%	11.0%	9.5%	1.0%
Total Fixed Income	**26%**	**31%**				
Real Estate - Core	8.3%	8.3%	5.6%	14.7%	5.4%	0.0%
Real Estate - Non-Core	2.7%	2.7%	7.2%	25.0%	7.2%	0.5%
Private Real Assets - Natural Resources	1.0%	1.0%	8.1%	32.5%	3.9%	0.5%
Private Real Assets - Infrastructure	7.0%	7.0%	5.8%	10.6%	3.2%	0.5%
Total Real Assets	**19%**	**19%**				

10-Year Expected Return (Geo)	7.0%	6.8%
30-Year Expected Return (Geo)	8.0%	7.8%
Asset Volatility	13.8%	12.6%
Sharpe Ratio (10 years)	0.22	0.23
Sharpe Ratio (30 years)	0.33	0.34
Portfolio Income Yield	3.73%	3.98%
Portfolio Alpha (Net)	0.52%	0.49%

Probability of 1-Yr Return Under 0%	30.5%	29.4%
Probability of 30-Yr Return Over 6.5%	58.5%	55.9%
95% 1-Year Max Drawdown	-14.7%	-13.0%

Liquidity Profile

Tier 1 (Daily Liquidity)	40%	40%
Tier 2 (Semi-liquid)	18.5%	23.5%
Tier 3 (Illiquid)	41.5%	36.5%

NEPC

ASSET-LIABILITY ANALYSIS

PURPOSE OF ASSET-LIABILITY STUDY

- **Review the current/projected financial status of the plan over long-term horizon**
- **Determine appropriateness of current asset allocation with consideration of:**
  - Expected progress of liabilities and cash flows/liquidity needs
  - Path of funded status
- **Test sensitivity of plan (Assets and Liabilities) to various range of outcomes**
  - Market performance across range of economic environments
  - Contribution volatility
  - Range of liquidity environments
- **Consider appropriate asset mixes and expected return on assets**
  - Assess return target against tradeoff of volatility/range of outcomes
  - Analyze inclusion/exclusion of various asset classes/strategies

FIRST PRINCIPLES

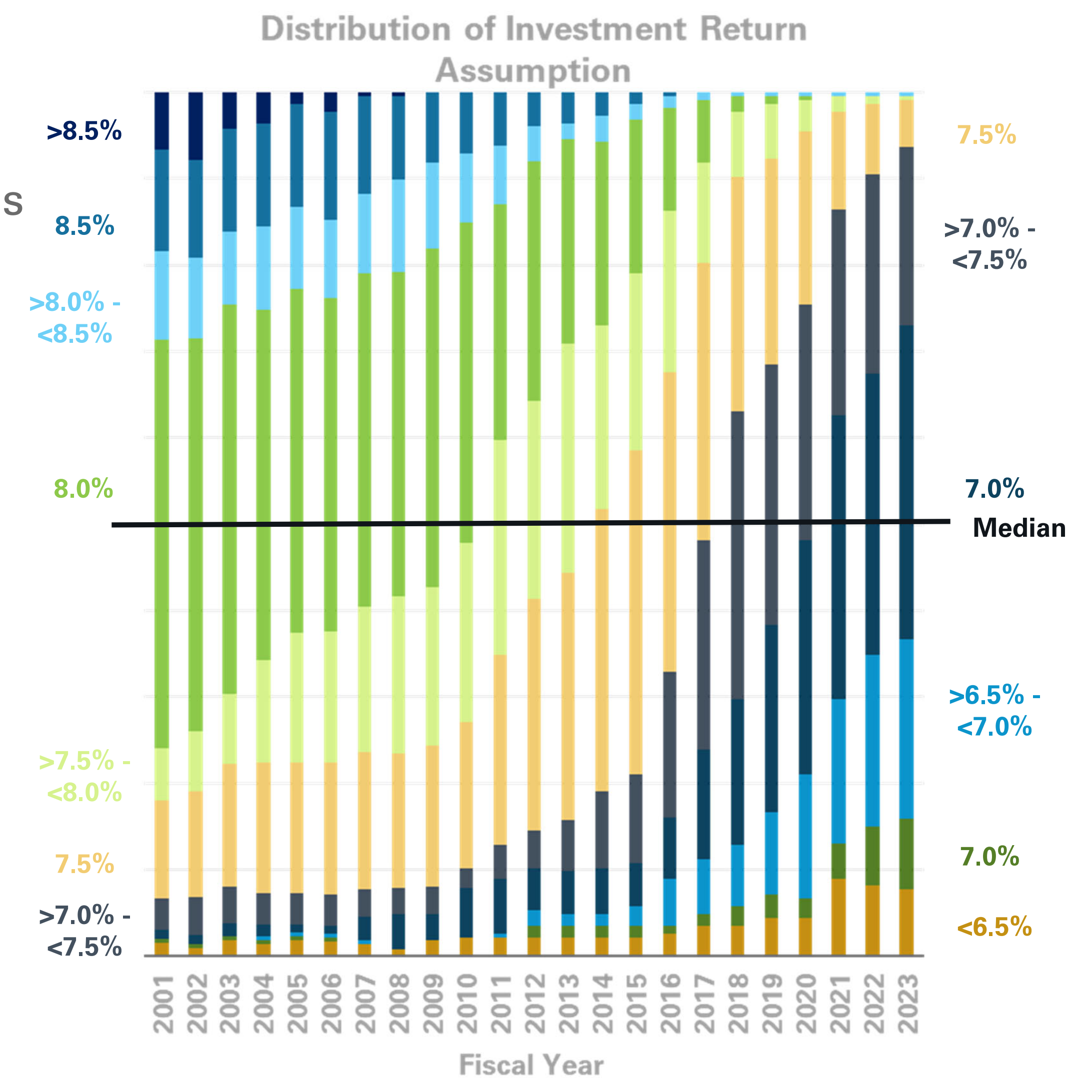
- **All the complexities of pension plans boil down to the classic equation:**

$$B + E = C + I$$

- **Benefits (B), Expenses (E), Contributions (C), and Investment Earnings (I)**
- **The funding of pension benefits is made possible through the combination of member and employer contributions and returns on investment**
- **The long-term expected return on assets drives the selection of an appropriate discount rate for public pension liabilities**
- **Expected return on assets is based on assumptions – actual experience will likely depart from those assumptions**
- **Long-term nature of pension obligations positions well-funded pension plans to take advantage of long-term investment opportunities**
- **It is critical and healthy for pension trustees to regularly review fundamental characteristics of the pension plan:**
  - Risk tolerance
  - Viability of long-term investment return
- **Risk is multi-dimensional and should be considered from different perspectives – Risk is not just volatility!**
  - Volatility, potential for drawdowns, illiquidity, exposure to economic factors, etc.
- **Return expectations are generally lower than historical returns, forcing many investors to reconsider both return expectations and appropriate levels of risk**

