

Texas Municipal Retirement System

Asset Liability Modeling Study August 2019

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Agenda

- Define Purpose and Source of Data
- How results will be communicated
- Discuss methods and limitations
- Baseline Results
- Impact from Benefit Structure
- Ways to assess choices
 - Reward vs Risk
- Simple Illustration using Stocks and Bonds
- Impact from portfolio choice
- Impact from funding policy
- Combination of options
- Key Takeaways



Purpose of the Study

- Determine expected population development and future cash flow needs of the System
- Illustrate the range of future valuation results based upon the current asset allocations, funding policies, economic possibilities, and capital market assumptions (i.e., stochastic projections)
- Provide various metrics to assist the Board and Stakeholders understand the unique risks to the System
- Help the Board prioritize the best "questions to ask" and how to evaluate options
- Provide data for use in setting future asset allocations, funding policies, and methods for tracking experience



Approach to Stochastic Modeling





Stochastic Projections

- Deterministic projections based on regular valuation assumptions demonstrate patterns and a base on which to build.
- They do not incorporate the reality that, while hopefully offsetting over time, significant year-to-year market gains and losses will occur.
- Stochastic projections help illustrate the effect of future possible market conditions on selected valuation results by varying the parameters in the model.



Summarizing the Outcomes

- Thousands of simulations plotted in one graph would be impossible to interpret
- Instead, the simulations are ranked at each point over the future
- This produces a distribution of outcomes illustrating the range of uncertainty over the projection period
- The Xth Percentile means X% of the outcomes are below (or above depending on whether counting from top or bottom) this point at this time
 - Might be easier to use terminology like 1 in 4 or 1 in 20, or more descriptive language





Percentile Charts and Terminology





Limitations

- Remember this is a model
- It is built on a set of assumptions, presumptions, and an overly-simplistic version of reality
- The reality will most certainly be different, and much more complicated and nuanced, than any of the scenarios modeled
- It is impossible to predict the future



Reliability

- A different set of assumptions, or even a different modeling procedure, will produce different results for a specific option.
- Thus, don't over emphasize the specific result for a given choice
- However, the relationship between choices will be more reliable across different models
- Example:
 - Using probability of being less than 80% funded as a metric. If an option shows a 20% probability of being less than 80% funded, be careful with that because a different model could produce a 10% probability or a 30% probability.
 - However, if Option A shows a 20% probability and Option B shows a 10% probability, that relationship is more reliable as Option B will likely have a smaller probability than Option A in most models, and significantly so. It just may not be 20/10. Might be 10/5 or 30/15, etc.



Baseline Results





Asset Class Characteristics

	Median Return	Standard Deviation
Global Equity	6.3%	18.4%
Fixed Income	3.6%	6.0%
Non-Core Fixed Income	6.0%	11.3%
Real Return	6.0%	9.1%
Real Estate	5.6%	13.9%
Absolute Return	5.6%	9.0%
Private Equity	8.3%	21.3%
Other Economic Variables:		
СРІ	2.5%	1.5%
GWI	3.0%	2.0%



Median Return is the 50th percentile outcome (geometric return)



Baseline

- The following slides provide System-wide summaries of the major metrics found in the valuation
- The scenarios are based on the current portfolio and capital market assumptions
- Based on those assumptions, the current portfolio is expected to return 6.30% with a standard deviation of 10.65%
 - These are 10 year numbers and have no allowance for time horizon or additional alpha
- With a portfolio that is not expected to meet the investment return assumption, the expected outcomes will not meet the results as presented in the valuation on the same timeframe
- Assumes other assumptions are met, the current funding policies continue, and no future benefit changes except the units that have been giving Ad hoc COLAs will continue to do so





Market Returns





Impact from Price & Wage Inflation

- In general, cash balance plans are not very sensitive to inflation experience
- However, the COLA provision for TMRS is based on actual inflation, although it is less than 100%
- The liability from the USC provision will be sensitive to wage inflation
- The payroll growth (contributions) will also be sensitive to wage inflation



\$ in billions and adjusted for inflation to 2018



Compared to Investment Performance

 However, compared to investment volatility, the liability stream is rather predictable



