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Alternatives for Pension Cost Recognition—Issues and Implications

KEY POINTS

- It is common to develop pension cost based on a single aggregated discount rate, i.e., that used to develop projected benefit obligation.
- Alternative approaches have been identified that represent more "granular" applications of yield curve rates.
- Use of such alternatives may reduce the amount of recognized pension cost, but also have implications for expected gains/losses to be recognized at year-end.
- There are varying views about what yield curves represent that impact expectations for year-end gains/losses and thus may act to justify different levels of cost recognition.

This issue brief provides a discussion of an area of emerging practice. Its objective is to inform actuaries and other interested parties about alternative expense methodologies, and their theoretical rationales and implications. Because it is not an actuarial standard of practice (ASOP) promulgated by the Actuarial Standards Board, it is not a definitive statement as to what constitutes generally accepted practice in the area under discussion. Actuaries are not bound to adhere to the conclusions that may be identified in issue briefs or to conform their work to the practices described therein.

Introduction

For U.S. pension accounting, the present value of benefits based on service to date (i.e., the projected benefit obligation [PBO]) is typically calculated based on the application of yield curve spot rates to projected benefit cash flows. A single discount rate that produces that same present value is then determined and disclosed. The most common approach has been to also use that same single rate in determining other cost components such as service cost and interest cost.

Alternative approaches have been proposed for the recognition of various components of pension cost. These involve more granular applications of interest rates for developing service cost and interest cost. The measurement of PBO, as described above, does not change.

In comparison to the current "aggregated" (single rate) approach, alternative approaches might result in a lower cost amount being recognized during the measurement period. However, because every dollar of service cost and interest cost recognized is—by definition—reflected in the expected year-end value of obligations, a change in recognized cost also changes the expectation for the year-end obligation and thus affects the gain or loss that results when obligations are re-measured at year end.

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The actual year-end obligation and the amount of any gain/loss realized will depend on whether and how fixed-income market conditions change over the course of the year, along with other experience factors. The increase in the value of obligations at year-end is of course unaffected by the cost amount that is recognized for the period. The accounting issue under discussion involves finding a rationale for allocating the change in PBO value between recognized cost and experience gain/loss. The allocation is important because although the balance sheet will reflect the total change in value, recognized cost and experience gain/loss have different income statement consequences.

This issue brief outlines a range of approaches for determining pension cost, some of which might be viewed as "back-loading" that cost recognition in comparison with the aggregated approach. The varying pension cost elements under each approach are identified, and representative examples are provided that quantify the effect on bottom-line cost and the associated implications for gain/loss outcomes at year-end.

In order to evaluate the resulting year-end situation some presumption must be made about the prevailing interest rate environment at year-end. Each pension cost recognition approach can be justified by positing some assumption about year-end interest rates. While it might seem reasonable to evaluate the implications of various methods of cost determination in reference to an assumed stationary yield curve—i.e., interest rates at all maturities stay exactly the same through the year—an expectation for no change in yield curve rates may not be the only reasonable basis for estimating the level of benefit obligations at year-end.

(Note that there is a more detailed examination of alternative capital market views in a later section of this paper; however, no position is taken as to the supportability or reasonableness of various capital market views.)

Current (Widely Used) Aggregated Approach

The traditional interest cost calculation uses an aggregated single discount rate—the single rate that when applied to the PBO cash flow reproduces the present value of those same payments. The resulting single rate can be viewed as a weighted average of the yield curve spot rates that are used to develop that present value. This rate is aligned with the payment timing and associated participant demographics related to already-earned benefits as of the beginning-of-year measurement date.

Under the aggregated approach, that single interest rate is used for all pension cost calculations—including the development of service cost and the interest cost that is applied to PBO and service cost amounts. While the service cost is similar to the PBO in that it is determined as of the measurement date, the interest cost is intended to accumulate the PBO and service cost values from the beginning to the end of the year.

By using the single rate associated with already-earned benefits to also develop the value associated with new accruals (in the service cost determination), the aggregated approach produces a larger service cost value than would be calculated if the demographics associated with service cost were considered separately. This is because the demographic maturity associated with participants earning new benefit accruals is almost always less than that associated with existing accruals, i.e., service cost-related payments are more deferred and would thus generally be assigned a higher discount rate if evaluated separately.

