

Contractual Accrual Rate

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The discount rate used to estimate a pension plan's liability is the subject of a fair amount of debate among pension trustees across the country. Most of these debates focus on which of the various possible market conditions are most likely to prevail over the coming decades. But a government's employment and promotion practices, and the benefit policies of its pension plan, can also be said to define an accrual rate, one that can be defined without reference to the financial markets. While this may not be a substitute for an assumed rate of return, it provides a useful point of comparison for those debates.

For any individual member of a pension plan, the cash flow presented by his or her lifetime's worth of contributions and benefits can be said to define a discount rate. Such a career has a series of credits—the employer and employee share of pension premiums—followed by a series of benefit payments, or debits. An internal rate of return calculation on that cash flow defines a discount rate that would have those lifetime contributions and benefits net out to zero. For a member hired at a young age with a long tenure, such a rate might be quite low compared to a member who retires after serving only the minimum number of years to be vested. For an older member, or for one with a very generous benefit and (currently) low contribution, the rate would be higher.

This was spelled out by Iain Clacher and Con Keating, an actuary and pension consultant in the UK, who call it the “Contractual Accrual Rate” (CAR). They described the CAR, and a method for estimating it, in a report for the organization, Long Finance¹ in October 2017.²

Defining a rate in terms of an individual's cash flow might seem antithetical to the risk-pooling nature of a pension system, but one can make the calculation for a sample population, and create a dollar-weighted average of members' rates as a measure of the accrual rate for the entire population. This average can be thought of as an implicit accrual rate that depends not on the investment markets, but on the details of the plan benefit and contribution structure and the plan sponsor's hiring and promotion policies. That is, these are all intrinsic to the plan, the implicit results of policy choices made during its construction and operation.

In a sense this is merely reversing the usual order where the liability is calculated and then a discount rate assumed in order to develop a contribution rate or amount. With the CAR, a contribution rate is assumed and the discount rate derived from the accrual of benefits. It is essentially the same

¹<https://www.longfinance.net>

²Clacher, Iain and Keating, Con and Tilba, Anna, “A Primer On The Risk Structure & Contractual Accrual Rate Of DB Pensions” (October 01, 2017). The Risk Structure & Contractual Accrual Rate Of DB Pensions - Long Finance, Available at SSRN: <https://ssrn.com/abstract=3676204>.

equation, but with different assumptions and solving for different variables. But since this calculation is done without reference to asset markets or prevailing interest rates, the CAR has effectively separated the question of the liability from the question of how it is to be financed.

Again, the important point is that the CAR is implicitly—and completely—defined by the employment contract. There is no need to reference market forces or other exogenous effects to define it. In this sense, the use of a CAR is analogous to the recommendation of GASB 87 for valuing the liability of lease agreements. The recommendation there is to use the value of the leased property and the payments to be made to derive the appropriate discount rate, again in a fashion defined implicitly by the lease agreement itself, without reference to any exogenous factors like market interest rates.³

Other schools of thought agree that the assumed rate of return is not the correct accrual rate to estimate liability. One commonly heard claim is that the proper tool is the “risk-free” rate, presumably based on the claim that the government is assuming the risk on behalf of plan members. Though there is some agreement that the assumed rate is not the best choice for liability accrual, otherwise the perspective could not be more different. The statement of the CAR is that there is an accrual rate that can be measured, and that is completely defined by the employment contract and pension policy. One need not mine the investment markets to divine a risk-free rate to find it.

0.1 Calculating the CAR

Utility is not a guide to calculation. The literature of economics and investing is filled with measurements that are important, but difficult or impossible to calculate exactly: elasticities, efficiencies, productivities, and more.⁴ Some metrics would be useful for forecasting, but are only possible to calculate retroactively: e.g. investment alpha, or risk ratios. The CAR can only be a useful metric to plan managers and other policy makers if it is straightforward to calculate for an existing plan.

Exact calculation of an existing plan’s CAR would require decades’ worth of salary and benefit history for all plan members. This kind of record keeping is seldom in place in a practical sense and would require waiting too long to be reasonable. The method suggested in the Long Finance report uses projected benefit payments to make and then refine a CAR estimate over a number of years. This is useful, but such a multi-year approach is difficult to use to entertain hypothetical employment or benefit policy changes.

Even if an exact number is infeasible, a CAR can be estimated using actuarial assumptions about merit and promotion salary increases and mortality tables, along with the membership demographics found in plan valuation reports. With more years of data, the confidence increases, but a decent estimate can be made from the point measurement. Using these, one can generate a collection of artificial, but representative, salary histories. By applying the retirement benefit policies and mor-

³GASB 87, paragraphs 21–29.