\$ in billions and adjusted for inflation to 2018





Funded Ratio



Expected Outcome in 2047 is 93.4%



UAAL



\$ in billions Expected Outcome in 2047 is \$6.3b



Aggregate Contribution Rate



Expected Outcome in 2047 is 12.9%



Observations - Cash Flow Projection

- External cash flow expected to become more negative over the next 30 years
- However, even long term should be in the preferred range of 3-4%
- Should not exceed 3% for two decades, unless there is <u>favorable</u> investment experience
- Favorable investment experience would push contributions down faster, expanding negative cash flow sooner





Impact from Benefit Structure





Impact of Benefit Structure on the Distribution of Outcomes

- A traditional cash balance plan with a fixed interest credit has very low distribution of projected outcomes
 - All liabilities from the past grow at 5% each year
- The USC provision adds sensitivity to Wage Inflation, and then a repeating COLA provision adds additional sensitivity to Price Inflation
- Cities with both have the widest distribution of outcomes, and thus will see the most volatility in their contribution rates





Variability in Liability Growth

- Group 1: No COLA/No USC
 - Very predictable pattern. All past liabilities will grow at 5% pre retirement, no variability post. High growth rate due to demographics. Outcomes +/- 1% from expected.





Variability in Liability Growth

- Group 3: USC/COLA
 - 76% of Liabilities
 - Higher growth rate due to COLA.
 Outcomes +/- 4% from expected.





Cities Providing Ad Hoc COLAs

- The cities providing ad hoc COLAs have just as wide a potential outcomes as the cities providing repeating
- However, their contribution rates have an upward bias over time, so their volatility changes from expecting 0% change with +/- 0.20% per year to an +0.15% expectation with the same +/- 0.20% per year, for a total range each from -0.05% to 0.35%.
- Assuming the ad hoc COLAs continue to be provided, the contribution rate will eventually be higher for this group
- There is real risk that retirees in these groups will not receive COLAs longer term



Projected Funded Status for Ad Hoc Groups

- Group 3: USC/COLA
 - Currently 86% Funded. Ends up 96% Funded. Contribution Rate declines from 14.9% to 12.6%. Rate will continue to decline to about 9.0%.
- Group 4: USC/Ad hoc COLA
 - Currently 87% Funded. Ends up 88% Funded. Contribution Rate increases from 11.1% to 15.2%. Never expected to be more than 90% funded and rate will remain high.





Projected Funded Status for Ad Hoc Groups

- The funded status for cities providing ad hoc colas is not expected to improve
- The additional liability from colas is expected to offset the reducing of the current UAAL from the financing policy
- Due to lower contributions over the short term, the assets for this group will not grow as fast as the assets for the repeating cola group, even though they ultimately have the same liabilities
- May need to consider reducing amortization period for ad hoc colas to improve the sustainability for these units





Assessing Risk



Investor Example

- Individual has \$5,200 to invest for 10 years
- Does not need the money for other reasons
 No savings goals tied to the money
- Finds 3 investment options:
 - 10 year, zero coupon treasury at 2.5%
 - A portfolio of Core Bonds
 - Expected return of 3.6% with a standard deviation of 6%
 - An Equity portfolio
 - Expected return of 6.2% with a standard deviation of 18%



Investor Example: Ending Value

- So, at the end of the decade, the investor calculates the expected value of their account to be:
 - Treasuries: \$6,700 @ 2.5%
 - Core Bonds: \$7,400 @ 3.6%
 - Equities: \$9,500 @ 6.2%
- However, what about that other metric? The standard deviation? What does that mean?



Compound Balance After 10 years

• The standard deviation can be used in a model to provide example outcomes, and probabilities of certain events occurring

	Good Outcome (1/4)	Expected Value (50/50)	Poor Outcome (1/4)	Very Poor Outcome (1/20)
Treasury's	\$6,700	\$6,700	\$6,700	\$6,700
100% Bonds/0% Stock	8,100	7,400	6,800	6,200
65% Bonds/35% Stock	9,300	8,400	7,500	6,800
35% Bonds/65% Stock	11,400	9,100	7,400	5,900
0% Bonds/100% Stock	14,000	9,500	7,000	4,300

Start with \$5,200 Balance shown after 10 years



Is that the Right Question?