EXPECTED RETURN

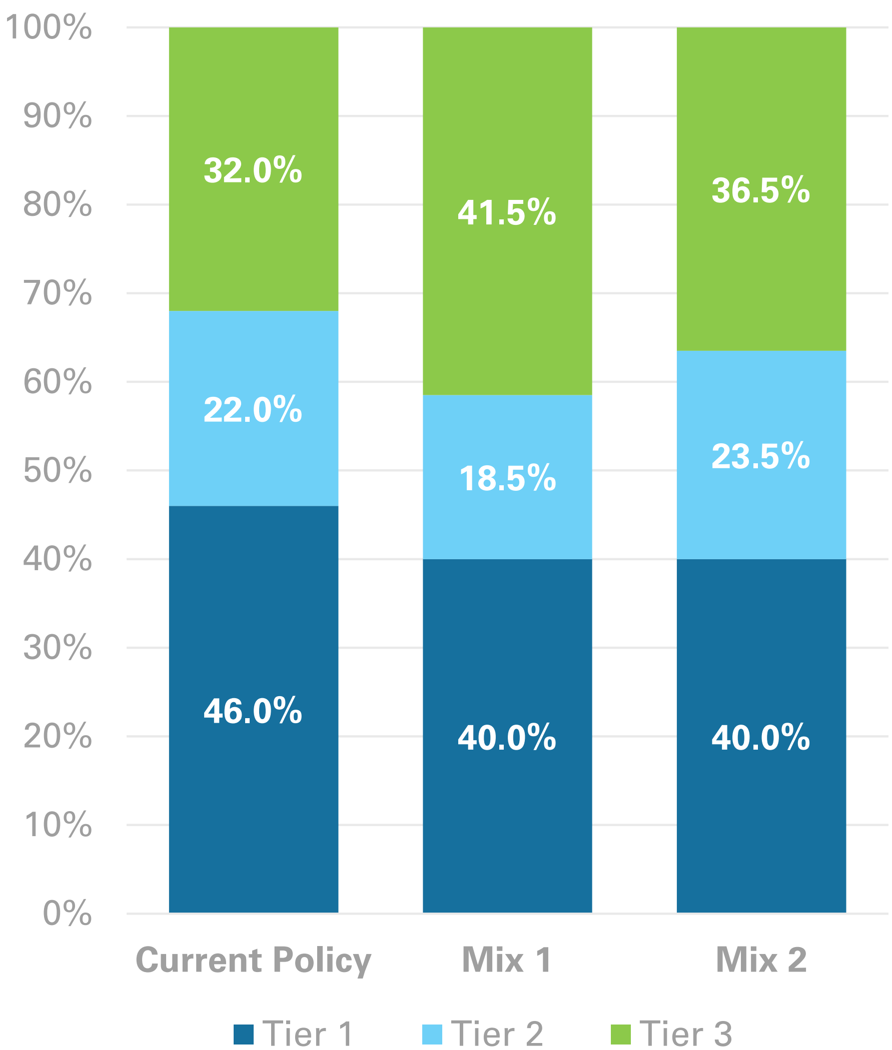
- **Expected return and liability discount rate are closely linked for public pension plans**
  - Corporate DB: stringent regulations
  - Going-concern of government entities has historically provided comfort in public plans taking longer term approach
  - Expected returns are forward-looking
- **Historical market environment has led to downward trend in EROAs for public pensions**
  - Median 2023 EROA = 7.0%
- **Low expected returns put pressure on assumptions and outcomes but…**
  - Market re-pricing and higher inflation may push return expectations higher looking forward