Members of the Pension Cost Work Group, a joint effort of the Pension Committee and the Pension Accounting Committee, include: James Burke, MAAA, FSA, EA, FCA; Bruce Cadenhead, MAAA, EA, FSA, FCA; James Clark, MAAA, EA, FCA, FSA; Arthur Conat, MAAA, EA, ASA; Timothy Geddes, MAAA, EA, FSA, FCA; Eric Keener, MAAA, FSA, EA, FCA; Gerard Mingione, MAAA, FSA, EA, FCA, CERA; Keith Panetta, MAAA, EA; Michael Pollack, MAAA, EA, FSA, FCA; Francis Ratna, MAAA, FIAA, FSA; Jay Rosenberg, MAAA, EA, FSA, FCA; Mark Spangrud, MAAA, FSA, EA; and John Stokesbury, MAAA, FSA, EA, FCA.

On the other hand, presuming that the yield curve remains unchanged (and has a typical upward slope), the aggregated approach produces a smaller value for interest cost associated with PBO than would be developed under a "more precise" application of yield curve rates. This is because over the course of a year each of the related payments becomes a year closer to ultimate payment date, and thus the duration of the payment stream shortens. The discount rate determined at the beginning of the year includes no provision for the effect of the reduced term premium expected to relate to those benefits, which under these "no change" conditions would result in a reduced year-end discount rate with respect to this (fixed) set of payments.[1]

Expensing using a single aggregated rate for all components of pension cost implies that the discount rate re-determined at year end would have to be exactly the same as the beginning-of-year discount rate in order to avoid a gain or loss attributable to discount rates. If expected year-end values are instead evaluated based on the presumption of no change in yield curve rates, a no gain/loss outcome would be achieved only if the gain from the service cost portion of benefit payments (which would be assigned a higher discount rate if measured on its own) equates to the loss coming from the PBO portion of benefit payments (which if measured on its own would result in a lower year-end discount rate). In other words, in the fully balanced case the addition of service cost (and the associated longer duration cash flow) to the end-of-year PBO cash flow results in stable plan demographics and a stable liability duration from year to year.

Plan demographics and the duration of liabilities could be changing over time, so this balance dynamic cannot be expected to play out exactly for all plans. If a plan is curtailed or closed, or if the participant demographics are long service/older, the PBO/service cost ratio will generally be higher (or in the opposite case, with a newer/growing plan, possibly lower) than in the fully balanced case. In these situations, the gain from "overstating" service cost may not suffice to balance out the loss related to the PBO as the timing associated with past service-related payments shortens during the year.

This implies that—if yield curve rates remain unchanged—using a single aggregated discount rate could result in a pattern of losses exceeding gains in mature plans (all other things being equal), in particular those that are curtailed or closed. That is, mature plans with relatively low rates of accruals will experience a tendency toward declining (aggregated single) discount rates as the duration of benefit payments declines—and thus a pattern of losses attributed to that discount rate reduction. On the other hand, given the same unchanged yield curve rates, gains could exceed losses in younger/growing plans (admittedly less common today), where liability duration may be lengthening and there is a resulting tendency toward increased discount rates.

Even with plans experiencing demographic change, a no gain/loss outcome can still be achieved through a change in fixed-income rates sufficient to offset the effect of changing participant demographics. All that is required is that the aggregated discount rate remains unchanged, regardless of the specific factors that enable that outcome. Also, even for extremely mature plans, the rate of demographic change and the experience losses implied by a trend toward declining discount rates are not likely to be very significant over the one-year measurement period involved in pension cost calculations.

Note that if the aggregated approach is applied separately to different subgroups of an employer's population (with different demographics), the results could change. Thus an employer with multiple plans accounted for separately can see different service cost and interest cost results than if all obligations were included in a single plan.

1 Technical Notes: (a) given a typical upward sloping yield curve, a liability with a shorter duration will be valued at a lower rate; (b) while the duration associated with a given payment stream almost always declines over the course of the year, there may be situations where the duration of a stream of payments would increase from one year to the next, e.g., if a large lump-sum payment is made during the current year.