- This investor had no obligation
- In a pension plan, there is a financial obligation that must be met, regardless of how the investments are performing
- Is the right question: *How much money do you have?*
- Or perhaps a better one is: *How much money do you owe*?
- C+I=B or C=B-I



New Example

- You have to pay another party \$10,000 at the end of 10 years
- You currently have \$5,200
- You can't contribute any more until year 10, when the balance is due
 - Must make a cash payment equal to any difference between the \$10,000 and your balance at time 10
- Same investment options as before



How Much is Owed in 10 years?

	Probability of owing \$0	Good Outcome (1/4)	Expected Value (50/50)	Poor Outcome (1/4)	Very Poor Outcome (1/20)
Treasuries	0%	\$3 <i>,</i> 300	\$3,300	\$3,300	\$3,300
100% Bonds/0% Stock	8%	1,900	2,600	3,200	3,800
65% Bonds/35% Stock	13%	700	1,600	2,500	3,200
35% Bonds/65% Stock	35%	0	900	2,600	4,100
0% Bonds/100% Stock	44%	0	500	3,000	5,700

Start with \$5,200 Amount owed is \$10,000 less the balance, after 10 years



Timeframe

- Timeframe allows more volatile investments more time to generate their return and perhaps make up for poor performance
 - But, also allows more time for bad performance
- New Example:
 - You have to pay another party \$25,000 at the end of 20 years
 - You currently have \$6,750



How Much is Owed in 20 years?

	Probability of owing \$0	Good Outcome (1/4)	Expected Value (50/50)	Poor Outcome (1/4)	Very Poor Outcome (1/20)
Treasuries	0%	\$13,900	\$13,900	\$13,900	\$13,900
100% Bonds/0% Stock	8%	9,400	11,300	12,500	14,500
65% Bonds/35% Stock	15%	4,400	7,300	9,200	12,300
35% Bonds/65% Stock	30%	0	4,500	8,000	11,600
0% Bonds/100% Stock	44%	0	2,400	7,300	13,200

- Of note: Owe \$13,900 in all "risk free" scenarios
- Of note: Owe \$7,300 in the Expected/65% Bond scenario and the Poor/0% Bond scenario
- Of note: Owe \$11,600 in the Very Poor/35% Bond scenario vs \$11,300 in the Expected/100% Bond scenario

Start with \$6,750 Amount owed is \$25,000 less the balance, after 20 years



Financing the TMRS Liability

	No		Treasury]	Balanced		High Risk
	Investments		Bonds		<u>Portfolio</u>			Portfolio
All Future Payments	\$	188	\$	188	\$	188	\$	188
Current Assets		(29)		(29)		(29)		(29)
Future Member Contributions		(6)		(6)		(6)		(6)
Expected Investment Earnings		-		(93)		(141)		(148)
Future Employer Contributions	\$	153	\$	60	\$	12	\$	5
Poor Outcome								
Investment Earnings		-		(93)		(127)		(132)
Future Employer Contributions	\$	153	\$	60	\$	26	\$	21
Very Poor Outcome								
Investment Earnings		-		(93)		(104)		(48)
Future Employer Contributions	\$	153	\$	60	\$	49	\$	105

- Pension Plans have obligations that must be met
- Investments can help finance a significant portion of the liability
- But can also increase the potential cost in adverse outcomes

Amounts in Billions



Fight the Right Fight

- Do not fight an abstract concept
 - "We can't do that because it is too risky"
- How <u>exactly</u> is it risky?
 - What is the outcome you find undesirable?
 - Keep asking questions until you find the end of the path (the outcome you are most concerned about)
 - Why is this metric important? Because it tells me something about.....



Questions of Reward

- How little do I expect to pay?
- How stable and predictable is what I pay?
- How fast can we pay off the UAAL?





Questions of Risk (Financial)

- How much could I potentially pay?
- How much does what I pay change each year?
- How likely is it that what I pay changes more than I can absorb in a given year?
- How likely is it we have a poor funded ratio?