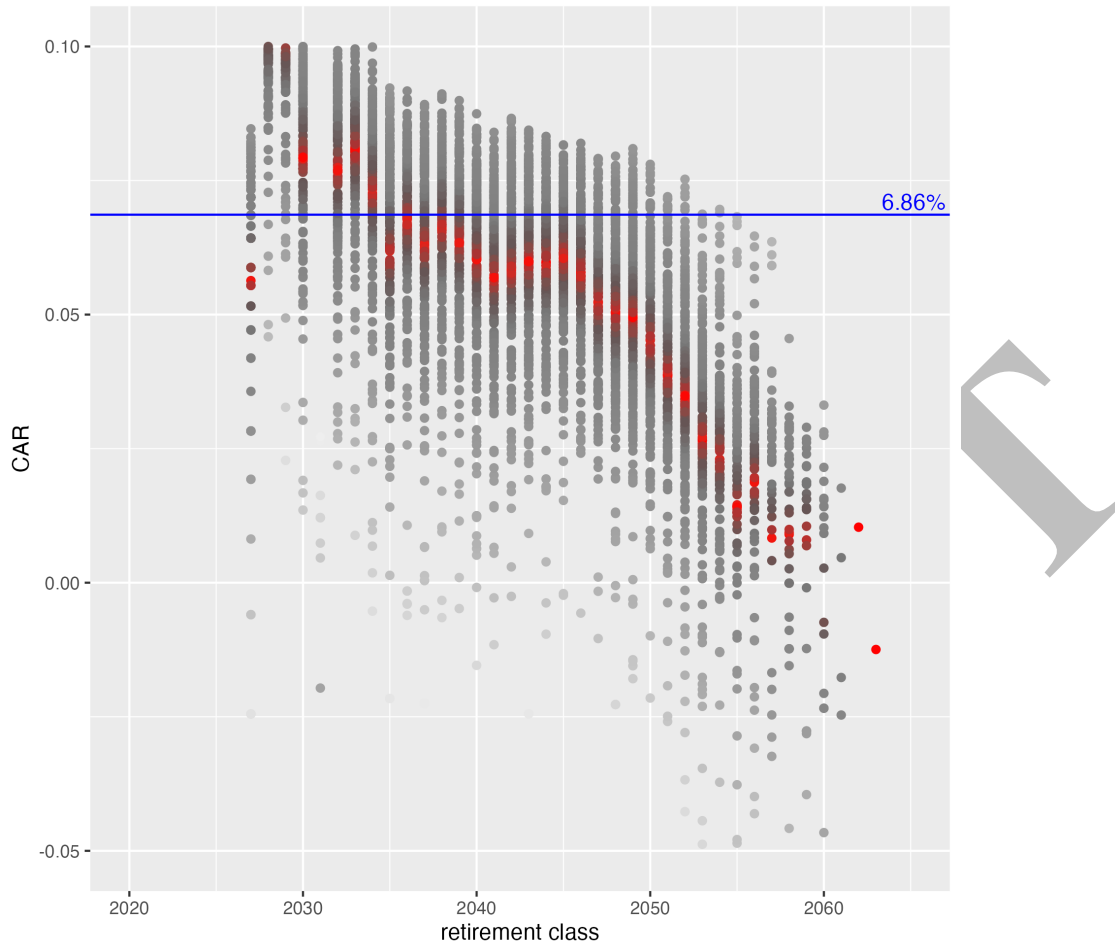
⁴In fact, GASB 87, that directs the calculation of an internal rate or return for leases, provides a workaround if calculating the implicit interest rate is not feasible, for example if there are variable or performance-based payments, or termination penalties.

tality tables, these salary histories can be extended to include retirement benefits. This is analogous to how a liability is estimated, done on the individual rather than the collective level.

With the lifetime salary and benefit history defined for each employee in the model population, one can calculate the CAR for each member, for each retirement “class” (all the members expected to retire in a given year), or for the aggregate of all the members under consideration. It will be challenging to design a sampling strategy to account for the complexities of a real pension system that would make this a good measure of a plan’s overall liability—to account for changes in plan demographics, for disability benefits, survivor benefits, changes in policy and so on. Gross measures, such as suggested by Clacher and Keating, accommodate these vicissitudes more naturally and may have advantages on those grounds. Still the approximation represented by this calculation may be of value.