Source: Public Plans Data, NEPC

LIQUIDITY PROFILE

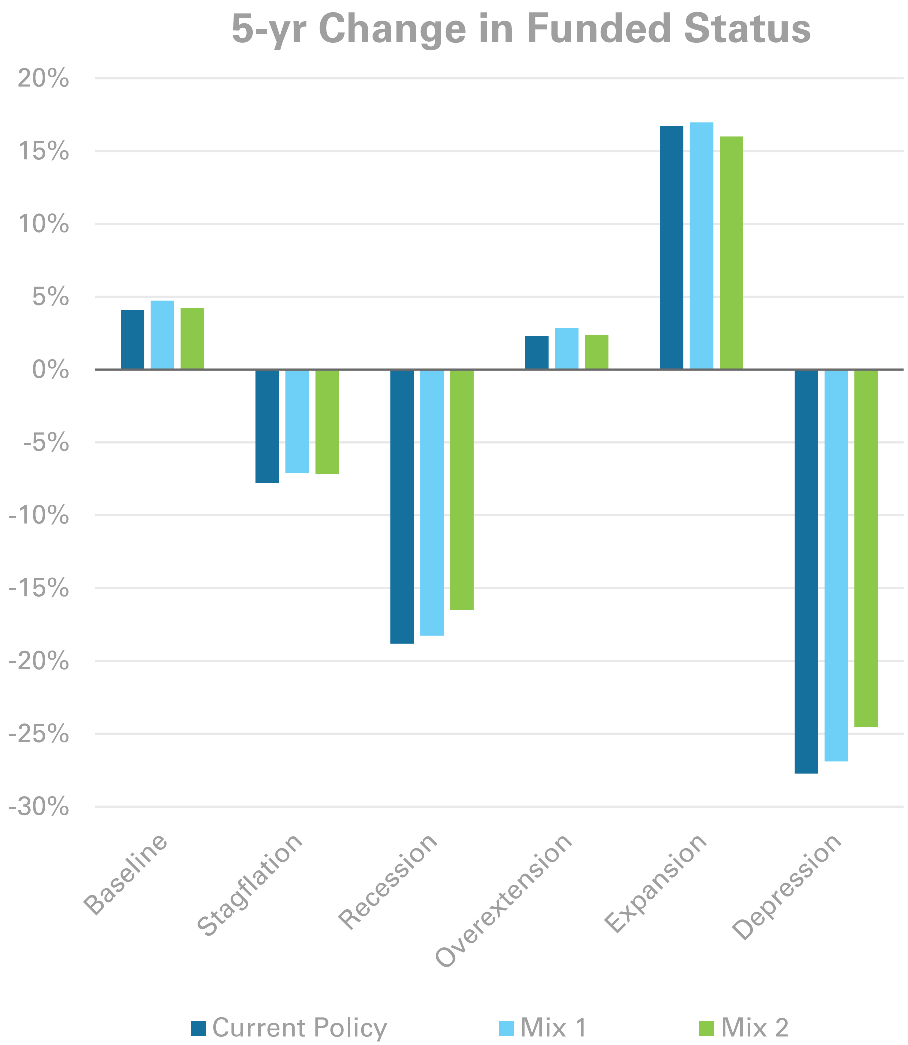
TEACHERS' FUND FOR RETIREMENT

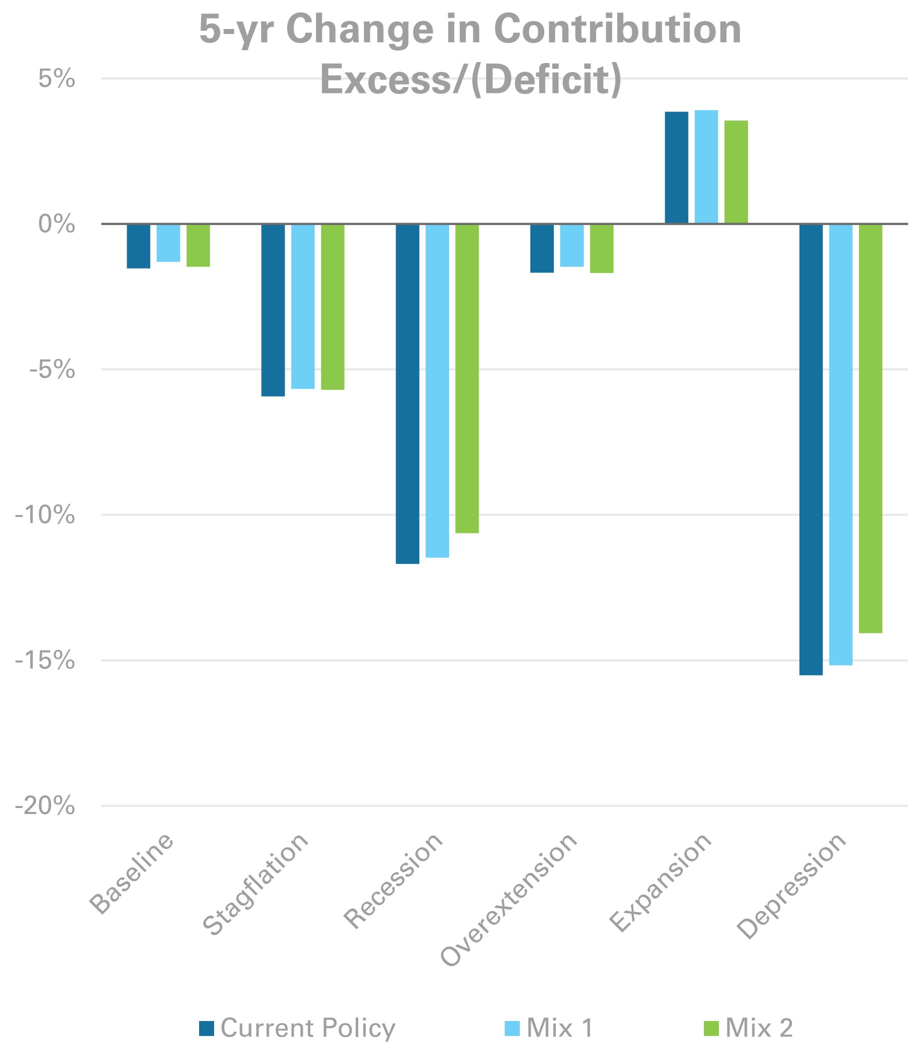


- **Net cash flow is expected to remain negative over next 10 years, averaging -1.5% outflow**
  - Public funds average between -2% and -4% net cash flow
- **Negative cash flow is typical for a mature pension plan**
- **Fixed contribution model provides consistent and predictable cash inflows**
- **NEPC believes the plan can take on the recommended increase in illiquids with no material impact in the plan's ability to meet its obligations**