Questions of Risk (Non-Financial)

- How bad could the outcome be over the short term?
- How different can we be from everyone else?
- What is the perception of these asset classes?
- Etc.
- The Asset/Liability model is a quantitative model; it is not addressing these risks, but these risks are important and need to also be considered



Macro Illustration using TMRS and Simple Stocks and Bonds Portfolios





Stock/Bond Portfolios



Stock portion is 75% Global Equity/25% Private Equity Bond Portion is 75% Core Bond/25% Non-Core Bond These are not historical. They are based on current capital market assumptions.

GRS Retirement Consulting

Using Projected Contribution as Risk and Reward

Employer Contributions Over Period, Plus Remaining UAAL										
	1 Year				10 Year					
				Very Poor			٧	/ery Poor		
	Exp	ected	Outcome		Expected		Outcome			
0% Stock	\$	4.9	\$	6.5	\$	16.3	\$	24.7		
20% Stock		4.7		6.6		14.6		21.0		
40% Stock		4.4		7.5		12.0		20.1		
60% Stock		4.2		8.2		10.2		22.0		
80% Stock		4.0		9.2		9.8		24.9		
100% Stock		3.9		10.5		10.2		26.7		

- Risk is not rewarded over the short term
- By a 10 year horizon, the risk that less returning investments will not keep up with the 6.75% assumption is showing
- The 40% stock portfolio has the smallest cost in adverse scenarios



'Poor Outcome' is the 1 in 4 outcome 'Very Poor Outcome' is the 1 in 20 outcome

Distributions based on current market expectations \$ in billions



Using Projected Contribution as Risk and Reward

Employer Contributions Over Period, Plus Remaining UAAL												
		20 Year					30 Year					
					V	Very						'ery
			Рс	or	Р	Poor			Poor		Poor	
	Expe	cted	Outo	come	Out	come	Ехре	cted	Outo	come	Out	come
0% Stock	\$	29	\$	36	\$	44	\$	42	\$	52	\$	63
20% Stock		25		32		36		37		46		53
40% Stock		22		26		32		32		37		43
60% Stock		20		25		31		28		32		40
80% Stock		19		25		32		26		33		41
100% Stock		19		26		33		26		33		45





'Poor Outcome' is the 1 in 4 outcome 'Very Poor Outcome' is the 1 in 20 outcome

Distributions based on current market expectations \$ in billions



Impact from Portfolio Construction



Current Situation

- Based on the current forward looking capital market assumptions provided by RVK, the current portfolio is expected to produce a median (geometric) expected return of 6.30% over the next 10 years.
- This means that at the median expectation, as the investment portfolio is slightly underperforming the 6.75% return assumption:
 - The UAAL would not be fully amortized
 - The contribution rate would drift upwards from 14.9% toward 16.4% over the 20 year period
- To explicitly address this would require tightening the amortization strategy, lowering the return assumption, generating alpha, including an allowance for timeframe, and/or modifying the portfolio in a way to increase the expected return (or a combination)
- Lowering the return assumption would increase the 14.9% to basically 16.4% immediately





Portfolio Construction

- Other portfolio options based on the constraints from the 2015 study require a substantial move higher on the risk spectrum to get reasonably close to 6.75%
- Some of the reasons for the 2015 constraints have changed
 - Private Equity was at 0%
 - Other resources needed to be developed
- For illustrative purposes, we have chosen some portfolios off of a less stringent set of constraints
 - Allows more room to see variance
- This is not a recommendation and the implementation risks from the options would have to be considered



Illustrated Portfolios

		Same Return,	More Return,	Extra Return,
	Current	Less Std Dev	Same Std Dev	More Std Dev
	•			0
Median Return	6.3%	6.3%	6.5%	6.6%
Standard Deviation	10.7%	9.5%	10.7%	11.3%
Probability of a Negative Return	27.1%	24.1%	26.4%	27.4%
Probability of -10% Return	4.3%	2.3%	4.1%	5.1%
1/100 Worst Annual Return	-14.9%	-12.3%	-14.7%	-15.9%
Probability of Achieving 6.75% over 10 Years	43.7%	43.0%	46.0%	47.2%
Probability of Achieving 6.75% over 20 Years	42.5%	41.5%	45.8%	47.2%

- The question is: how much more risk is acceptable to try to get the additional return?
- How would these portfolios help, or hinder, TMRS in achieving its goals?