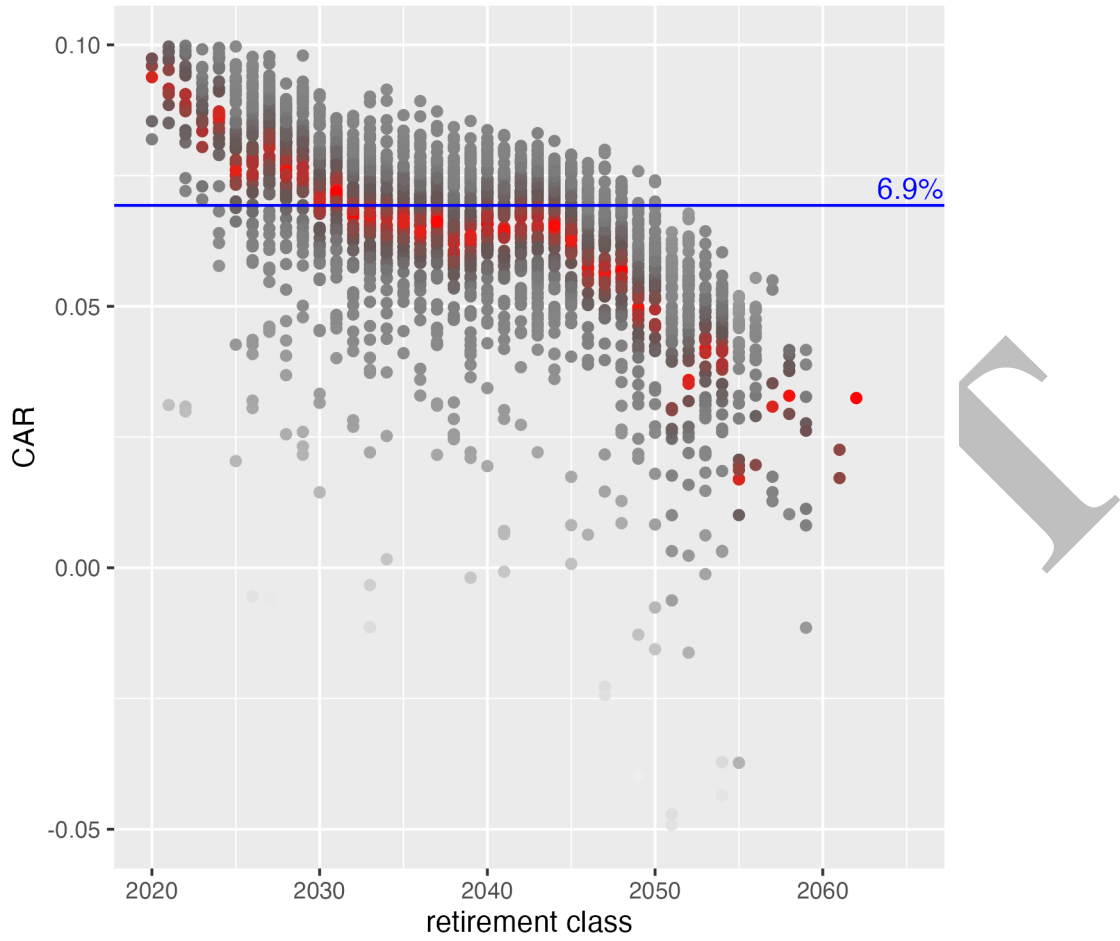
We completed this calculation for the fire plan for the city of Queen Creek, a suburb of Phoenix, Arizona. The Queen Creek fire department is small (75 employees) and has only been in existence since 2008, so it was possible to get the complete payment history of each member from the department founding to July 2021. Using the actuarial assumptions for merit and salary increases, the benefit policies, and actuarial tables, we projected the complete salary and retirement histories for each employee, and aggregated them into retirement classes. These projections were made repeatedly (N=100), and the retirement classes averaged to produce the images below.

Each dot in the images is a CAR estimate for some retirement class on a particular model run. The red dots are the mean for each class, and the blue line is the aggregate, dollar weighted, mean value. For the overall plan, pictured here, the CAR estimate is 6.86%. Note that the CAR can be negative if the retirement class has put aside more money than they use in benefits. This can happen, for example, when someone dies before or soon after retirement. Because the Queen Creek system has so few members, a single member can have a large effect on a retirement class mean.



Queen Creek has only had a fire department for a little more than a decade, so the plan is young and very few have retired yet. You can see in the image that the members retiring sooner have not paid in for very long, so the CAR is high for them. Members who do not retire for a long time have much lower rates. There are very few current members planning to defer their retirements beyond 2050, so the right-hand end of the record is noisy, with some of the dots representing just one or two projected individuals.