ECONOMIC SCENARIO ANALYSIS

TEACHERS' FUND FOR RETIREMENT

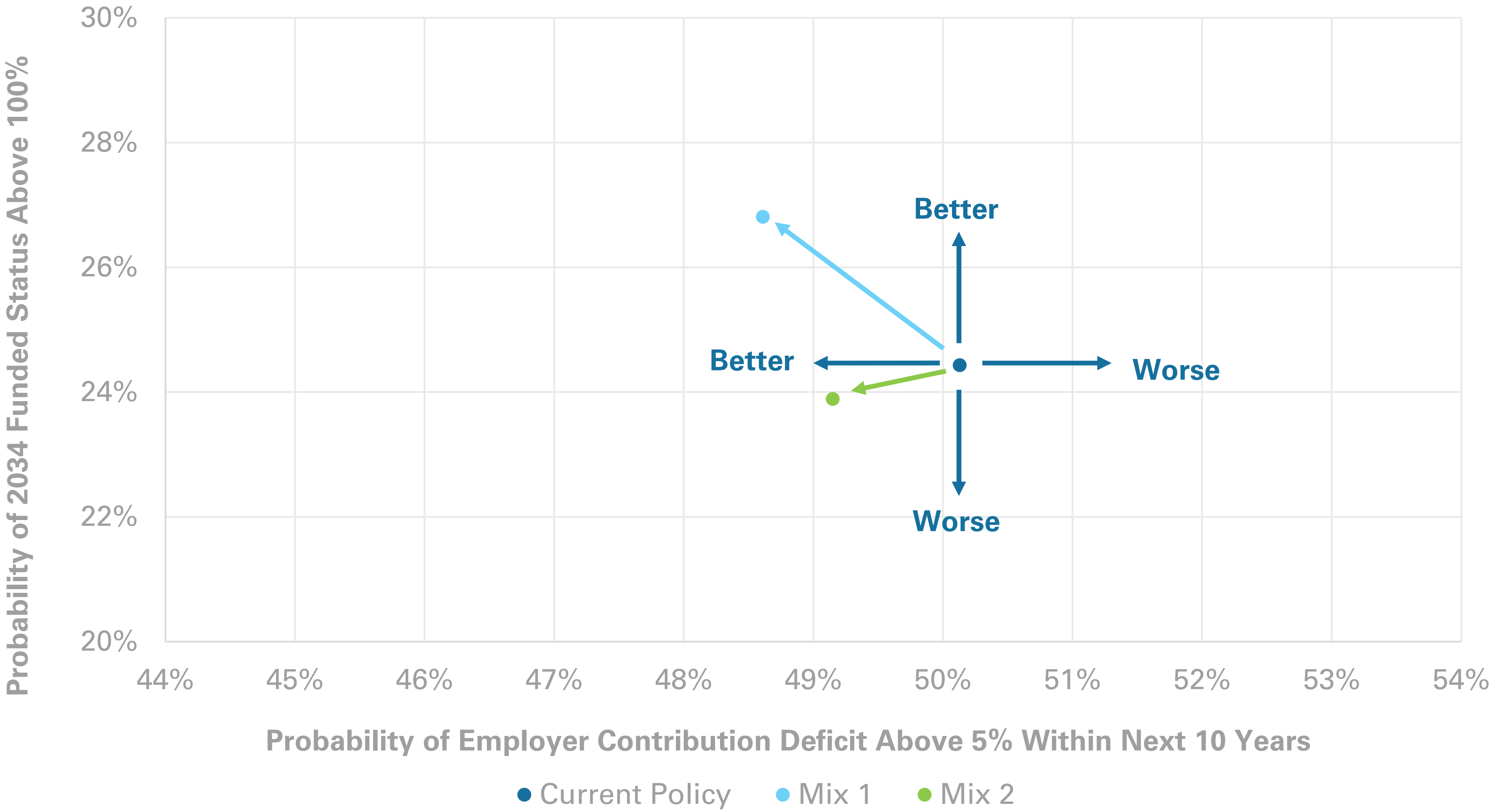




Notes: Scenarios reflect a 5-year market cycle. Change in funded ratio is relative to 71.6% as of July 1, 2024 and change in contribution excess/(deficit) is relative to 0.3% for FY2025

STOCHASTIC ANALYSIS

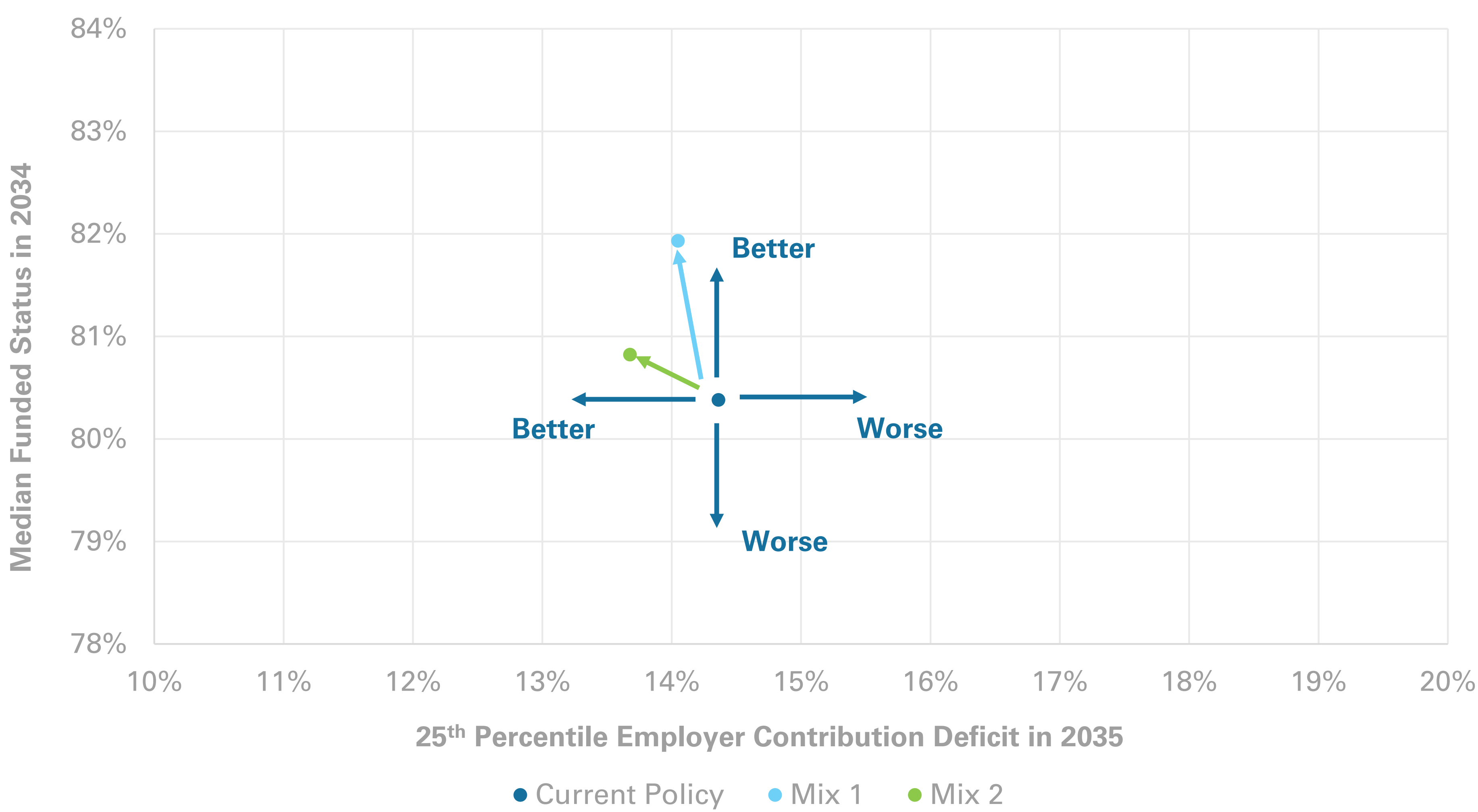
TEACHERS' FUND FOR RETIREMENT



Notes: Reflects 10,000 simulations based on mean expected return equal to each allocation's 10-year arithmetic return and with each allocation's annual volatility

