MOODY'S INVESTORS SERVICE

CROSS-SECTOR METHODOLOGY

Adjustments to Pension and OPEB Data Reported by GASB Issuers, Including US States and Local Governments Methodology

Table of Contents:

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This rating methodology replaces the *Adjustments to US State and Local Government Reported Pension Data* published in December 2017 We have added descriptions of how we calculate the pension asset shock indicator and how we adjust other postemployment benefits (OPEB). We have also made minor editorial changes to enhance readability.

Introduction

This cross-sector rating methodology explains our general approach to making adjustments to defined-benefit pension and OPEB plan assets and liabilities of US states and local governments, and other US entities reported under the standards of the Governmental Accounting Standards Board (GASB). We make adjustments to reported data to enhance its analytical value from the perspective of assessing credit risk and to improve the comparability of financial data among peers. Our adjustments do not imply that reported financial statements fail to comply with applicable accounting rules. Our goals are to bring greater transparency and consistency to the analysis of public pension and OPEB liabilities and to enhance the analytical value of financial data for credit analysis.

This methodology applies to data reported by governmental entities and their pension plans under GASB Statements 67 and 68. We make adjustments to reported pension data; we calculate a "tread water" indicator to assess the strength or weakness of pension contributions relative to reported funding needs; and we calculate an asset shock indicator to assess issuers' exposure to the risk of pension investment losses. We also make adjustments to OPEB liabilities reported under GASB 74 and 75.

Highlights of the report include:

» An overview of the scope of the methodology

» A description of the standard balance sheet[1] adjustment for pension liabilities

» A description of the standard balance sheet adjustment for OPEB liabilities

[1] Issuers may report their annual financial position on both an accrual basis and on a modified accrual basis of accounting. Throughout this document, whenever we refer to a "balance sheet," we are referring to the statement of net position, which reflects the accrual basis of accounting and is where entities book unfunded pension and OPEB liabilities. The balance sheet adjustments described in this methodology are made to the statement of net position. Balance sheets presented on a modified accrual basis do not include long-term liabilities such as unfunded pensions and OPEBs.

- A description of the standard income statement adjustments
- A description of the tread water indicator
- A description of the asset shock indicator

Scope of This Methodology

This methodology applies to US states, US territories and US local governments as well as to other US entities that report under GASB standards. Such entities include US municipal utilities, public universities and community colleges, toll roads, mass transit enterprises, airports, ports, joint action agencies, charter schools, US public pension funds and not-for-profit healthcare enterprises. The adjustments described in this methodology apply to the financial statements of GASB-reporting entities rated under the methodologies for the above-listed sectors,[2] unless specified otherwise in those methodologies.

In some cases, sector methodology scorecard metrics are affected by these adjustments. In other cases, risks related to pensions or OPEB liabilities are a specific credit consideration that is assessed qualitatively in a sector specific methodology, and our view of these risks may be informed by the quantitative metrics or indicators described in this methodology.

Standard Balance Sheet Adjustment for Pension Liabilities

We adjust reported balance sheet pension liabilities using the FTSE Pension Liability Index (FTSE PLI), a high-investment-grade long-term taxable bond index, as a discount rate to compute the present value of accrued benefits.[3] This approach yields a point-in-time liability measurement that provides better comparability among reporting entities for the purpose of balance sheet analysis. We compare adjusted liabilities to pension assets to arrive at the adjusted net pension liability (ANPL).

For clarity, the balance sheet adjustment applies to all entities described in the "Scope of This Methodology" section above that report under GASB standards (including entities for which we may primarily use modified accrual financials in our analysis).

The reporting problem

Under GASB standards, public pension plans with the same benefit obligations and similar asset values may report different unfunded pension liabilities due to differences in assumed rates of investment return. Issuers may have incentives to use overly optimistic assumed rates of return or to take on greater pension investment risks, or both, which have the effect of understating the unfunded pension liability.

Under governmental actuarial funding and accounting rules, discount rates are largely based on the plans' assumed rates of investment return on assets. Governmental accounting standards set the reported single equivalent discount rate equal to a given plan's assumed rate of investment return, unless the plan projects that it will deplete its assets. Plans that project asset depletion apply their assumed rate of investment return as a discount rate to projected benefit cash flows up until projected asset depletion, and apply a municipal bond index to projected benefit cash flows thereafter. For these

[2] A link to an index of our sector methodologies can be found in the "Moody's Related Publications" section.

[3] In the event that this index were to undergo a material change or become unavailable, we would choose a comparable high-investment-grade, long-term taxable bond index.

plans, the single equivalent discount rate represents a blend of their assumed rate of investment return and a municipal bond index.

Under these rules, public pension plans with the same benefit obligations and similar asset values may report different unfunded pension liabilities solely due to differences in assumed rates of investment return. Since assumed rates of investment return are linked to pension fund portfolio asset composition, plan funded status can improve under GASB accounting rules solely due to greater asset risk-taking. The following two hypothetical examples demonstrate the analytical problem that results from the GASB pension approach to balance sheet valuation.

Pension Plan A projects that it will pay out $1.0 million a year for the next five years to retirees. Plan A has $2.5 million of assets as of June 30, 2018, with 65% in equities and 35% in fixed income and cash. Its expected return associated with this asset allocation is 7.50%. Under the GASB approach, the present value of the projected benefit payments is about $4.0 million, using the 7.50% assumed investment rate of return as a discount rate, leaving a net liability of about $1.5 million (see Exhibit 1).

EXHIBIT 1

Date	Equities	Fixed Income & Cash	Total Assets	Expected Return On Assets	Benefit Payments	GASB Present Value
6/30/2019	$1,625,000	$875,000	$2,500,000	7.50%	$0	$0
6/30/2020					$1,000,000	$930,233
6/30/2021					$1,000,000	$865,333
6/30/2022					$1,000,000	$804,961
6/30/2023					$1,000,000	$748,801
6/30/2024					$1,000,000	$696,559
					Total Pension Liability	**$4,045,885**
				Net Pension Liability (Total Pension Liability less Total Assets)		**$1,545,885**

Pension Plan B projects that it will pay out the exact same benefit amount as Plan A: $1.0 million a year for the next five years. Plan B has about $2.7 million in assets, slightly more than Plan A's $2.5 million, with 35% in equities and 65% in fixed income and cash, yielding an expected return of 5.50%. The application of a 5.50% discount rate under GASB rules results in a $4.3 million total liability and a net liability of $1.6 million. Despite having more assets, a less risky portfolio composition and identical benefit payments, Plan B would report a greater level of underfunding under GASB rules than Plan A (see Exhibit 2).