Strengths of the aggregated approach:

- Simple, straightforward execution; and
- Extremely straightforward in terms of the outcome necessary, i.e., no change in discount rate, to avoid a gain/loss (attributable to discount rates) at year-end.

Weaknesses of the aggregated approach:

- Calculation methodology is more approximated than under other potential methods;
- Plan design and demographic conditions might be such that—absent any change in yield curve rates—some plans could experience at least some (likely small) tendency toward declining discount rates and experience losses (or alternatively, in the less common case, increasing discount rates and gains); and
- Cost component measures might vary based on how obligations are split among multiple plans.

More Granular Approaches

Applying the yield curve rates in a more granular way allows for a number of alternative approaches for recognizing annual pension cost. Under both granular and aggregated approaches, the specific yield curve rates (spot rates) are applied separately to each year of projected cash flow, with the resulting present value associated with past service benefits being labeled the PBO. Under the aggregated approach there is then a second step where a single rate is derived that produces that same present value. This does not change the PBO value, since the present value of benefit payments is developed in the same way for PBO purposes whether represented by an aggregate rate or not (i.e., the single rate is "backed into"). In fact, even under a granular approach, that aggregated single rate is generally still developed and used for disclosure purposes. The critical difference is that, under such granular approaches, the aggregated single rate is not used to develop other elements of pension cost such as service cost and interest cost.

Measuring service cost from a more specific application of spot rates to service cost-specific cash flows recognizes the generally longer duration of new benefit accruals as compared to the duration of already accrued benefit payments underlying the PBO—and generally results in a higher effective discount rate and a lower measure of service cost (than derived using an aggregated rate).

While the reduction in measured service cost is common to all granular approaches, the development of interest cost (on both PBO and service cost) based on the application of yield curve rates to the year-by-year cash flows is not as clear-cut. Three potential alternatives for measuring interest cost (see appendix for numerical examples):

- Apply the **individual forward rates applicable for each future time period** (the longest/last forward rate applicable to each projected payout). This approach is theoretically best aligned with a goal of avoiding gains and losses under a presumption that yield curve rates remain unchanged. Since the resulting interest cost amount is typically larger than under the aggregated approach, using this method may reduce, eliminate, or (for more mature plans) reverse the cost-reducing effect of using a more granular approach for measuring service cost.
- Apply the **individual spot rates for each time period**. Under this approach, a no gain/loss scenario requires the individual spot rates assigned to each cash flow to remain unchanged even as the period to payment of that cash flow amount is reduced. If the spot rate attached to a given future year (say 2020) is lower next year, a loss results. In other words, the yield curve must rise sufficiently to offset the expected loss of a portion of the yield attributable to term premium. Over many valuation cycles, a pattern of recurrent losses might be expected unless short-term interest rates converge over time to current (generally higher) long-term levels.
- Apply the **first-year spot/forward rate**. The rationale for this approach is that the first-year rate identified on the yield curve (the year one spot or forward rate) is that assigned to the current year. Since the first-year rate is almost

always the lowest rate on the yield curve, this approach will typically result in a much lower interest cost. It can be viewed as highly aggressive in that the avoidance of a loss outcome requires the yield curve to increase rather substantially, particularly at the short end of the curve. That is, all forward rates would have to move down by one year of maturity (so that the rate applicable for year five becomes the rate applicable for year four). This approach results in a very significant pattern of emerging actuarial losses unless yield curve rates increase each year.

What should be derived from the above descriptions is the direct connection between the level of pension cost recognized for a given period and the conditions required to achieve a no gain/loss outcome at the end of that period—*the lower the recognized cost, the higher year-end fixed-income rates would have to be in order to avoid a loss*. Said another way, the lower the recognized cost for the year, the greater the implied increase in the plan's discount rate at year-end.

Other observations:

- In each of the three granular approaches, a more refined calculation of service cost can be viewed as more closely reflecting the timing/demographics associated with newly earned benefits—and typically results in a smaller value for service cost than under the aggregated approach.
- In the first approach, the service cost reduction would be offset by an expected increase in the interest cost applied to PBO—which would now reflect, on a more refined basis, the aging of the PBO-related payments (again, based on an expectation that the yield curve will remain unchanged). This more refined treatment avoids the need for a balance of gains and losses from the two components, as implied under the aggregated approach. Though the components are different, for a plan with stable demographics, the resulting cost will be essentially the same as that developed from the aggregated approach. With a maturing or curtailed plan, one would expect to see higher cost, while the cost may be reduced for a younger/growing plan.
- In the second and third approaches, there will generally be a reduction in interest cost due to the application of lower effective rates on PBO.[2] The reduction in interest cost is typically of greater magnitude than the reduction in measured service cost. (See numerical examples in the appendix.)