To explore the effect of using less data, we also made the calculation using only the demographic information available in the published valuation report. This required creating a uniform distribution of plan members for each category presented in the table of information, and extrapolating a career forward, as before, but also backward from the year of the valuation report. The figure below shows that result, and the CAR estimate is quite close to the estimate made from a long record of data.



The CAR for Queen Creek fire personnel seems to be just below the actual assumed rate of return used by the pension system, which is 7.3% for the older employees and 7.0% for the newer. If a system is managed responsibly, it makes sense that the CAR will tend to settle at a level approximately equal to the assumed rate of return. The CAR is, after all, just a solution to the same equation that was used to estimate the normal costs in the first place, so the adjustments made over time by an attentive and active management could be anticipated to converge on the same result.

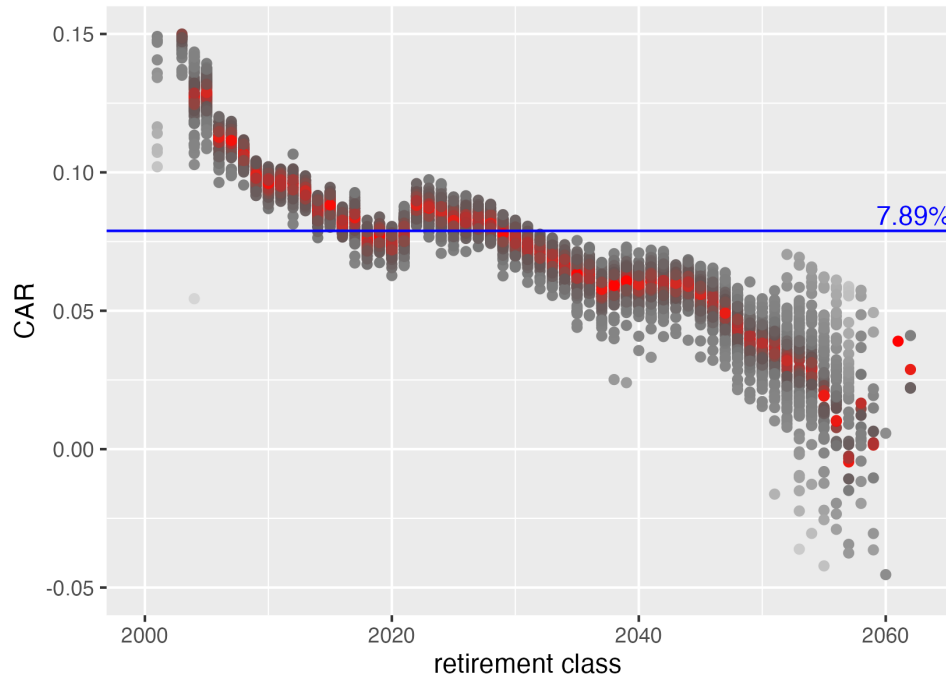
We completed a similar calculation for the police department in the city of Scottsdale, another suburb of Phoenix, using data from 1992 through June of 2021. The Scottsdale system is decades older than Queen Creek, with many more older and retired members, and a much higher proportion of Tier 1 members to Tier 3.

Tier	1	2	3
Queen Creek Fire	45	25	26
Scottsdale Police	781	118	88

The prospective contribution rates in Scottsdale are comparable, with Queen Creek projecting 22.65% for all employees going forward, while the Scottsdale rates vary from 19.8% to 25.6%, depending on tier and hire date.⁵ The result is that the CAR is substantially higher in Scottsdale,

⁵These are exclusive of the contributions devoted to legacy costs in the valuation report.

as can be seen in the figure below.



0.2 What does it tell us?

Where the CAR can be a useful addition to current practice is in looking forward. For example, it can be used to evaluate the risk inherent in the promise of a given set of pension benefits and promotion policies. Given the current contribution rate, if an employer is making promises that accrue at 7%, the pension plan can keep up with the demands of benefit payments by making the contributions produce income at that same rate. Given the current consensus of future investment income, a CAR of 8% would imply a plan is taking a substantial risk on those benefits, or should raise contributions.

Obviously, actuaries answer these kinds of questions about proposed pension benefits all the time, by predicting contribution rates, and running stress tests. The CAR is simply a different way to describe the same information, but with two differences.

The first is that the CAR contains within it an intimation of the risk inherent in a particular level of benefits. Pension managers and actuaries, through debates on the appropriate level for investment return assumptions, are largely familiar with the idea of the risk present at a given assumption of investment returns. Expressing benefit accruals in these terms thus provides a direct comparison to a measure of risk with which many are already familiar. To say that benefits will accrue at a rate equivalent to 4% or 12% given current contributions provides a readily understandable way to express the risk of those benefits because they imply a comparison with which many are already familiar.