EXHIBIT 2

Date	Equities	Fixed Income & Cash	Total Assets	Expected Return On Assets	Benefit Payments	GASB Present Value
6/30/2019	$927,500	$1,722,500	$2,650,000	5.50%	$0	$0
6/30/2020					$1,000,000	$947,867
6/30/2021					$1,000,000	$898,452
6/30/2022					$1,000,000	$851,614
6/30/2023					$1,000,000	$807,217
6/30/2024					$1,000,000	$765,134
					Total Pension Liability	**$4,270,284**
				Net Pension Liability (Total Pension Liability less Total Assets)		**$1,620,284**

Our analytical response: We adjust liabilities using a standard market-based discount rate

Our approach values accrued pension liabilities independently from pension plan asset amount, composition and return expectation.[4] Our adjustment is intended to reflect the point-in-time market value of a zero-coupon fixed-income payment stream that is similar in risk, timing and amount to accrued pension benefits. To achieve this, we use the FTSE PLI, which is composed of high-quality taxable bonds, as a discount rate to produce adjusted pension liabilities. ANPL, our point-in-time balance sheet estimate of unfunded pension liabilities, is the difference between adjusted pension liabilities and the fair value of pension assets reported under GASB 67 and 68.

The adjustment allows for greater transparency and comparability of pension liability measures for use in our credit analysis. We use this adjustment to obtain a more consistent point-in-time measurement or estimate of pension obligations across reporting entities, one that reflects the economic value of pension promises weighed against the assets backing them as of the measurement date, and one that we consider comparable to measures of debt outstanding.

Our adjustment produces identical total liabilities for identical sets of future benefit payments measured as of the same date. For example, if we use a common 3.51% discount rate (which, in this example, we assume is the FTSE Pension Liability Index as of June 30, 2019) and apply that to the two hypothetical examples described above, Exhibit 3 shows that the estimated ANPL for both Plan A and Plan B is higher than their reported liabilities; however, Plan B's ANPL is lower than Plan A's because Plan B has a larger amount of assets, even though its future benefit payments are identical (see Exhibit 3).

EXHIBIT 3

Date	FTSE Pension Liability Index	Future Benefit Payments - Identical for Plan A and Plan B	GASB Present Value - Plan A: 7.50% Assumed Return / 7.50% Discount Rate	GASB Present Value - Plan B: 5.50% Assumed Return / 5.50% Discount Rate	Moody's Present Value - Plan A: 7.50% Return / 3.51% Discount Rate as of 6/30/2019	Moody's Present Value - Plan B: 5.50% Return / 3.51% Discount Rate as of 6/30/2019
6/30/2019	3.51%	$0	$0	$0	$0	$0
6/30/2020		$1,000,000	$930,233	$947,867	$966,069	$966,069
6/30/2021		$1,000,000	$865,333	$898,452	$933,290	$933,290
6/30/2022		$1,000,000	$804,961	$851,614	$901,623	$901,623
6/30/2023		$1,000,000	$748,801	$807,217	$871,030	$871,030
6/30/2024		$1,000,000	$696,559	$765,134	$841,476	$841,476
			Balance Sheet Valuation as of 6/30/2019			
		Total Pension Liability	$4,045,885	$4,270,284	$4,513,488	$4,513,488
		Assets	$2,500,000	$2,650,000	$2,500,000	$2,650,000
		Net Pension Liability	$1,545,885*	$1,620,284*	$2,013,488†	$1,863,488†

Note: For simplicity, this hypothetical example assumes that the cash flows related to future benefit outflows and accrued liabilities are equivalent, which occurs with closed pension plans, but not those with active employees.

* Reported net pension liability

† Moody's-adjusted net pension liability

How we adjust reported balance sheet information

In the prior section, our demonstration of the rationale for our standard discount rate adjustments used projected future benefits. However, projected future benefit payments and other key data points

[4] Since our liability adjustments do not consider plan assets, we apply a discount rate to liabilities in their entirety, regardless of whether a plan projects asset depletion. The discount rate that we apply may be higher or lower than reported discount rates under GASB rules.

such as future normal costs are not reported under GASB rules. Only the present value of accrued liabilities, along with a description of key assumptions such as the discount rate, are reported.

Thus, to adjust public-pension balance-sheet information reported under GASB Statements 67 and 68, we typically first estimate the liability duration of each of an issuer's pension systems in order to provide an estimate of the size and timing of future benefits that comprise that pension system's reported liabilities.[5] We derive our duration estimate, in years, by calculating the percentage increase in total liabilities associated with a 100-basis-point decline in the discount rate, using the discount rate sensitivity information that issuers disclose under GASB standards (see Lines F, G and H in Exhibit 4). In the event that this information is not available because an issuer's financial reporting does not comply with Generally Accepted Accounting Principles, or it has not applied GASB 68 to a pension plan where no trust for assets has been established, we assume a standard 13-year duration.

We then use the discount rate implied by the FTSE PLI, as of the measurement date for pension liabilities and assets (see Lines A and I in Exhibit 4). We move reported liabilities forward in time by a number of years equal to our liability duration estimate, using the single equivalent (i.e., reported) discount rate, and then calculate the present value of that result using the FTSE PLI (see Line J in Exhibit 4). We then estimate the ANPL, which is the resulting adjusted liability less the reported fair market value of the assets (see Line K in Exhibit 4). The resulting ANPL is a point-in-time measurement of pension liabilities that is comparable across entities, net of the market value of the assets set aside to pay for the obligation.