Strengths of these granular approaches:

- More refined determination of service cost, reflecting service cost-specific demographics;
- Reduced or no reliance on stable plan demographics and approximate offsets of gain vs. loss outcomes; and
- Cost component measures are the same regardless of how liabilities are split among multiple plans.

Weaknesses of the granular approaches:

- More complex/less straightforward calculation of pension cost;
- Possible loss in transparency, because cost calculations are based on rates that differ from the rate disclosed for PBO (which implies a need for the disclosure of multiple equivalent rates); and
- Increases in discount rates are necessary to avoid gains/losses under two of the three granular methodologies—the greater the implied increase, the more difficult it can be to rationalize.

Other/Mixed Approaches

As noted earlier, applying the traditional aggregated approach separately to different

2 It may not be immediately apparent how the individual spot rate approach results in a lower effective interest cost than the aggregated approach, because the mechanism for assigning interest costs to projected benefit cash flows seems fairly similar when stated in words. The difference, however, is in the weighting associated with shorter vs. longer maturity payments. In the development of a single aggregated rate, much greater weight is assigned to the long-deferred payments (which are subject to long periods of discounting), while in the application of spot rates to the present values of payments, greater weight is assigned to less discounted near-term payments and less weight is assigned to more discounted (and thus relatively small in terms of present values) long-deferred payments.

segments of the obligation will change the result. Another potential approach involves aggregating the calculation and application of discount rates for PBO while handling service cost on the more refined basis, so that the younger demographic profile associated with new accruals (with payments more deferred) is used as a rationale for determining a higher effective discount rate (and consequently lower service cost).

Note, however, that a switch to a more refined calculation of service cost also results in a change to the balance of gains and losses that is implied in the traditional aggregated approach. Thus, in order to avoid an end-of-year loss, some increase in yield curve rates must be presumed.[3]

This approach can be further refined by determining separate discount rates for segments of the PBO, such as those relating to active, terminated vested, and retired participants. Carrying this approach to the extreme of developing separate PBOs and discount rates for each year's expected payments results in the granular "individual spot rate for each time period" approach previously identified.

Issues That Arise With Application to a Bond-Matching Model

A more granular application of interest rates generally requires the availability of a complete series of yield/spot/forward rates across the entire array of maturities. These are readily available, or easily developed, from any yield curve model. However, under bond-matching models, a specific portfolio of bonds is identified that is associated with the overall cash flow timing/duration of plan benefits. The selected bond portfolio may not include information about yield rates across the entire maturity spectrum.

Alternatively, because the premise of a bond selection approach is that the resulting bond portfolio is a good match for the obligation, the expected return on the referenced portfolio could be considered for use as the interest cost. Of course, defining the level of expected return requires defining an expectation for yields on the portfolio's bonds at year-end. Assuming that fixed-income rates remain unchanged implies a higher return on the bond portfolio (akin to the interest cost defined under the individual forward rate approach previously identified), while an assumption that interest rates rise over the course of the year implies a lower expected return.

Alternative Capital Market Views

While the above analysis has provided an evaluation of gain/loss outcomes against a baseline of "no change in yield curve rates," other assertions are sometimes made about capital market expectations that do imply some expected change in future yield curve rates. Because yield curves typically include some degree of upward slope, many of the assertions about capital market expectations derived from yield curves lead to a presumption that discount rates in future periods will increase, which would of course better support the recognition of a reduced cost for the current period (compared to cost elements determined under the aggregated approach and a constant rate assumption).