The work of Thaler and others in the field of the psychology of choice or “prospect theory” show

the question of what information people find most readily understandable and that most easily translate into action is one that can—and should—be addressed empirically.⁶ Anecdotally, most people who think about pensions professionally share confidence that the general public’s intuition about discount rates is not reliable. Many discussions of changes to interest rate assumptions hinge on detailed explanations of exactly those points. It makes sense at least to ask whether there are presentations of information that might be clearer in some inherent way, at least to some people.

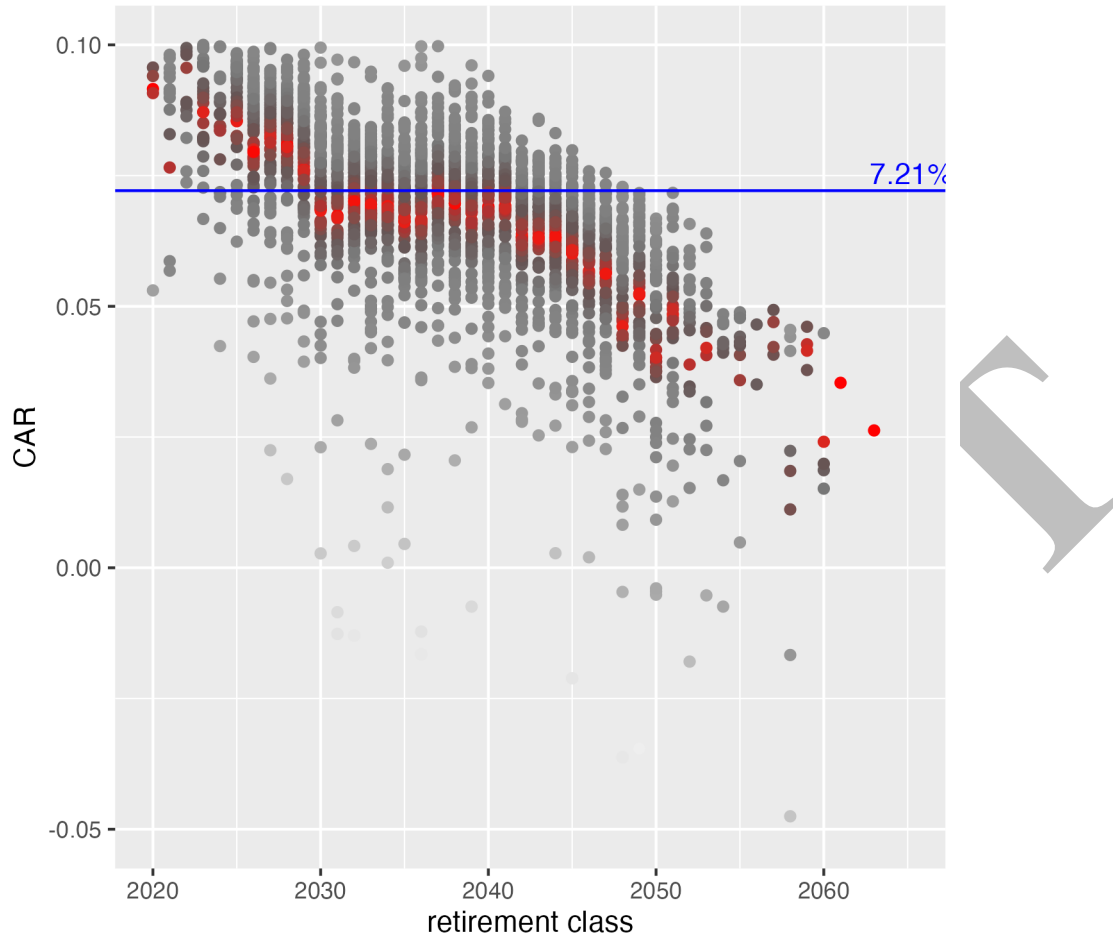
Second, because the CAR calculation is the result of aggregating a collection of members, it can be used not only to distinguish between the cost of benefits for different classes of employee, but to estimate the difference with precision. This may be of value as a negotiation tool, or to forecast the development of the pension liability.

Turning again to Queen Creek, there are three tiers of employees in the fire department, whose benefits differ significantly. As a way to acknowledge those differences, the plan uses different discount rates to project liabilities for each of the tiers: 7.3% for tiers 1 and 2, and 7.0% for tier 3. One might ask whether the CAR can be used to measure the difference in the expense of the different benefit tiers.