EXHIBIT 4

Label	Line Item	Value - Hypothetical Example	Source
A	Measurement Date	6/30/2019	Reported
B	Single Equivalent Discount Rate	7.25%	Reported
C	Total Pension Liability	$10,000,000	Reported
D	Plan Fiduciary Net Position (i.e., market value)	$7,500,000	Reported
E	Net Pension Liability	$2,500,000	Reported = C less D
F	Net Pension Liability (Single Equivalent Discount Rate minus 100 bp)	$3,850,000	Reported
G	Total Pension Liability (Single Equivalent Discount Rate minus 100 bp)	$11,350,000	= F less E, plus C
H	Estimated Liability Duration	13.50	= 100 * (G less C, divided by C)
I	FTSE Pension Liability Index as of Measurement Date	3.51%	Published monthly by the Society of Actuaries
J	Moody's Adjusted Liability	$16,142,682	$= C * (1+B)^{H} * (1+I)^{-H}$
K	Moody's Adjusted Net Pension Liability (ANPL)	$8,642,682	= J less D

Standard Balance Sheet Adjustment for OPEB Liabilities

We adjust reported OPEB liabilities in a manner that is identical to our adjustment for pension liabilities, again using the FTSE PLI to discount reported OPEB liabilities. This approach yields a point-in-time liability measurement that provides better comparability among reporting entities, as well as between pension and OPEB liabilities. The OPEB liability adjustment also produces values comparable to FASB reporting. We compare adjusted OPEB liabilities to the plan's fiduciary net position to arrive at the adjusted net OPEB liability (adjusted NOL).

[5] We use the concept of Macaulay Duration, which represents the weighted average term of a future stream of cash flows.

For clarity, the balance sheet adjustment applies to all entities described in the "Scope of This Methodology" section above that report under GASB standards (including entities for which we primarily use modified accrual financials in our analysis).

The reporting problem

OPEB liabilities may represent a significant source of balance sheet leverage, and GASB discount rates can skew comparison of unfunded OPEB liabilities among issuers. Furthermore, issuers can use different discount rates for pension and OPEB liabilities under GASB rules, making it difficult to compare OPEB liabilities and pension liabilities. Similar to pensions, OPEB liabilities reported under GASB rules reflect a single-equivalent discount rate equal to the assumed rate of return on OPEB assets, unless OPEB assets are projected to deplete. OPEB plans that project asset depletion apply their assumed rate of investment return as a discount rate to projected benefit cash flows up until projected asset depletion, and apply a municipal bond index to projected benefit cash flows thereafter. For these plans, the single equivalent discount rate effectively represents a blend of their assumed rate of investment return and a municipal bond index.

Also similar to pensions, OPEB plans with the same benefit obligations and similar asset values may report different unfunded OPEB liabilities under GASB rules solely due to differences in assumed rates of investment return, or due to differences surrounding the assumed future contributions by sponsoring entities.

Unlike US public pension systems, OPEBs are often largely unfunded. Thus, reported GASB OPEB liabilities are often based on single-equivalent discount rates that largely reflect high grade municipal bond rates. A given increase in OPEB assets may overstate the reduction in unfunded OPEB liabilities by pushing out projected GASB depletion dates and thus increasing the GASB single-equivalent discount rate, creating accounting "extra credit" in excess of the increase to asset values.

In the hypothetical example shown in Exhibit 5 below, we demonstrate how issuing a $1.5 billion OPEB bond could produce a net reduction in balance sheet liabilities under GASB rules by reducing the GASB NOL by about $2.8 billion:

- Before the bond, the OPEB plan's assets amount to $3.5 billion, and its GASB Total OPEB Liability amounts to $7.4 billion, based on a 4.13% discount rate resulting from projected asset depletion in 2037.
- After issuing a $1.5 billion bond and depositing the proceeds into the OPEB trust, OPEB assets increase by $1.5 billion, from $3.5 billion to $5.0 billion. The system's projected solvency also extends to 2051, rather than 2037 before the bond issuance, due to the increase in assets.
- Under GASB rules, the extension of projected solvency results in the application of a 5.22% discount rate, more than 100 basis points above the 4.13% discount rate applied before the bond. The higher discount rate reduces the GASB Total OPEB Liability to $6.1 billion from $7.4 billion, although no change to projected cash benefit outflows has occurred.
- The GASB NOL falls to $1.1 billion from $3.9 billion, a decline that provides a $1.3 billion net reduction in reported balance sheet liabilities even after considering the increase in debt from the OPEB bond.

EXHIBIT 5

Line Item	$ billions	Before Bond	After $1.5 Billion OPEB Bond
A	**Plan Fiduciary Net Position**	**$3.5**	**$5.0**
	GASB depletion date	2037	2051
	GASB discount rate	4.13%	5.22%
B	**GASB Total OPEB Liability**	**$7.4**	**$6.1**
C	**GASB Net OPEB Liability (B less A)**	**$3.9**	**$1.1**
D	OPEB Bond Debt	$0.0	$1.5
	GASB Net OPEB Liability Plus OPEB Bond Debt (C+D)	**$3.9**	**$2.6**

Our analytical response: We adjust liabilities using a standard market-based discount rate

Identical to our approach to pensions, we value OPEB liabilities at a common discount rate, specifically the FTSE PLI as of the measurement date.[6] As a point-in-time balance sheet measurement of accrued liabilities in their entirety, we apply the FTSE PLI regardless of OPEB asset amount, composition or return expectation. In addition to improving comparability, our adjustments prevent the potential for GASB accounting "extra credit" from an OPEB bond issuance, as explained above.

» Continuing with the same example, since the discount rate applied to OPEB liabilities under our adjustments is not linked to asset amount or composition, an OPEB bond issuance has no impact on point-in time balance sheet leverage (see Exhibit 6).

EXHIBIT 6

Line item	$ billions	Before Bond	After $1.5 Billion OPEB Bond
A	**Plan Fiduciary Net Position**	**$3.5**	**$5.0**
	GASB depletion date	2037	2051
	GASB discount rate	4.13%	5.22%
B	**GASB Total OPEB Liability (reported)**	**$7.4**	**$6.1**
C	**GASB Net OPEB Liability (B less A)**	**$3.9**	**$1.1**
D	OPEB Bond Debt	$0.0	$1.5
	GASB Net OPEB Liability Plus OPEB Bond Debt (C+D)	**$3.9**	**$2.6**
E	**Moody's Adjusted Total OPEB Liability***	**$7.7**	**$7.7**
	Moody's discount rate	3.87%	3.87%
	Moody's Adjusted Net OPEB Liability (E less A)	**$4.2**	**$2.7**
F	OPEB Bond Debt	$0.0	$1.5
G	**Moody's Adjusted Net OPEB Liability Plus OPEB Bond Debt (E plus F)**	**$4.2**	**$4.2**

* See Exhibits 3 and 4 for illustrative, step by-step examples of how we calculate the Adjusted Total Pension Liability and ANPL. We use the same process to calculate Adjusted Total OPEB liability and Adjusted NOL. In this example, we apply a FTSE PLI of 3.87%, which corresponds to the FTSE PLI as of the retirement system's financial statement reporting date.