Two of the granular approaches might be viewed as representing the extreme ends of potential fixed-income market views. The most aggressive of these would be the "expectations" approach that presumes forward rates are predictive of future rates that will be attached to a particular calendar year—rather than to that same period of years into the future.[4] The first-year forward rate approach for determining interest cost is consistent with this expectations

3 The resulting imbalance (with presumed constant rates) is similar to what occurs in the situation where the aggregated approach is applied to a curtailed plan. In both cases there is no opportunity for a gain to arise due to the "overstatement" of service cost to offset the impact of the reduction in discount rate that occurs with the aging of the existing benefit accruals/PBO.

4 Note that under the expectations approach there is an implication that current long-term rates (e.g., the 30-year forward rate) will ultimately become the applicable short-term rates (e.g., the one-year spot/forward rate). While the assertion required over any given one-year measurement period is obviously much less extreme, this long-term equality would be required in order to avoid a series of experience losses over time.

view. By applying the year-one forward rate to determine interest cost, there is no gain/loss only if all the remaining forward rates (other than the first) remain in place for discounting that cash flow at year-end. Thus it presumes that the yield curve slope represents implications for expected future changes in/levels of interest rates rather than term premium (i.e., because interest rates don't remain attached to years-to-maturity periods, there is no presumed compensation for the disutility associated with the fixed commitment of funds).

The individual forward rate approach, on the other hand, is consistent with an assertion that the shape of the yield curve is fully explained by term (or liquidity) premium rather than representing a consensus market view about expected future changes in interest rates. For example, in assigning interest cost to a year 30 cash flow it applies the 30th year forward rate, which implies that at the end of the year the forward rates that previously applied from years 1 to 29 are expected to remain in place. Thus it aligns with a baseline view that yield curve rates are not expected to change.

It might also be possible to develop a model based on an expectation that current spot rates will remain attached to a given cash flow even as that cash flow becomes closer to its payment date, as would be necessary for an expectation of a no gain/loss outcome under the individual spot rate approach. The capital market fundamentals underlying this assertion are harder to define—that is, what rationale supports a presumption that forward rates increase by the exact amount necessary for spot rates to essentially shift downward one year. From a bottom-line perspective, the assertion about future interest rates that underlies the individual spot rate approach could be viewed as representing some combination of the presumptions underlying the expectations and constant-yield-curve views described above.

The numerical examples in the appendix indicate the range of cost and discount rate outcomes that can be associated with, explained and (potentially) defended based on the full array of potential capital market views.

U.S. GAAP Accounting Issues

A change to a more granular calculation of service cost and/or interest cost for purposes of measurements under the Financial Accounting Standards Board's Accounting Standards Codification (ASC) Topic 715-30 can be viewed as moving toward a more explicit approach to assumptions as defined under ASC 715-30-20.[5] In evaluating the appropriateness of a methodology in that context, it also seems relevant and necessary to assess the implicit assumptions about capital markets necessary under each expense method in order to avoid an expected gain/loss.[6]

As discussed in the previous sections, the implicit assumptions necessary under the various approaches can generally be described as follows:

- Under the traditional/aggregated approach, no change in PBO discount rate from the beginning to the end of year is required, however that is achieved. This could be considered as an implicit assumption about changes in demographics and/or yield curves, generally that there will be little or no change in either (or that the changes offset).
- Under the individual (last year) forward rate approach, the yield curve rates remain totally unchanged.
- Under the individual spot rate approach, forward rates increase by the exact amount necessary for spot rates to essentially shift downward one year, so that each rate remains attached to a given projected cash flow (even as it becomes closer to its payment date). This results in a PBO discount rate that is generally presumed to be higher at year-end than at the beginning of the year.

5 An explicit approach is defined as "an approach under which each significant assumption reflects the best estimate of the plan's future experience solely with respect to that assumption."

6 *Gain or loss* is defined as "a change in the value of either the benefit obligation (projected benefit obligation for pension plans or accumulated postretirement benefit obligation for other postretirement benefit plans) or plan assets resulting from experience different from that assumed or from a change in an actuarial assumption, or the consequence of a decision to temporarily deviate from the other postretirement benefit substantive plan."

- Under the first-year forward rate approach, the forward rates advance one year (so that the rate applicable for year five becomes the rate applicable for year four, etc.). This generally implies significantly rising fixed-income rates, and a commensurate significant increase in the PBO discount rate over the course of the year.