STOCHASTIC ANALYSIS

TEACHERS' FUND FOR RETIREMENT



Notes: Reflects 10,000 simulations based on mean expected return equal to each allocation's 10-year arithmetic return and with each allocation's annual volatility

CONCLUSION AND RECOMMENDATION

JN1

CONCLUSIONS AND NEXT STEPS

ADOPT MIX 1 FOR TFFR

	Mix 1	TFFR
Cash	**0.0%**	1.0%
Total Cash	**0.0%**	**1.0%**
Global Equity	**40%**	45.0%
Private Equity	**15%**	10.0%
Total Equity	**55%**	**55.0%**
US Aggregate Bond	**16.0%**	18.0%
US High Yield Corporate Bond	**2.5%**	4.0%
Private Debt - Direct Lending	**7.5%**	4.0%
Total Fixed Income	**26.0%**	**26.0%**
Real Estate - Core	**8.3%**	6.8%
Real Estate - Non-Core	**2.7%**	2.3%
Private Real Assets - Natural Resources	1.0%	1.0%
Private Real Assets - Infrastructure	**7.0%**	8.0%
Total Real Assets	**19.0%**	**18.0%**

10-Year Expected Return (Geo)	**7.0%**	**6.8%**
30-Year Expected Return (Geo)	**8.0%**	**7.7%**
Asset Volatility	**13.8%**	**13.2%**

- Mix 1 offers meaningfully better long-term returns than the current policy
- Volatility for Mix 1 is like the current policy for TFFR
- Mix 1 offers improved (combination of lower risk and higher return) plan financials over the long-term relative to the current policy

Slide 18

JN1 Combine mixes for all six plans with Mix 1; add bullet points for recommendation on right side of slide

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RATIONALE FOR PRIVATE MARKETS

RELATIVELY ATTRACTIVE MARKET EXPOSURE

- **Private market investments offers differentiated market exposure and fundamental advantages to add value**

- **1. Differentiated market exposure with attractive expected returns**

- **Private markets combine systematic (beta) and active (alpha) returns**
  - Private assets offer relatively attractive expected returns vs comparable public markets (NEPC assumes 300-400bps of annual excess returns vs public equity)
  - In contrast to public markets, allocators cannot easily separate the beta and alpha components of private market returns

- **Private markets offer an "illiquidity premium" relative to public market assets**
  - Illiquidity premiums compensate investors for long-term capital commitments

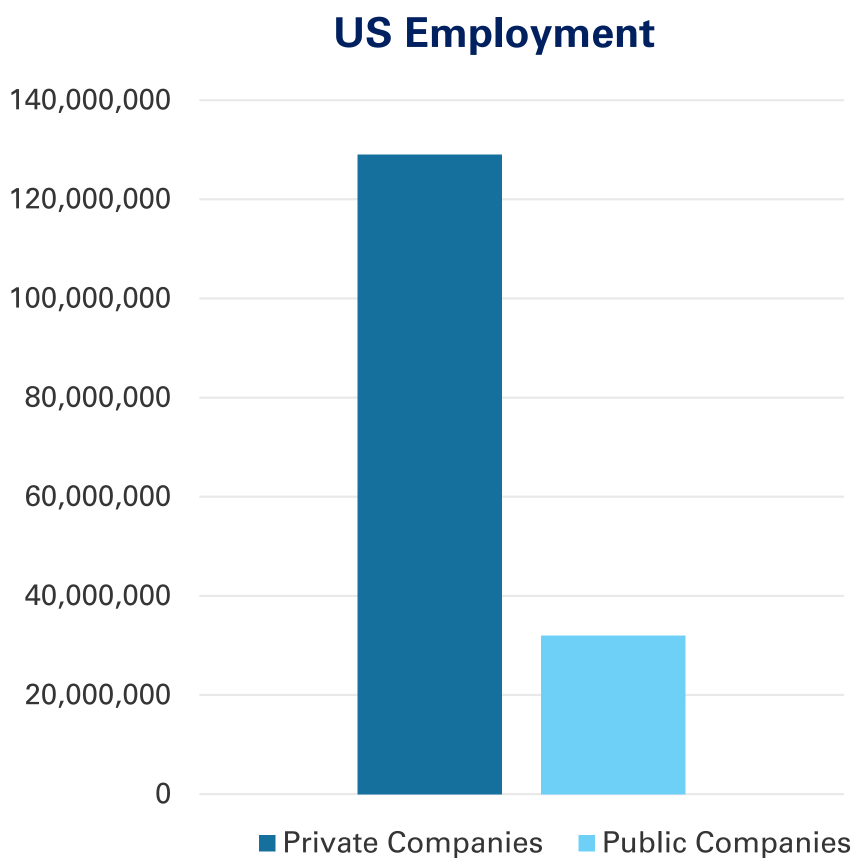
- **Smoother private valuations and illiquidity are both an advantage and challenge**
  - Periodic updates in private asset valuations smooth accounting volatility, which is sometimes seen as an advantage by plan sponsors
  - However, smoother valuations complicate rebalancing of the total portfolio and evaluating risk and return relative to marked-to-market public market assets
  - Illiquidity also requires robust management of total fund liquidity