[6] In addition to discount rates, assumptions related to the rate of growth in healthcare costs can heavily influence the value of OPEB liabilities. The information reported by GASB does not enable standard adjustments to healthcare cost trend assumptions, nor does the information enable concurrent adjustment to discount rates and to healthcare cost trend rates. As a result, the healthcare cost portion of our Adjusted Total OPEB Liabilities will have the same variability as liabilities reported by issuers.

How we adjust reported balance sheet information

The mechanics underlying our OPEB liability adjustments are identical to those we apply for pensions. By applying a standard discount rate, our adjustments produce comparable unfunded liabilities among entities. For example, under GASB reporting, OPEB Plan A is underfunded by about $199 million based on a 7.00% discount rate. OPEB Plan B uses a much lower GASB discount rate of 3.87% and is underfunded by almost an identical amount of roughly $200 million. Under our discount rate adjustments, however, Plan A is underfunded by $308 million, considerably higher than Plan B's adjusted net OPEB liability of $190 million (see Exhibit 7).

EXHIBIT 7

Line item	$ millions	Plan A	Plan B
	Measurement Date	6/30/2018	6/30/2018
GASB Reporting			
A	GASB Discount Rate	7.00%	3.87%
B	Total OPEB Liability	$370	$204
C	Plan Fiduciary Net Position	$171	$4
D	Net OPEB Liability (B less C)	$199	$200
E	Funded Ratio (C / B)	46.21%	1.87%
F	Net OPEB Liability, -1% discount rate	$234	$239
Moody's Adjustments			
G	FTSE PLI, as of measurement date	4.14%	4.14%
H	Est. liability duration {100* [(F less E plus B)/B, less 1]}	9.6	19.1
I	Moody's Adj. Total OPEB Liability $[B * (1+A)^{H} * (1+G)^{-H}]$	$479	$194
J	Moody's Adj. Net OPEB Liability (I less C)	$308	$190
K	Moody's Adj. Funded Ratio (C / I)	35.66%	1.96%

How we apply balance sheet adjustments in certain situations

Following is additional guidance for making balance sheet adjustments in certain situations:

» **Issuers that participate in multiple-employer cost-sharing plans**. Under GASB reporting, participating issuers must disclose their proportionate share of net pension liabilities associated with cost-sharing plans. We typically rely on the reported proportionate shares disclosed by issuers. In some cases, however, we may consider the issuer's current economic responsibility for pension liabilities to be different from reported proportionate shares. For example, in cases in which we believe that state governments take practical and economic responsibility for local pensions even though this funding is not reflected by reported allocations, we typically allocate a greater share of reported multiple-employer cost-sharing plans to them, and commensurately lower allocations to the entities receiving state support.

» **In some cases, we exclude certain items from reported pension or OPEB assets or remove pension- or OPEB-related balance sheet assets**. For example, in the event that issuers dedicate future but currently uncollected revenue streams to pensions and include the present value of these revenue streams in the reported Plan Fiduciary Net Position, we typically exclude that portion of pension assets from our calculation of balance sheet metrics because those future revenue streams have not actually been received by the pension plan. Once revenue streams are received by the pension fund, we include them in our calculation of the pension assets. For the same reason, we exclude deferred contributions from issuers, even if statutorily permissible, from our balance sheet metrics if they are included in the reported Plan Fiduciary Net Position as receivables. Similarly, once they are received, we include them. We also exclude regulatory assets

associated with the adoption of GASB Statement 68 and Statement 75. Some entities recognized a pension or OPEB regulatory asset on their balance sheets when they initially adopted GASB 68 or GASB 75 and for the first time they reported a GASB net pension or OPEB liability. The asset is associated with future revenue collectible without further governing body approval. It allows those entities to amortize the decrease in net position reported on their balance sheet that resulted from the adoption of GASB 68 over a multi-year period for accounting purposes, rather than recognizing a one-year expense spike on their income statement driven solely by the adoption of new pension accounting standards. However, this revenue must still be deposited in a pension or OPEB trust fund before it can be used to fund benefits, so we exclude it from our balance sheet adjustment.

» **Issuers that issue financial statements that do not comply with Generally Accepted Accounting Principles (GAAP)**. Some governmental entities may issue "non-GAAP" financial statements and, in some cases, may not report pension information that complies with GASB 67 and 68 rules, nor with GASB 74 or 75 rules for OPEBs. In these circumstances, we use information from other sources when available and otherwise make estimates based on available information. For example, if these issuers participate in multiple-employer cost-sharing plans, their individual GASB pension or OPEB information may nonetheless be made publicly available by the pension plan itself. In other cases, issuers may continue to report according to legacy pension accounting standards in their own financial reports. Our adjustments in such circumstances are similar to the approach under GASB 67 and 68 rules, but with some differences. If an entity's proportionate share of a cost-sharing plan is not available, we estimate it based on that entity's pro rata share of contributions relative to all participating entities. We may also use non-public information to perform our pension or OPEB adjustments, such as actuarial valuation reports provided to us by an issuer.

Standard Income Statement Adjustments

Some income statement metrics we use in our credit analysis are intended to gauge financial performance in a given year. We make an adjustment to these metrics to better reflect the annual contribution associated with pensions and OPEB liabilities, and the extent to which an entity generates net revenue in excess of debt service in a given year.

The pension- and OPEB-related income statement adjustments are separate and distinct from our balance sheet adjustments. We adjust the calculation of debt service coverage and other cash-flow-related metrics by using cash contributions to pensions and OPEB liabilities as an input, instead of the reported expense required under GASB standards.

The income statement adjustment applies to all entities described in the "Scope of This Methodology" section that report under GASB standards, except for the entities where we primarily use modified accrual financials in our analysis.

The reporting problem

Under GASB 68 and GASB 75, reported accrual-basis pension and OPEB expenses represent the annual change in reported net liabilities, plus the net effect of rule-based recognition deferrals. There are several analytical challenges associated with these reported expenses, including the following:

» The key components of pension and OPEB expenses are based on reported discount rates that are inconsistent across rated entities. For example, "service cost," which represents the present value of current-year benefit accruals, is recognized in its entirety as part of annual pension or OPEB

expense. Service cost is heavily influenced by the discount rate assumption and thus tends to increase or decrease based on the aggressiveness of plan asset allocations and asset depletion projections, because of the link between assumed rates of investment return and discount rates under GASB rules. GASB rules do not require any disclosure related to the sensitivity of service costs to changes in the discount rate.