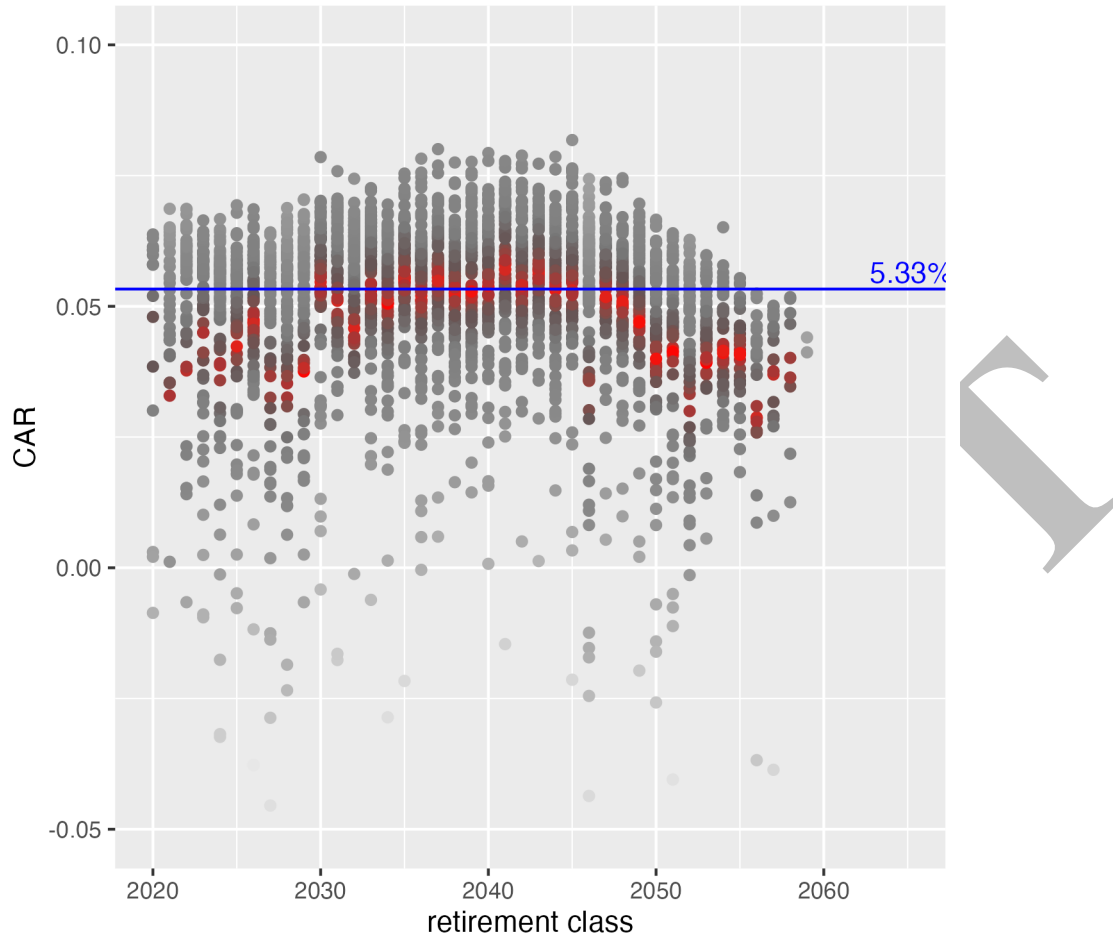
For a question like this, where the average age and service record of two tiers of employees is quite different, a raw comparison between the two populations will be misleading, and tend to underprice the younger employees, most of whom have years to go before they retire. But we can offer an answer to the question nonetheless by artificially assigning the entire population to one tier or another and calculating the CAR to that artificial population while holding the contribution rate constant across the comparison.

Below is a CAR estimate that assumes all the Queen Creek Fire employees represented in the valuation report demographic summary are tier one employees. This is precisely the same as the model calculation above with all the tiers set to 1.

⁶See, for example, “Mental Accounting and Consumer Choice”, Richard H. Thaler, *Marketing Science*, 27(1), January–February 2008, pp15–25. The canonical work for the intersection of this field with public policy is “Nudge: Improving Decisions About Health, Wealth, and Happiness”, Richard H. Thaler and Cass R. Sunstein, Penguin, 2009.



Below is the same calculation for tier three. These employees have a minimum retirement age in addition to the service minimums of tier one. They also have a statutory limit on the compensation that can be counted toward pension credit, set at well below half what many firefighters earn in a year.