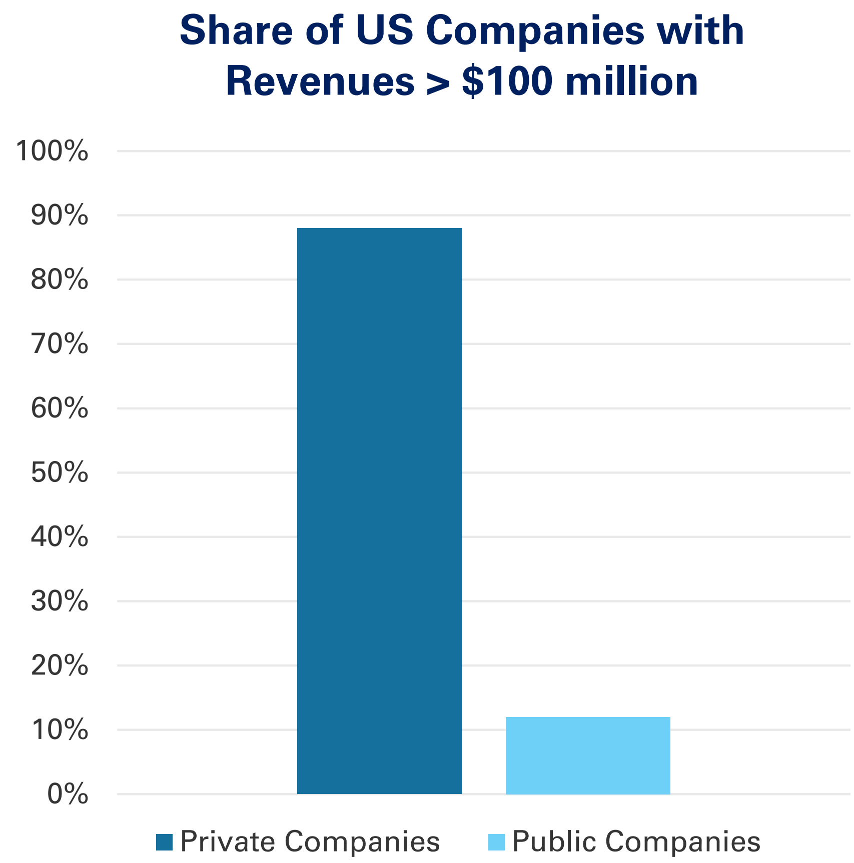
ADVANTAGES IN ADDING VALUE

- **2. Fundamental advantages in adding value (using Private Equity as an illustration)**
- **Governance benefits**
  - Closer integration reduces the principal/agent problem
  - Board control and more frequent CEO touchpoints lead to quicker decision-making and improved ability to see through strategies
- **Financial benefits**
  - Capital structures with higher debt create discipline and tax benefits
  - Incentives are aligned; management has significant equity
- **Operational benefits**
  - Less regulatory burden; focus less on legal compliance
  - Ability to command additional resources to improve operations
  - “Punch above weight” in ability to attract staff
  - Assistance in generating acquisitions, customer introductions, etc.

MAJORITY OF U.S. COMPANIES ARE PRIVATE

The universe is sizable as more than 85% of U.S. companies are privately held, representing a large share of employment and production not captured by listed stocks.