In addition to the assessment of reasonableness, it is also necessary to determine whether a change in pension cost recognition will be recognized as a change in accounting principle or a change in accounting estimate. A change in accounting principle generally results from a shift from one methodology to another in a case where two or more such generally accepted principles could apply. A change in accounting estimate is considered to be a necessary consequence of the assessments made in presenting figures in financial statements that incorporate estimates and expectations. Treatment as a change in accounting estimate generally implies that there is new (or newly available) information or more refined techniques for determining values.

If viewed as a change in accounting principle, the key question is whether the new method can be seen as "preferable." It might be difficult to conclude that a method that implies lower pension cost recognition and a resultant expectation of greater losses being generated and then (possibly) deferred to future years is preferable. Alternatively, it could be argued that moving to a more granular approach that more explicitly applies the yield curve rates might be preferable from that perspective. Furthermore, if the revised approach is deemed to represent a change in accounting principle, accounting standards require retrospective application, i.e., a retroactive recalculation of costs as though the new method had always been used. For a methodology that generally reduces annual cost recognition (for companies that defer gains/losses), this shift would typically result in the establishment of a large unrecognized loss as of the change date (which could then require amortization, thus raising annual cost).

If the change is deemed to represent a refinement of an accounting estimate, then changing the application of the discount rate for pension cost purposes would generally be evaluated as to whether the change is to a more refined approach and whether it provides a better estimate. There could be a further requirement to demonstrate what new information led to the change in accounting estimate. (Auditors can be expected to ask "why?" and "why now?")[7] Changes in accounting estimate are reflected only prospectively in financial statements.

While the majority of the discussion above has focused on the evaluation of alternative pension cost recognition approaches as applied to pension benefits, it is clear that the rationale for such approaches could be applied to other postretirement benefits accounted for under ASC 715-60, and possibly also to postemployment benefit programs where accrual accounting is applied under ASC 712 (i.e., in situations where benefit are deemed to accumulate or vest). The issues attendant to the pension benefits discussed above would likely apply in a similar fashion to these other postretirement/postemployment benefits.

In this regard it is noteworthy that postretirement (ASC 715-60) benefits would be expected to have dynamics similar to those for pensions (e.g., relatively high ratios of benefit obligations to service costs), which entails that the key evaluation issue—the need to rationalize an expectation for discount rate increases—would be essentially the same. Postemployment benefit programs accounted for under ASC 712 might have quite different valuation dynamics, and thus the issues and comparisons might also be different.

7 In addition to the alternatives of a change in accounting principle or a change in accounting estimate, there is also a third, less commonly seen, category of change defined in the accounting literature. ASC 250-10-45-18 identifies a Change in Accounting Estimate Effected by a Change in Accounting Principle as a situation where a new method is adopted in partial or complete recognition of a change in estimate. While a change determined to be in this category must be deemed preferable to the prior approach, it is accounted for the same as for a change in accounting estimate—with no retrospective adjustment required.

Appendix —Numerical Examples

Simplified Two-Payment Example (to illustrate the concepts)

The yield curve rates indicated below are taken from the December 31, 2014, Citigroup Yield Curve.

Yield Curve Rates		
Time Period	**Spot Rate**	**Forward Rate**
1	0.65%	0.65%
2	1.04%	1.44%
3	1.57%	2.62%
4	1.97%	3.18%
5	2.24%	3.36%
19	4.00%	5.37%
20	4.08%	5.56%

Initial year forward rate is sole rate used to credit interest in the "first-year forward rate" approach.

Applicable year forward rates are used to credit interest in the "individual forward rate" approach.

Technical notes:

- Spot rates are rates applicable for discounting a payment made in a given year back to the starting point/measurement date.
- Forward rates are rates applicable for discounting from the beginning to the end of a given year. An accumulation of (1/1+forward rates) provides the spot rate; thus forward rates can be directly derived from spot rates (and vice versa).