As noted above, the three tiers have differences in the treatment of plan assets. The assumed rate of return is substantially lower for the tier 3 employees than for the other two tiers (7.0% vs. 7.3%), probably because the plan managers and actuaries anticipated that benefits would accrue much more slowly for this tier of employee. But the level of benefit accrual is apparently lower than that.

Beyond the mere question of the value of the benefits, one can use this to predict that the costs of the system will decline soon, as the expensive tier 1 employees are eventually replaced by the much less expensive tier 3 members.

Because this method of estimating the CAR is essentially forward-looking, it is relatively straightforward to incorporate potential changes in benefit or contribution policy, thus providing immediate feedback to policy makers. Rather than saying, “this policy change will increase the liability by 10% which will result in a 10% premium increase phased in over the next few years,” one could say “at the current contribution rates, this policy change will raise the CAR from 7% to 7.5%.” These are two ways of looking at the same proposed set of changes, but risk is fairly difficult to describe rigorously. There remains the possibility that one presentation will convey the essential information about risk more effectively than the other, to some audiences.

There are other methods that are frequently used to compare pension benefit policies. For example, one frequently sees benefit generosity measured with a “benefit replacement rate,” defined as a ratio

between a pension benefit and some target year's salary. (See Chapter 6 about the scorecard.) This is a useful metric, and homes in on what is no doubt an important feature of any pension benefit, but it is incomplete in some respects important to policy makers, especially about the promotion and salary policies of the employer. Was that final salary the result of many years of 2% raises, or a few years of 5% raises? Is this a population of people with many years in the system or few? By incorporating that kind of information into the calculation, the CAR can help distinguish between these different cases.

0.3 What doesn't it tell us?

In addition to describing what the CAR can say about a pension system, it is worth also being clear about what it does not say. For example, at first glance the CAR would seem a plausible answer to the question posed in the previous chapter about how fast a pension liability accrues. But the CAR does not take into account variables like changes in the employee population headcount or demographics. Disability pensions can be modeled, but without large numbers behind them, they will provide a source of significant uncertainty. Of course, these factors are also a problem for the more traditional methods of estimating a liability.

A more sophisticated sampling strategy could serve to model factors like demographic changes and disability pensions, but this is not a simple problem to solve, and the techniques involved are distant from current industry practice. Given the variety of different pension systems and their circumstances, it would be challenging to prescribe these calculations in a form that would be widely accessible. Even so, there is utility to the metric. As shown above, the CAR can be used as a way to compare actual and hypothetical choices of pension benefit and employment contract features, and can provide an estimate of the risk to the sponsor of making those promises to a pension system member.

Perhaps more significantly, the CAR serves as a sort of existence proof for a liability accrual rate that is independent of the question of investment returns. There can be little question that the cash flow defined by an individual's career of payments into a system and benefits paid out of it has nothing to do with the vicissitudes of investment markets or the plausible rates of return an investor might achieve, whether they are prudent, reckless, or "risk-free". Furthermore, there is no path through which an aggregation of plan members would acquire such a dependency that was not present at the individual level. Thus, even if the modeling technique described here is impractical to use for routine reporting, there are other ways to estimate the accrual rate for a liability.