Effective Contribution Rate

- For a given scenario, the Effective Contribution Rate is the sum of:
 - The weighted average contribution rate over the time horizon
 - An amortization of any UAAL that still exists at the end of the time horizon, as if it is paid for over the time horizon
- Essentially, what contribution rate would be needed to be paid over the time horizon to make the UAAL \$0 at the end
- The actual contribution rate will trend toward this number
- The difference between the Effective Contribution Rate and the actual current rate is a measure of the economic value pushed into a future generation





Using Projected Contribution as Risk and Reward

20 Year Time Horizon				ota	l Contribu	utions	Effective Contribution Rate		
									Very
	Expected				Poor	Very Poor		Poor	Poor
	Return	SD	Expecte	d	Dutcome	Outcome	Expected	Outcome	Outcome
Current	6.3%	10.7%	\$ 18.3	3	\$ 25.2	\$ 33.4	16.4%	21.3%	27.4%
Same Return, Less Std Dev	6.3%	9.5%	18.2	2	24.6	31.8	16.3%	20.8%	26.1%
🔵 More Return, Same Std Dev	6.5%	10.7%	17.1	l	24.1	32.3	15.5%	20.4%	26.5%
😑 Extra Return, More Std Dev	6.6%	11.3%	16.7	7	23.8	32.7	15.2%	20.3%	26.7%

- All three illustrated have less contributions across the spectrum of outcomes
- All four portfolios have substantially higher contributions in the Very Poor Outcome

\$ in billions Aggregate of All TMRS Cities with Repeating USC and COLA Approximately 76% of Liabilities 14.9% Average Contribution Rate



Frontier Based on Contribution Effort



20 year time horizon



Using Contribution Volatility and Funded Status



- All four portfolios have about the same contribution volatility, with the current having slightly the highest
- All three alternatives have better downside funded ratio protection, and the two higher returning portfolios have much better probabilities to be 100% funded in the next 20 years



Impact from Funding Policy



Funding Policy

- The funding policy will dictate the timing of the contributions much more than the amount
- It will also impact the ability to prevent the funded status from deteriorating



Current Policy

- The current policy annually calculates the required contribution for each individual city based on
 - 25 year layered, closed amortization of any UAAL
 - 10 year smoothing, with acceleration to 3 years if market value gets more than 15% away from smoothed value
 - Both methods allow for offsetting gains and losses to reduce volatility
 - 25 year open amortization of any surplus



Impact of Offsetting

- We have several offsetting mechanisms in the funding policy designed to reduce volatility and "always turn towards the target"
- These items do not increase the risk to the system

	Probability of	
	Contribution	Probability
	Increase Greater	Less than 80%
	Than	Funded
	0.50%	In 2050 (MVA)
Traditional 25/10	31%	25%
TMRS 25/10	18%	25%





Time Horizon for Amortizing an Asset

- With 10 year asset smoothing and a 25 year amortization strategy, the current process could take 35 years to fully recognize a significant event
- This combination would not fall under current industry best practice
- We recommend one of the two parameters be decreased by 5 years



Asset Smoothing vs Amortization Period

		Probability of Contribution			Probabili	ty Less than	Prob, >100%
		Increa	ise Greater	Than	80%	Funded	Funded
	Probability					Anytime	Anytime
	Contribution				In 2050	before	before 2040
	Rate Changes	0.00%	0.50%	1.00%	(MVA)	2040 (AVA)	(AVA)
25/10 Layered	99%	50%	18%	7%	25%	31%	52%
25/5 Layered	99%	51%	28%	12%	23%	43%	59%
20/10 Layered	99%	50%	22%	9%	20%	26%	53%

- The investment performance is the most volatile and least predictable input into the funding equation
- Keeping the longer recognition period appears preferable





Other Strategies

- The 20 year layered strategy would be the fully optimized point available under that methodology
 - Meaning to reduce volatility any further would require a different strategy
- The following slide presents two alternatives
- For now the focus should be on the outcomes based on the alternatives to decide if either are items the Board wants to further develop them for a future implementation