» Reported pension and OPEB expenses can include significant non-cash elements related to actuarial assumptions and accounting recognition rules that may not fully reflect underlying financial performance.

» Reported pension and OPEB expenses can be highly volatile. The accounting recognition rules are significantly different from the actuarial funding approach that guides many governmental entities' pension contributions, and from the "pay as you go" direct benefit funding approach that is more commonly utilized for OPEBs. For example, differences between assumed investment returns and actual returns in a given year are recognized for accounting purposes in pension and OPEB expenses over five years, in equal installments. In the actuarial funding approach, these differences are commonly amortized over 20- to 30-year periods, and are further deferred by actuarial "asset smoothing" for the purposes of deriving contribution requirements. As a result, pension expense tends to exhibit far greater volatility than actual contributions and can be negative in years when governmental entities make pension contributions. Similarly, GASB OPEB expenses can exhibit far greater volatility than cash contributions due to the recognition of a variety of non-cash actuarial factors.

» There can be up to a 12-month lag in reported pension and OPEB data under GASB rules. A government's balance sheet on a fiscal year-end may reflect a net pension or OPEB liability measured as far back as the prior fiscal year-end. In such a case, pension or OPEB expense pertains to an entirely different 12-month period than that covered by the government's income statement.

Our analytical response: We use annual cash contributions instead of pension and OPEB expense

Because reported pension and OPEB expenses are potentially volatile due to GASB 68 and GASB 75 accounting recognition rules, we instead use annual cash contributions for pensions and OPEBs as an input into our calculations of metrics affected by these expenses, for example debt service coverage calculations and other measures of cash flow coverage.

How we adjust reported income statement information

Unless a sector-specific methodology states otherwise, to calculate annual cash contributions to pensions and OPEBs, we determine the difference between reported pension and OPEB expense and actual cash contributions. We do this by calculating the year-over-year changes in reported net liabilities, deferred inflows and deferred outflows related to pensions and OPEBs.

We then sum the change in net liabilities and the change in deferred inflows related to pensions and OPEBs, and subtract the change in deferred outflows related to pensions and OPEBs.

The result is the difference between GASB expense and cash contributions to pensions and OPEBs. If the difference is positive, we reduce expenses by this amount for use in debt service coverage calculations and other measures of cash flow coverage; if the difference is negative, we increase

expenses by this amount. We may make other non-pension or OPEB-expense adjustments described in sector methodologies,[7] if applicable.

The example below illustrates a scenario where reported pension expense is not only far below the entity's actual contributions but also is negative. Our adjustment in this case results in higher expenses associated with pensions than reported under GASB rules (see Exhibit 8). While this exhibit pertains solely to pensions, we also make corresponding adjustments to OPEB expenses reported under GASB 75 that are identical.

EXHIBIT 8

Line		Reported on Balance Sheet in Year 1	Reported on Balance Sheet in Year 2	Year-Over-Year Change	Source
A	Net Pension Liability	$860,748	$771,122	($89,626)	Line A in Year 2, Less Line A in Year 1
B	Deferred Inflows Related to Pensions	$682,995	$421,232	($261,763)	Line B in Year 2, Less Line B in Year 1
C	Deferred Outflows Related to Pensions	$546,202	$462,593	($83,609)	Line C in Year 2, Less Line C in Year 1
D	**Pension Expense, Less Cash Contributions**			($267,780)	**Year-Over-Year Change in Line A, Plus Year-Over-Year Change in Line B, Less Year-Over-Year Change in Line C**
Reconciliation					
E		Pension Expense		($22,318)	Note Disclosure
F		Contributions		$245,462	Note Disclosure
G		Adjustment to Net Revenue		($267,780)	E less F

Using cash contributions rather than pension or OPEB expense removes potentially misleading non-cash elements from key credit analysis metrics, such as debt service coverage. Cash contributions alone, however, do not provide insight into the relative strength or weakness of pension funding efforts. For this assessment, we rely on the 'Tread Water' Indicator.

The 'Tread Water' Indicator

The tread water indicator provides an important indication of the strength or weakness of issuer pension contributions relative to reported plan funding needs. It represents our estimate of the pension contribution necessary to prevent unfunded pension liabilities from growing, year-over-year, in nominal dollars, if all actuarial assumptions are met. Unlike our balance sheet adjustment, the tread water indicator is based on reported discount rates, and thus may not be comparable across issuers (see the sections below for more details).

Contributions that exceed the tread water indicator reflect positive amortization of reported unfunded liabilities. In contrast, contributions that lag the tread water indicator typically signal the presence of an ongoing structural budgetary imbalance, because the ongoing contribution does not cover the cost of implied interest on unfunded liabilities under reported assumptions. Ongoing contribution weakness signals that government pension costs may rise in the future and shift from an implicit deferred cost to an actual budgetary cost that may compete with other spending priorities.

[7] A link to an index of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

The reporting problem

Different measures of pension costs are provided under GASB 67 and 68 accounting standards. However, none of these measures provides a comparable or reliable indication of the cost of keeping up with pension plan funding.

» **Pension expense provides no indication of the strength or weakness of pension contributions relative to reported funding needs in a given year**. Pension expense can be highly volatile because it is sensitive to changing actuarial assumptions and investment performance. Pension expense can even be negative in a given year, despite the presence of large unfunded liabilities and positive government contributions.

» **Actuarially Determined Contributions (ADCs) are not universally reported, lack standardization and are subject to substantial cost back-loading**. Not all pension plans report an ADC under GASB Statement 67. Further, accounting standards require conformity with Actuarial Standards of Practice but set few rules pertaining to the calculation of ADCs. This inconsistency in reporting is problematic for credit analysis because it renders ADCs incomparable across plans and governments. Furthermore, many ADCs are weak compared with plan funding needs. ADC methods and assumptions can be set such that a government's contribution schedule begins low and steeply escalates, allowing unfunded liabilities to grow for many years through negative amortization.[8]

» **Contribution requirements set by statutory provisions may produce ongoing pension underfunding**. In some cases, governments participate in plans where contribution requirements are set by a state statute, often as a set percentage of employee salaries. Governments only report their contribution against such statutory requirements. However, statutory requirements may or may not be related to pension funding needs. In some cases, statutory requirements that are set too low significantly understate ongoing costs to cover current pension accruals and amortize unfunded liabilities.