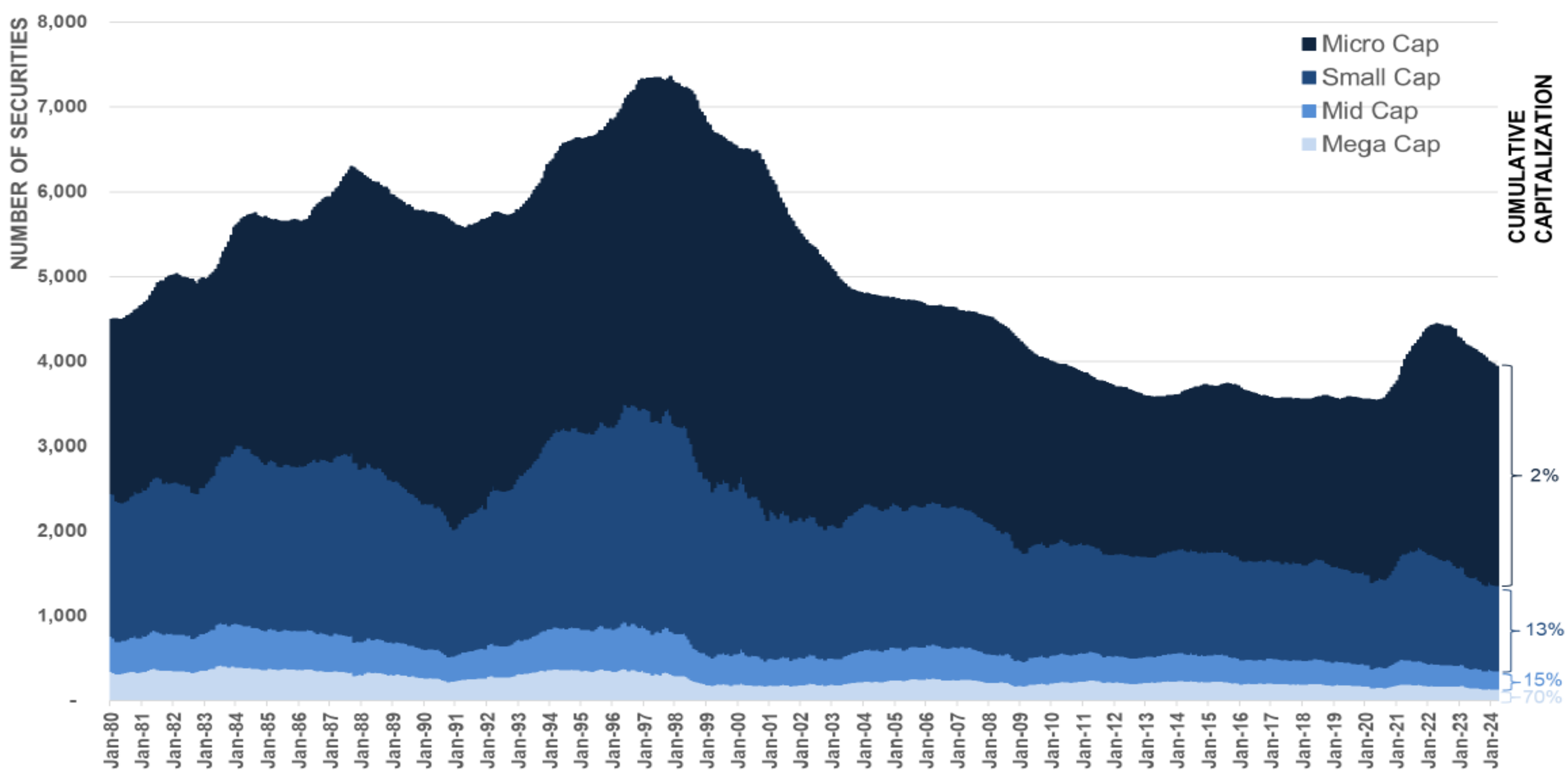




Source: U.S. Bureau of Labor Statistics

REDUCTION IN PUBLIC COMPANIES CONTINUES

In 1996 there were over 8,000 public companies across all US exchanges. Today it's around 3,700.

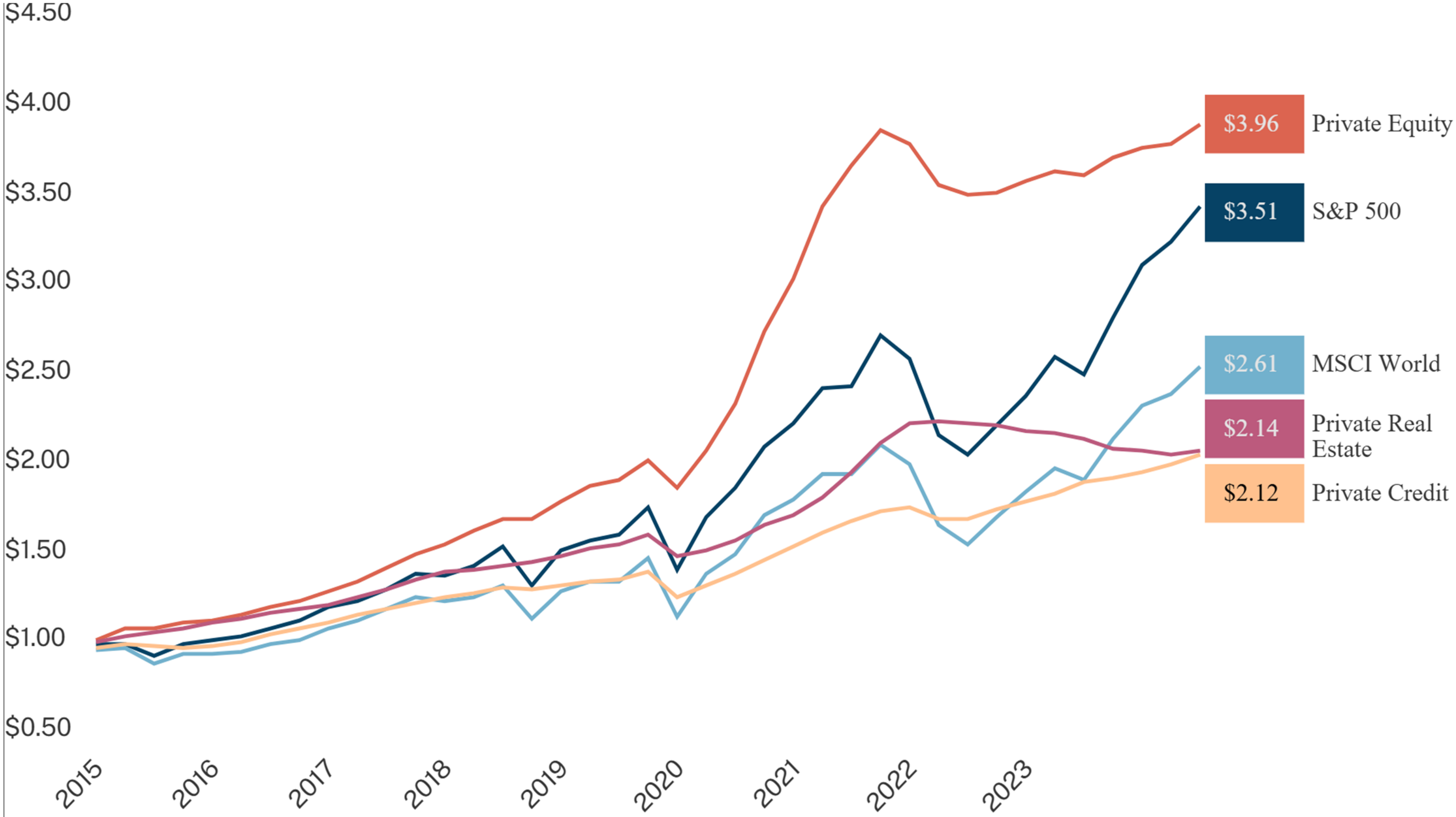


Source: CRSP US Stock Databases, Center for Research in Security Prices, LLC (CRSP), ©2024
Note: Stocks are defined as share codes 10 and 11. The counts are done at the PERMCO level, and exclude securities that did not have market capitalization on the date of measurement. The categories are based on cumulative capitalization. Securities in the top 70% of cumulative market capitalization are defined as Mega Cap; securities in the next 15% of cumulative market capitalization are Mid Cap; the next 13% of cumulative market capitalization are Small Cap; the last 2% of market cap are called Micro Cap. Data is on monthly frequency.