This illustration of the various cost recognition alternatives is developed based on the above yield curve rates for a simplified plan for which the benefit commitments consist of two cash flows:

Time Period	Rate for Calc. of PBO	PBO Discount Factor	Projected Payment (PBO)	Present Value -- PBO	Rate for Crediting Interest on PBO	Interest Cost	Rate for Calc. of Service Cost (SC)	SC Discount Factor	Projected Payment (SC)	Present Value -- SC	Rate for Crediting Interest on SC	Interest on SC	Year-End PBO	Year-End Discount Rate Needed to Avoid Loss
Current/Aggregated (single rate)														
5	3.50%	0.842	10,000	8,420	3.50%	295	3.50%	0.842	200	168	3.50%	6	8,889	
20	3.50%	0.503	10,000	5,027	3.50%	176	3.50%	0.503	1,200	603	3.50%	21	5,827	
total				13,448		470				772		27	14,717	3.50%
Two Aggregated Groups (separate calculations for SC and PBO)														
5	3.50%	0.842	10,000	8,420	3.50%	295	3.94%	0.824	200	165	3.94%	6	8,886	
20	3.50%	0.503	10,000	5,027	3.50%	176	3.94%	0.462	1,200	554	3.94%	22	5,779	
total				13,448		470				719		28	14,665	3.54%
Individual Forward Rate														
5	2.24%	0.895	10,000	8,950	3.36%	301	2.24%	0.895	200	179	3.36%	6	9,436	
20	4.08%	0.450	10,000	4,498	5.56%	250	4.08%	0.449	1,200	540	5.56%	30	5,317	
total				13,448		551				719		36	14,753	3.47%
Individual Spot Rate														
5	2.24%	0.895	10,000	8,950	2.24%	201	2.24%	0.895	200	179	2.24%	4	9,334	
20	4.08%	0.450	10,000	4,498	4.08%	183	4.08%	0.449	1,200	540	4.08%	22	5,243	
total				13,448		384				719		26	14,576	3.60%
First Year Forward Rate														
5	2.24%	0.895	10,000	8,950	0.65%	58	2.24%	0.895	200	179	0.65%	1	9,188	
20	4.08%	0.445	10,000	4,498	0.65%	29	4.08%	0.450	1,200	540	0.65%	4	5,070	
total				13,448		87				719		5	14,258	3.83%

Results Based on Cash Flow for (More Realistic) Sample Plans

MATURE POPULATION (declining duration) PBO/SC ratio = 37	Current/ Aggregated	Two Aggregated Groups	Four Aggregated Groups	Individual Forward Rate	Individual Spot Rate	First-Year Forward Rate
PBO-BOY	304.3	304.3	304.3	304.3	304.3	304.3
Service Cost (BOY)	8.25	7.85	7.85	7.85	7.85	7.85
Interest on SC	0.32	0.31	0.31	0.34	0.29	0.05
Interest on PBO	11.46	11.46	11.19	12.57	9.77	1.97
Sum - SC + IC	20.02	19.62	19.35	20.76	17.90	9.87
Change in (SC + IC) as % of PBO	--	**-0.13%**	**-0.22%**	**0.24%**	**-0.70%**	**-3.34%**
Change in (SC + IC) as % of current/aggregated	--	**-2.0%**	**-3.3%**	**+3.7%**	**-10.6%**	**-50.7%**
Aggregate rate - PBO	3.76%	3.76%	3.76%	3.76%	3.76%	3.76%
Aggregate rate - SC	3.76%	4.00%	4.00%	4.00%	4.00%	4.00%
IC rate applied to PBO	3.76%	3.76%	3.68%	4.13%	3.21%	0.65%
IC rate applied to SC	3.76%	4.00%	4.00%	4.34%	3.66%	0.65%
Overall IC rate	3.76%	3.77%	3.69%	4.14%	3.22%	0.65%
Aggregate rate - PBO-EOY to achieve no G/L outcome	3.76%	3.77%	3.78%	3.75%	3.81%	4.00%
PBO duration (BOY)	14.5					
SC duration (BOY)	21.9					
Duration PBO + SC (BOY)	14.7					
PBO duration (EOY)	14.2					