Our analytical response: We calculate a tread water indicator

By calculating the estimated cost to tread water, we are able to more closely compare the strength or weakness of pension contributions relative to the reported funding needs of plans.

Exhibit 9 illustrates how reported ADCs lack comparability and how they may compare with the tread water indicator, using three potential pension payments associated with a $1.0 million unfunded liability. ADC No. 1 is set to cover the employer portion of current-year benefit accruals (the employer service cost) and then to amortize the unfunded liability over 30 years as a level percentage of payroll (which is shown as the amortization payment of $60,481 in Exhibit 9). After making a contribution of $135,481 according to ADC No. 1, the reported unfunded liability is expected to grow to $1.01 million from $1.0 million.

In contrast, ADC No. 2, which is designed to amortize the original $1.0 million unfunded liability on a level dollar basis over 20 years, requires a higher overall contribution of $171,235 (including an amortization payment of $96,236), but the unfunded liability would be expected to fall under plan assumptions to $976,265 from the original $1.0 million.

[8] The annual required contribution (ARC), which was reported under prior GASB pension rules, is no longer reported under GASB 68. This metric was similar but not identical to the ADC.

Both scenarios would be reported as a complete fulfillment of the ADC, despite ADC No. 1 negatively amortizing the unfunded liability, which illustrates the lack of comparability.

Finally, the expected unfunded liability produced by a contribution equal to the tread water indicator would be the beginning value, $1.0 million.

EXHIBIT 9

	ADC No. 1	ADC No. 2	Tread Water Indicator
Amortization Period	30	20	Not Applicable
Amortization Method	Level Percentage of Payroll	Level Dollar	Employer Service Cost, Plus 100% of Interest
Reported Discount Rate	7.25%	7.25%	7.25%
Beginning Unfunded Liability	$1,000,000	$1,000,000	$1,000,000
Employer Portion of Service Cost	$75,000	$75,000	$75,000
Amortization Payment	$60,481	$96,235	$72,500
ADC / Tread Water	**$135,481**	**$171,235**	**$147,500**
Expected Unfunded Liability After Contribution	**$1,012,019**	**$976,265**	**$1,000,000**

How we calculate the tread water indicator

The tread water indicator is the sum of two components: the employer portion of the service cost and the implied interest on the net pension liability at the beginning of the plan's fiscal year. We calculate the tread water indicator using the reported discount rate.

To calculate the employer portion of the service cost, we subtract employee contributions from total service cost. To calculate the implied interest on the net pension liability, we multiply the net pension liability at the beginning of the plan's fiscal year by the discount rate from the prior year, or in other words, at the beginning of the plan's fiscal year (see Exhibit 10).

When governments participate in multiple-employer cost-sharing plans, we calculate the tread water indicator for the plan in aggregate and allocate the same proportionate share to participating governments that is applied to their balance sheets in a given year.

EXHIBIT 10

Label	Line Item	Value of Plan - Hypothetical Example	Source
A	Total Pension Liability (beginning of year)	$50,000,000	Reported
B	Plan Fiduciary Net Position (beginning of year)	$40,000,000	Reported
C	Net Pension Liability (beginning of year)	$10,000,000	= A less B
D	Single Equivalent Discount Rate (prior year)	7.50%	Reported
E	Implied Interest on Net Pension Liability	$750,000	= C * D
F	Service Cost	$500,000	Reported
G	Employee Contributions	$200,000	Reported
H	Employer Service Cost	$300,000	= F less G
I	**Tread Water Indicator**	**$1,050,000**	**= E plus H**

Comparing contributions to the tread water indicator is analytically useful because it demonstrates whether a government, under its own assumptions, is expected to amortize any portion of its net pension liability. However, it has some limitations. Since the tread water indicator is based on reported discount rates, it is not standardized across plans and issuers. For example, higher discount rates push

down the tread water indicator, and lower discount rates raise the tread water indicator, all else being equal.

We do not currently have a standardized adjustment for service cost, which, like accrued liabilities, is a function of the discount rate assumption. Since service cost is a key input of the tread water indicator, the tread water indicator is useful in analyzing the strength of an issuer's pension contributions but is not comparable across issuers. Governments and their plans do not disclose the sensitivity of service costs to discount rate changes under GASB 67 and 68. For plans that report using blended single equivalent discount rates due to projected depletion under GASB standards, we may supplement our tread water analysis with other data points, such as net liabilities at the beginning of the year and service costs, from an actuarial valuation report based on an assumed rate of return, if available, rather than the GASB single equivalent discount rate.

The Asset Shock Indicator

The pension asset shock indicator (PASI) represents our estimate of the one-year probability that an issuer experiences a pension investment loss that amounts to 25%, or more, of its operating revenues. It reflects two key factors: the size of pension assets relative to a sponsoring issuer's revenues, and pension investment risk-taking, expressed as the expected volatility, or standard deviation of pension investment returns. A higher asset shock indicator signals greater balance sheet exposure to pension investment volatility risk, and vice-versa.

The PASI is meaningful only when viewed in tandem with the ANPL. Considering both indicators together facilitates comparisons across issuers. The PASI indicates the balance sheet risk facing governments from potential pension investment return volatility in the future, whereas the ANPL indicates the point-in-time unfunded liability. All else being equal, a smaller ANPL is better for credit quality. However, across two issuers with the same ANPL burden, a higher PASI indicates greater balance sheet risk from pensions due to higher risk of material investment losses.

The PASI is point-in-time and does not indicate the pension asset accumulation or depletion that is likely to occur in the years following an investment loss, an assessment that would require a projected cash flow analysis of a government's pension system(s), including projected benefit payments, which are not disclosed under GASB rules.

The reporting problem

Under GASB rules, issuers report an unfunded or over-funded pension liability on their balance sheet, as opposed to reporting the Total Pension Liability on its own as a liability and the Plan Fiduciary Net Position on its own as an asset. Even though the scale of issuers' unfunded liabilities (which we measure with our ANPL) may be similar, the relative scale and composition of their pension assets may be very different. Different scales of pension assets relative to government operations mean that the scale of balance sheet susceptibility from a given rate of pension investment loss is also different.