Funding Policy

	r						
		Probabiliity of Contribution			Probabili	ty Less than	Prob, >100%
		Increase Greater Than			80% I	unded	Funded
	Probability					Anytime	Anytime
	Contribution				In 2050	before	before 2040
	Rate Changes	0.00%	0.50%	1.00%	(MVA)	2040 (AVA)	(AVA)
25/10 Layered	99%	50%	18%	7%	25%	31%	52%
25/5 Layered	99%	51%	28%	12%	23%	43%	59%
20/10 Layered	99%	50%	22%	9%	20%	26%	53%
20/10 Disciplined	43%	38%	18%	8%	18%	25%	62%
20/10 Float	25%	20%	10%	5%	23%	29%	56%

Aggregate of All TMRS Cities with Repeating USC and COLA Approximately 76% of Liabilities Starting Funded Ratio of 85.8% and Contribution Rate of 14.9%





Differences in Approach





Combination of Options



Example Combined View

- Eventually there will be a combination of investment and funding strategies to be implemented.
- The true comparison is the combined package <u>before</u> to the combined package <u>after</u>
- The following is an example comparison using one of the alternative funding strategies

											Probability of				Prob,
								20 Year Effective Contribution			Contribution		Probability Less		>100%
			20 Year Contribution Dollars			Rate			Increase Greater		than 80% Funded		Funded		
														Anytime	Anytime
							Very			Very				before	before
	Expected				Poor		Poor		Poor	Poor			In 2050	2040	2040
	Return	SD	Expe	cted	Outcom	e 0	outcome	Expected	Outcome	Outcome	0.50%	1.00%	(MVA)	(AVA)	(AVA)
Current Portfolio	6.3%	10.7%	\$	8.3	\$ 25.2	\$	\$ 33.4	16.4%	21.3%	27.4%	19%	7%	31%	34%	45%
25/10 Layered															
More Return More Risk	6.6%	11.3%	\$	6.7	\$ 23.9) \$	\$ 32.9	15.2%	20.3%	26.5%	10%	5%	23%	29%	56%
20/10 Floating															



Key Takeaways

- All of TMRS' obligations will be paid from trust assets, which will be made up of a mix of contributions and investment returns. In this way, the funding and investment strategies are linked. Lower investment returns would lead to higher required funding, and vice versa.
- In the context of a retirement system with a long time horizon, investment risk primarily consists of the level of uncertainty of achieving the returns as per the expectations of the system, or underperformance risk. For TMRS, this is the risk of falling short of the actuarial assumed rate of return assumption, currently 6.75%.
- Based on the current forward looking capital market assumptions provided by RVK, the current portfolio is expected to produce a median (geometric) expected return of 6.30% over the next 10 years. Since this is less than the 6.75% investment return assumption, the stochastic modeling does not anticipate the UAAL will be fully amortized (reduced to zero) at the median outcome.
- To explicitly address this would require tightening the amortization strategy, lowering the return assumption, including an allowance for timeframe, and/or modifying the portfolio in a way to increase the expected return.



Key Takeaways

- The 35 year combined asset smoothing and amortization period would not be considered industry best practices. The 20/10 combination appears to be optimal compared to the 25/5 option.
- There are combinations of portfolios and funding policies that can create better metrics across the entire spectrum: higher projected funding ratios, lower projected contributions, and lower contribution volatility.
- There are other non-financial risks which should be considered, although these are not in the purview of this analysis.
- All three of the alternative portfolios have higher allocations to a more diverse set of asset classes, many of which require more active management, are illiquid, and typically have higher fees. The Board must consider this complexity when accessing the appropriateness of those portfolios.
- This study is not making any recommendations on portfolio choice. The upcoming asset allocation study will dive into the details of individual classes and produce recommendations. This analysis attempts to provide a broader quantitative framework for the Board to assess the risks and rewards of the portfolios recommended in the asset allocation study.





Disclosures

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- Results were based upon data furnished by TMRS staff and RVK concerning members, retirees and beneficiaries as well as current and proposed target asset allocations.





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