CRSP CENTER FOR RESEARCH IN SECURITY PRICES
An Affiliate of the University of Chicago

Source: Center for Research in Security Prices (CRSP)

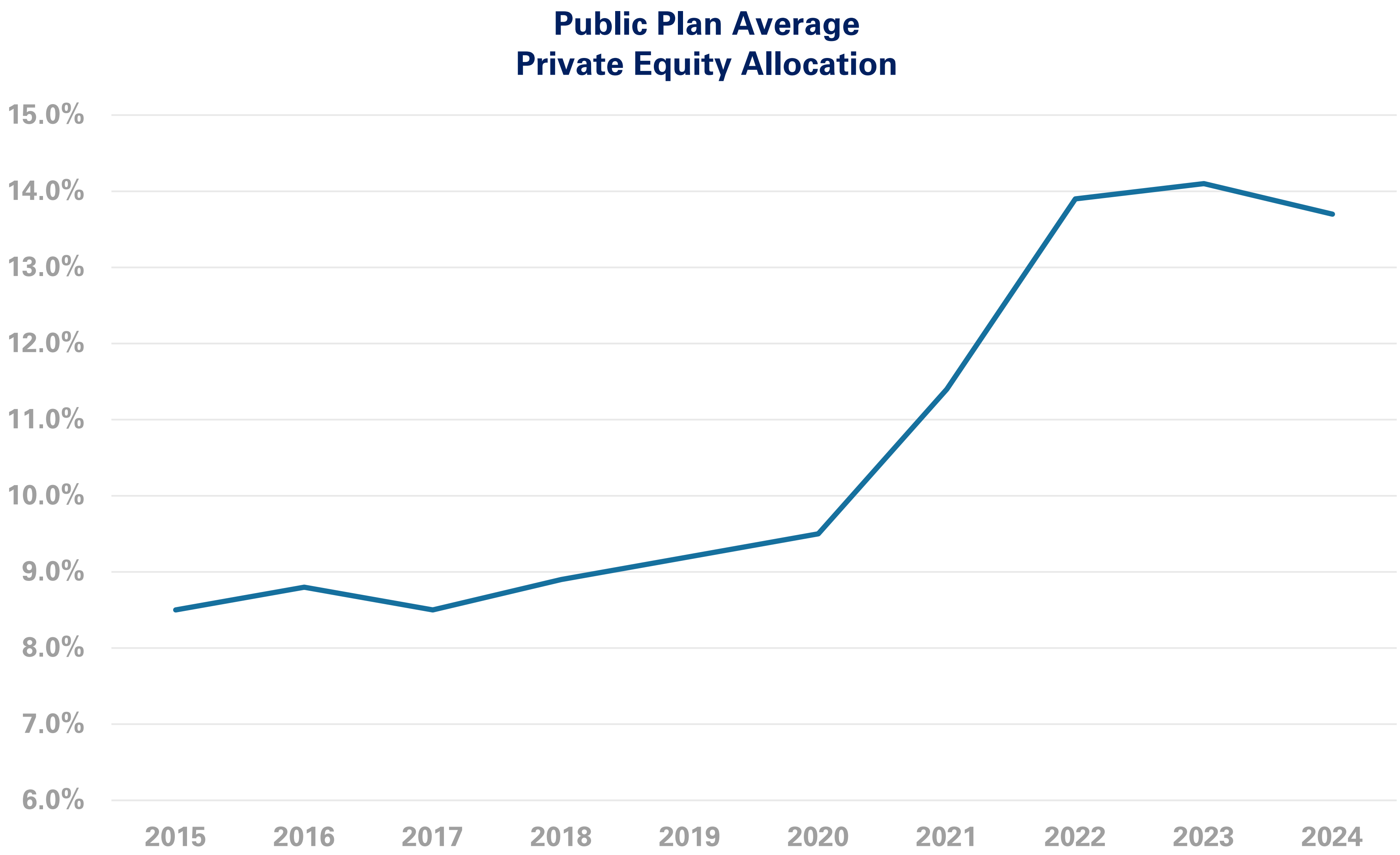
PRIVATE EQUITY HAS GENERATED SIGNIFICANT VALUE



Source: Hamilton Lane Data, Bloomberg (January 2025). Indexed at Q4 2014.

- **For the 10 years ending 12/31/24, Private Equity (Hamilton Lane Private Equity Universe) has generated annualized net-of-fee returns of 5.8% in excess of public equity markets (MSCI ACWI). Using the Cambridge Buyout Index, the spread is 4.5% annually.**

PUBLIC PLAN PRIVATE EQUITY ALLOCATIONS HAVE BEEN STEADILY INCREASING



Source: Public Plans Data

APPENDIX

ASSUMPTIONS AND METHODS

TEACHERS’ FUND FOR RETIREMENT

- **Deterministic and stochastic return projections are based on NEPC’s 3/31/2025 capital market assumptions**
  - Reflects return of 4.12% for the period 7/1/2024—331/2025 then NEPC’s return expectations thereafter
- **Asset-liability projections follow a roll-forward methodology based on the July 1, 2024 Actuarial Valuation Report**
  - Benefit payment projection provided by GRS
  - Other than those described herein, all assumptions remain unchanged from the valuation
  - No gains or losses are assumed other than those attributed to investment experience
- **Employer contribution based on statutory funding policy**
  - Statutory contribution rate of 12.75% until 100% funded, 7.75% thereafter
  - Actuarially Determined Contribution calculated in order to measure contribution excess/(deficit):
    - Normal cost plus amortization of unfunded liability plus administrative expenses
    - Level percent of payroll 30-year closed amortization of unfunded liability with 19 years remaining as of 7/1/2024 assumed to remain at 10 years once reached and remain open thereafter
- **Employee contribution base on statutory funding policy**
  - Statutory contribution rate of 11.75% until 100% funded, 7.75% thereafter

INFORMATION DISCLAIMER

Past performance is no guarantee of future results.

NEPC, LLC is an investment consulting firm. We provide asset-liability studies for certain clients but we do not provide actuarial services. Any projections of funded ratio or contributions contained in this report should not be used for budgeting purposes. We recommend contacting the plan's actuary to obtain budgeting estimates.

The goal of this report is to provide a basis for substantiating asset allocation recommendations. The opinions presented herein represent the good faith views of NEPC as of the date of this report and are subject to change at any time.

Information on market indices was provided by sources external to NEPC. While NEPC has exercised reasonable professional care in preparing this report, we cannot guarantee the accuracy of all source information contained within.

The projection of liabilities in this report uses standard actuarial projection methods and does not rely on actual participant data. Asset and liability information was received from the plan's actuary, and other projection assumptions are stated in the report.

All investments carry some level of risk. Diversification and other asset allocation techniques do not ensure profit or protect against losses.

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