The following comparison (Exhibit 11) between Government A and Government B demonstrates this issue. The relative scale of each government's balance sheet leverage from unfunded pension liabilities under our adjustments is nearly identical: Government A's ANPL amounts to 363% of its revenues, while Government B's ANPL amounts to 364% of its revenues. However, the relative size of each government's pension assets is much more varied. Government's A's pension assets amount to 192% of its revenues, which means that a 10% loss in pension assets would amount to roughly 19% of its revenues. The same 10% stress test to Government B's pension assets would amount to 42% of its

revenues because its pension assets are far greater in scale, at 425% of its revenues. In this example, Government B would face more than double the burden, relative to its revenues, to rebuild lost pension assets from a 10% pension investment loss in comparison to Government A.

EXHIBIT 11

		Government A		Government B	
Line item		$ bln	as % of revenues	$ bln	as % of revenues
A	GASB Total Pension Liability	$5.6	363%	$36.0	512%
B	**Plan Fiduciary Net Position (Pension assets)**	**$3.0**	**192%**	**$29.8**	**425%**
	GASB Net Pension Liability (reported on balance sheet, A less B)	$2.6	171%	$6.2	88%
	Adj. Total Pension Liability (Moody's)*	$8.6	555%	$55.4	789%
	ANPL (Moody's)*	**$5.6**	**363%**	**$25.6**	**364%**
	Stress Test: Loss of 10% of pension assets (10% * B)	$0.30	19%	$2.98	42%

*See Exhibits 3 and 4 for illustrative examples of calculations for the Adjusted Total Pension Liability and ANPL.

The likelihood that issuers' pension systems suffer a given rate of loss is a direct result of the level of investment risk taken on through their asset allocations. For example, assets carrying higher expected returns, such as equities, also tend to carry higher expected volatility of returns than assets with lower expected returns. Expected volatility is a common measure for risk of assets and investment portfolios, and mathematically is the expected standard deviation of investment returns.

Under GASB reporting rules, issuers report broad general categories of pension asset allocations in the notes to their financial statements. However, the description of asset classes under this reporting is often very general and is not uniform, making it difficult to compare pension asset risk-taking among issuers. Further, given the complexity and magnitude of US public pension system assets, spanning fixed income, public and private equity and various alternative classes such as real estate and natural resources, it is not feasible to gauge the investment risk-taking of each US public pension system in a comparable way based on these general financial disclosures. While US public pension systems' own financial disclosures offer greater detail, many (typically small) local governments whose financial disclosures do not comply with GASB 68 may not provide any detail surrounding pension asset composition in their financial disclosures, and their pension systems do not issue stand-alone financial reports.

Our analytical response: We calculate an asset shock indicator

To compare the balance sheet risk from potential pension investment losses, we use the PASI, which incorporates the relative size of pension assets compared to revenues, and the likelihood that pension systems suffer losses. To calculate the likelihood that pension systems suffer losses, we first estimate the expected return volatility of an issuer's pension assets using a "risk-return map" (often referred to as an "efficient frontier"). Our risk-return map provides an estimate of the minimum expected volatility (i.e., portfolio risk expressed as the expected standard deviation of investment returns) attainable for a given return target, enabling consistent volatility estimates across issuers.[9] The input we use is the target return of an issuer's pension system, or the asset-weighted average of target returns used by an issuer's pension systems if it has more than one. We map this pension investment

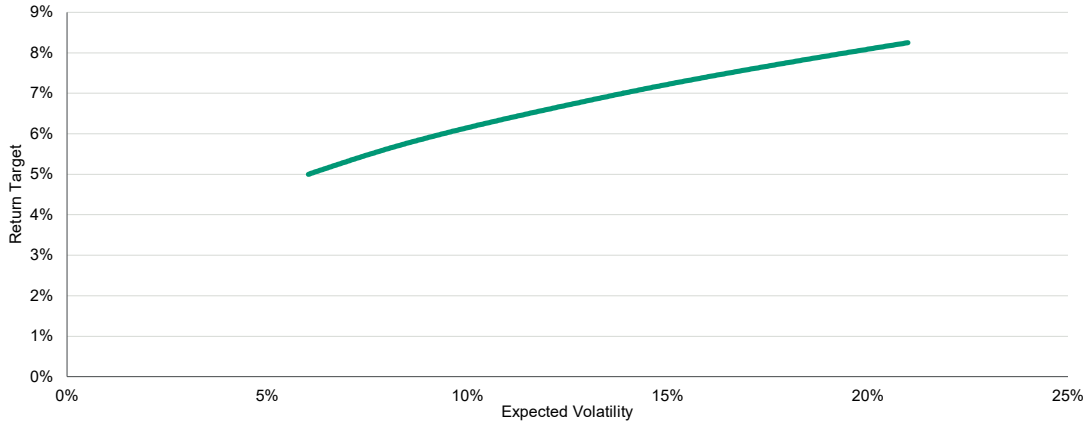
[9] A key assumption underlying our approach is that US public pension systems are investing efficiently, meaning that they are minimizing the expected volatility of their investment portfolios given their return targets.

return target input in a given year to a minimum expected volatility on our risk-return map for the corresponding year.

We calculate and publish our risk-return map annually during the first calendar quarter ending in March,[10] and apply it to all issuers' financial reporting covering the same year. For example, our 2019 risk-return map (published in the first quarter of 2019) applies to all issuers' financial reporting for fiscal years ending any time in 2019. We estimate the risk-return map based on a set of annual capital markets assumptions[11] covering expected returns, expected volatility and the correlation of numerous asset classes. We base the calculation of our risk-return map on an annually selected basket of asset classes that span the risk-return spectrum, including fixed income, equities and alternatives. Based on the expected return, volatility and correlation of the classes we select, the risk-return map represents the lowest expected volatility that is attainable through portfolio diversification across the asset classes in our basket for a given investment return target.[12] An illustrative risk return map is shown below in Exhibit 12.

EXHIBIT 12

Illustrative Risk Return Map



Source: Moody's Investors Service, using J.P. Morgan's Long-Term Capital Markets Assumptions

How we calculate the asset shock indicator

The PASI is calculated for a given entity in several steps:

» **Step 1**: Determine an issuer's target pension investment return, incorporating all of its pension systems. For issuers with multiple pension systems, we use the asset-weighted average target return across their pension systems. For example, in Government C's fiscal year reporting, its target return for both of its pension systems is 6.50%, meaning its asset-weighted average target return is also 6.50%. For Government D's reporting for the same fiscal year, its target return is 7.09%, reflecting the asset-weighted average target return across its three pension systems (see Exhibit 13).