YOUNGER GROWING POPULATION (stable/increasing duration) PBO/SC ratio = 12	Current/ Aggregated	Two Aggregated Groups	Four Aggregated Groups	Individual Forward Rate	Individual Spot Rate	First-Year Forward Rate
PBO-BOY	201.9	201.9	201.9	201.9	201.9	201.9
Service Cost (BOY)	16.43	15.49	15.49	15.49	15.49	15.49
Interest on SC	0.63	0.63	0.63	0.68	0.59	0.10
Interest on PBO	7.70	7.70	7.55	8.50	6.68	1.31
Sum - SC + IC	24.75	23.81	23.66	24.67	22.76	16.90
Change in (SC + IC) as % of PBO	--	**-0.46%**	**-0.54%**	**-0.04%**	**-0.99%**	**-3.89%**
Change in (SC + IC) as % of current/aggregated	--	**-3.8%**	**-4.4%**	**-0.3%**	**-8.0%**	**-31.7%**
Aggregate rate - PBO	3.81%	3.81%	3.81%	3.81%	3.81%	3.81%
Aggregate rate - SC	3.81%	4.05%	4.05%	4.05%	4.05%	4.05%
IC rate applied to PBO	3.81%	3.81%	3.74%	4.21%	3.31%	0.65%
IC rate applied to SC	3.81%	4.05%	4.05%	4.38%	3.81%	0.65%
Overall IC rate	3.81%	3.83%	3.76%	4.22%	3.35%	0.65%
Aggregate rate - PBO-EOY to achieve no G/L outcome	3.81%	3.84%	3.84%	3.82%	3.87%	4.05%
PBO duration (BOY)	15.5					
SC duration (BOY)	24.8					
Duration PBO + SC (BOY)	16.2					
PBO duration (EOY)	15.6					

Technical notes:

- The approaches described as two and four aggregated groups refer to valuation breakdowns for (1) new accruals/service cost and already accrued benefits/PBO, and (2) a further breakdown of PBO into portions relating to active, terminated vested and retired participant groups.
- The following provides examples for the reconciliation of PBO amounts between expected and unexpected (gain/loss) portions, for the above "mature" population example, presuming (1) no change in yield curve rates from the beginning to end of year, and (2) no change in discount rate:

MATURE POPULATION	Current/ Aggregated	Two Aggregated Groups	Four Aggregated Groups	Individual Forward Rate	Individual Spot Rate	First-Year Forward Rate
PBO - BOY	304.3	304.3	304.3	304.3	304.3	304.3
Sum - SC + IC	20.0	19.6	19.4	20.8	17.9	9.9
Expected PBO - EOY	324.3	323.9	323.7	325.1	322.2	314.2
Actual PBO - EOY (presuming no change in yield curve)	325.1	325.1	325.1	325.1	325.1	325.1
Resulting loss (gain)	0.8	1.2	1.4	--	2.9	10.9
Actual PBO - EOY (presuming no change in discount rate)	324.3	324.3	324.3	324.3	324.3	324.3
Resulting loss (gain)	--	0.4	0.6	(0.8)	2.1	10.1

Effect of Varying Yield Curve Slopes

The numerical example above was based on rates derived from the Citigroup Pension Discount Curve as of December 31, 2014. The fixed-income market as of this date indicated a reasonably typical upward slope. Since the impact of different interest rate applications might vary significantly based on the pattern of rates across maturities, the cost impact was also examined based on yield curve rates as of two other dates—January 31, 2011, when the yield curve was sloped more steeply, and April 30, 2000, when yield curve was almost flat.

The following is a summary of key results and comparisons for the "each year's spot rate" approach to determining service and interest costs (for the "mature" population):

Spot rate at year:	Jan. 2011	Dec. 2014	April 2000
1	0.97	0.65	7.42
5	3.09	2.24	7.73
10	4.91	4.08	7.91
30	6.23	4.17	8.13
range year 5-30	3.14	1.93	0.40

	Jan. 2011	Dec. 2014	April 2000
Change in (SC + IC) as % of PBO	-1.16%	-0.70%	-0.14%
Aggregate rate - PBO	5.51	3.76	7.95
Aggregate rate - SC	5.87	4.00	8.02
Overall IC rate	4.54	3.22	7.84
Aggregate rate - PBO - EOY to achieve no g/l outcome	5.60	3.81	7.96
YE discount rate change (in bps) to avoid loss outcome	+9	+5	+1

These results indicate a pattern that should not be surprising—that the impact on the cost components is directly tied to the level of yield curve slope. Expected gain/loss outcomes, or discount rate changes necessary to avoid these, would be expected to vary similarly.