0.4 Discussion

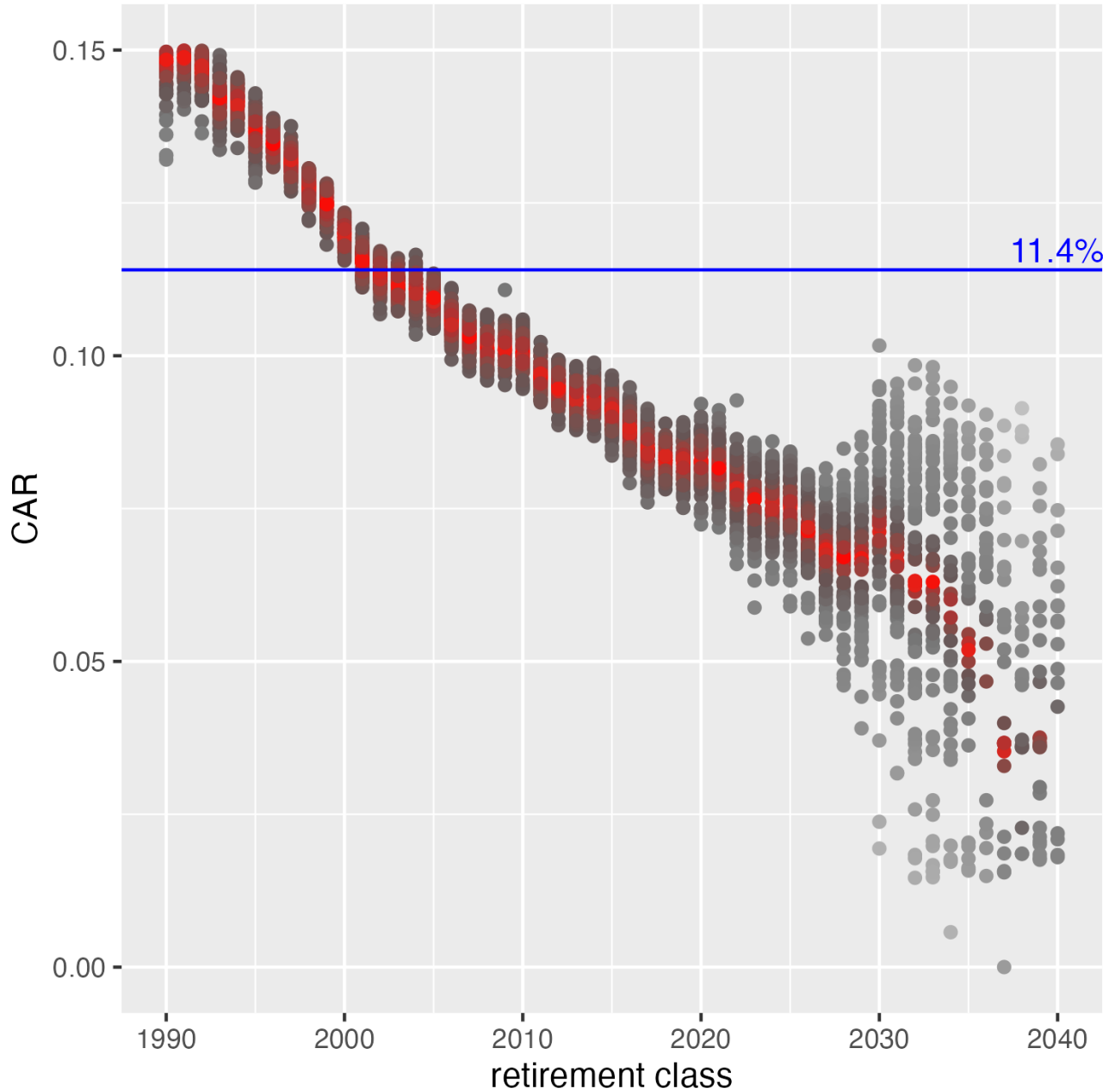
In some respects, the CAR is simply flipping the usual liability estimation around. Instead of holding the rate constant and deriving payments, you hold payments constant and derive a rate. Skepticism was frequently expressed that this would make a difference to decision makers. “Whereas the current construct allows policymakers to know that what additional costs they will face if they adopt a change, the [CAR] would require an additional layer of evaluation about whether increasing returns is feasible/advisable.”

Another point raised was that because the CAR does not appear in any current metrics and is not part of the status quo accounting, changes to the CAR resulting from some change in benefits or payments will not be relevant or relatable for decision makers. The CAR was said to be too abstract, especially when compared to something more concrete, like actual costs.

A point made in favor of the CAR was the value of having an objectively defined benchmark against which one can evaluate choices of discount rate. It is not perfectly clear what are the long-term consequences of using a discount rate significantly different from the CAR. Still, a statement that on average liabilities accrue at this specific rate seems like a useful standard against which to compare the discount rate in use.

Another participant noted that the CAR could have utility by providing a quick check on other factors. He pointed out that any financial analyst likes to have ways to cross-check assertions made in financial statements. For example, one can use cash from operations as a rough check on the quality of reported net income. The CAR can serve as a kind of cross-check on aspects of plan management. That is, because there are other measures of sustainability, one would expect the CAR of a well-managed pension plan over time to gravitate toward the discount rate in use. Knowing that a CAR was close to the discount rate could be a sign of good management. Alternatively, knowing that it was not close might be a sign that managers should find a way to nudge it closer, either by changing payments or the terms of the employment contract that define the CAR.

Here are a couple of additional pictures for different systems. First is for the city of Providence, in 1991, on the cusp of adopting pension benefits with 6% fixed cost of living adjustments (COLA). Even without including survivor or disability benefits, you can see that the city was planning to adopt a benefit structure that would accrue at 11.4%. This was a disastrous decision, made possible by the fact that the mayor at the time could plausibly claim he didn't realize how expensive it would be. Could he have made the claim so convincingly if this number had been available then?



Athens, Georgia. This *does* include survivor and disability benefits, but the city pension system does not offer a COLA except every now and then when the city council feels the whim.