[10] For a link to the current "Risk-Return Map," please see the "Moody's Related Publications" section.

[11] While the capital markets assumptions that we have used, covering the years 2016 – 2019, are J.P. Morgan's Long-Term Capital Markets Assumptions, we may in future years use similar capital markets assumptions published by another party, if for example, J.P. Morgan's annual capital markets assumptions were not available, or if we decided that other assumptions were more representative of the return-volatility trade-off.

[12] For simplicity, we assume no short positions (i.e., no "negative" portfolio allocations).

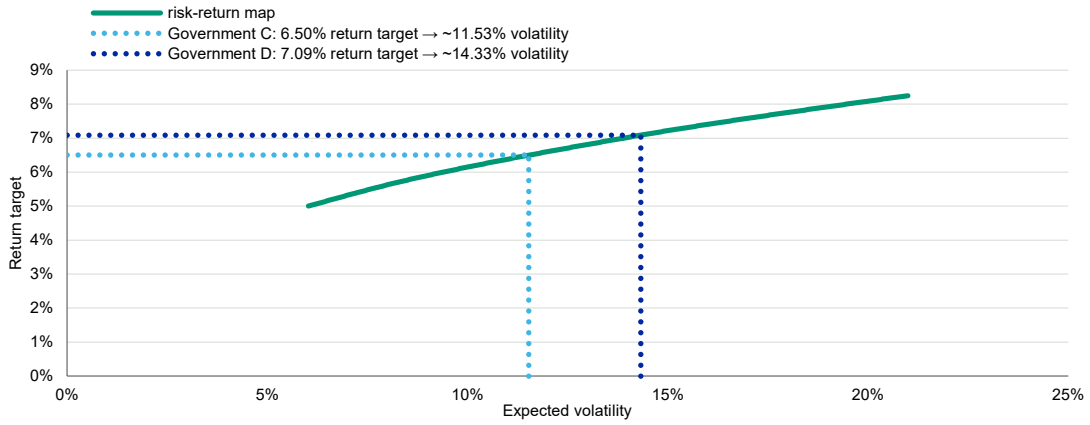
EXHIBIT 13

	Government C			Government D			
$ blns	Pension System 1	Pension System 2	Total	Pension System 1	Pension System 2	Pension System 3	Total
Pension assets	$6.0	$2.2	**$8.2**	$4.2	$2.2	$5.5	**$11.8**
% of pension assets	73%	27%	**100%**	35%	18%	46%	**100%**
Asset-weighted average target return							
Target return	6.50%	6.50%	**6.50%**	7.25%	7.00%	7.00%	**7.09%**

» **Step 2**: Assign an expected investment return volatility value from our risk-return map, using the target return from Step 1 as an input. In this example, we are using information from the fiscal year reporting by Governments C and D that aligns with the risk-return map shown in Exhibit 14. Along our risk-return map, Government C's 6.50% target return (calculated in Step 1, above) maps to an expected volatility of 11.53%. Government D's 7.09% target return maps to an expected volatility of 14.33% (see Exhibit 14).

EXHIBIT 14

Illustrative Risk-Return Map: Assigning Expected Volatility Based on Target Return



Source: Moody's Investors Service, using J.P. Morgan's Long-Term Capital Markets Assumptions

» **Step 3**: Calculate a "shock" return rate, by first multiplying a government's operating revenues by 25% to determine a shock pension asset loss, in nominal dollars.[13] This level of loss divided by pension assets produces our shock return rate, and is a direct function of the scale of pension assets relative to a government's operating revenues. The larger the scale of pension assets relative to a government's revenues, the less severe the pension investment loss required to amount to 25% of its revenues, and vice-versa. Government C, with pension assets that amount to only 95% of its revenues, would have to incur a 26.4% pension investment decline to lose assets that amount to 25% of its revenues. Government D, with pension assets that amount to 476% of its revenues, would only have to incur a 5.3% investment decline to lose assets that amount to 25% of its revenues (see Exhibit 15).

[13] We have chosen 25% of revenues as a standard benchmark for a loss that would be material in size compared to a government's annual revenues.

EXHIBIT 15

Line item	$ billions	Government C	Government D
A	Pension assets	$8.2	$11.8
B	Operating revenues	$8.7	$2.5
C	Pension assets as % of revenues (A / B)	95%	476%
D	"Shock" asset loss amounting to 25% of operating revenues (-25% * B)	($2.2)	($0.6)
E	Shock loss rate: shock loss as % of pension assets (D / A)	-26.4%	-5.3%

» **Step 4**: Calculate the probability of the shock return rate (from Step 3) materializing, by calculating the cumulative probability of the shock return rate, assuming a normal distribution with mean equal to an issuer's target return (from Step 1) and standard deviation equal to an issuer's expected volatility (from Step 2). The resulting probability is the PASI, our estimated one-year probability that a government experiences a pension asset loss that amounts to 25%, or more, of its revenues. For Government C, with a relatively small scale of pension assets and lower expected volatility associated with a lower target return, its fiscal 2018 PASI is 0.2%. For Government D, with a higher expected volatility due to a higher target return and a far less severe threshold for its shock loss return rate resulting from a far greater scale of pension assets, its fiscal 2018 PASI is 19.4% (see Exhibit 16).

EXHIBIT 16

	Source	Government C	Government D
Target return (mean)	Step 1	6.50%	7.09%
Expected volatility (standard deviation)	Step 2	11.53%	14.33%
Pension assets as % of revenues	Step 3	95%	476%
Shock loss return rate	Step 3	-26.4%	-5.3%
Probability of shock loss return rate (PASI)	**Cumulative probability of shock loss return rate (or worse) materializing, assuming a normal distribution with mean equal to target return and standard deviation equal to expected volatility**	**0.2%**	**19.4%**

Moody's Related Publications

Credit ratings are primarily determined by sector credit rating methodologies. Certain broad methodological considerations (described in one or more cross-sector rating methodologies) may also be relevant to the determination of credit ratings of issuers and instruments. An index of sector and cross-sector methodologies can be found here.

For data summarizing the historical robustness and predictive power of credit ratings, please click here.

The current and superseded "Risk-Return Maps" can be found here.

A list of potentially related sector and cross-sector credit rating methodologies can be found here.

For further information, please refer to *Rating Symbols and Definitions*, which is available here.

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