Annuity Market Pricing Approaches

March 2019

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Section 1: Introduction

1.1 Abstract

The method used by the Canadian Institute of Actuaries (CIA) for group annuity pricing provides an excellent approach for pension actuaries to approximate insurer pricing for pension plan solvency calculations. Differences between the United States and Canada make this method impractical for the U.S., where there is less cooperation with voluntary insurer pricing surveys. For the U.S., an alternative method would be helpful. The purpose of this study is to provide retirement actuaries with a resource on group annuity pricing. No resource is needed for individual annuities, prices for which are readily available on websites. Since the difference between group and individual annuities is primarily due to mortality and expenses, a method could be developed to get group annuity rates from individual rates from these websites.

1.2 Background

The Society of Actuaries (SOA) Retirement Section Research Committee commissioned this study to examine the CIA method for estimating group annuity closeout pricing; compare it to methods used in the United States; determine if it could be used in other markets, such as U.S. closeouts or individual annuities; and explore other approaches for pricing annuities based upon available data and pricing models.

1.3 Methodology

The CIA's publications and quarterly guidance on group annuity pricing were reviewed. An internet search and literature review of annuity pricing methods and data sources for U.S. group annuities and for individual annuities in the United States and Canada was completed. A survey of group annuity pricing was conducted for the United States and a model U.S. company was developed for U.S. group annuity pricing using a public National Association of Insurance Commissioners (NAIC) Category 1 bond strategy.

Section 2: Current Methods for Estimating Group Annuity Pricing

2.1 Canada

The CIA issues guidance in the form of an educational note on assumptions for group annuity pricing for hypothetical wind-up and solvency valuations. The CIA obtains annuity buyout quotes quarterly from seven insurers on three hypothetical groups with low, medium and high duration liabilities. For annuities with cost-of-living adjustments (COLAs), four companies provide quotes. The average of the best three quotes is used, along with supplementary information on actual annuity purchases provided by actuarial firms. The interest rates are derived from these quotes using projected Canadian pension mortality.[1] These interest rates are then expressed as a spread over yields on government of Canada marketable bonds with maturities over 10 years [Canadian Socio-economic Information Management System (CANSIM) series V39062]. For consumer price index (CPI) indexed annuities, less data is available. One spread is used for all durations. This spread, which is currently negative, is applied to yields on the benchmark government of Canada real-return long-term bonds (CANSIM V39057).[2]

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[1] CIA, CPM2014, with generational projection CPM-B scale.
[2] CIA, Assumptions for Hypothetical Wind-up and Solvency Valuation, p. 5.

In applying this guidance, the actuary calculates the duration of the liability by the change in value for a one basis point change in rates. This duration is then compared to the durations of the hypothetical groups. If it falls in between, linear interpolation is used to determine the spread. This spread is added to the government bond rate on the date of valuation and projected Canadian pension mortality is used. The other assumptions are left up to the actuary, subject to standards of practice.[3] The educational note is not binding, but deviations would need to be justified. Prior to 2009, the CIA computed credit spreads annually using actuals cases from consulting firms. However, during the financial crisis in 2008, the need for more frequent adjustment of credit spreads became apparent, leading to the current method of quarterly surveys.

There are a limited number of high-quality long-term corporate bonds issued in Canadian dollars. The CIA has contracted with Fiera Capital Corp. to publish a monthly corporate Aa spot curve using Aa provincial bonds beyond 10 years adjusted for the difference between Aa corporates and provincials that exist for issues under 10 years. These rates were developed for corporate accounting standards applicable to employee benefit plan sponsors.[4] They should also be indicative of rates at which bonds could hypothetically be issued by insurers. Individual annuity prices, which are available on websites, also provide a rate indication. Individual annuities could be used to settle small cases. The mortality and expenses are different, and the rates are slower to respond to market changes, limiting their usefulness.[5]

Figure 1 compares rates in effect June 29, 2018 (end of the second quarter). The CIA guidance is .4% below Aa yields. Insurers should be pricing inside of the appropriate credit curve. The credit ratings of the top three bidders is unknown. There is no safe annuity rule in Canada and these bidders could be weaker credits. Explanation for this .4% spread include administrative expenses, capital and profit margin and that the insurers might be using more conservative mortality assumptions than the CIA or fixed income investments with smaller credit spreads. The Canadian government yield curve is included for reference. It ranges from 1% to 1.5% below Aa yields as credit risk increases with time. For CPI indexed annuities, the spread for all durations is −.7%, while CANSIM V39057 was .47%. The rate on June 29, 2018, would be .47% − .7% = −.23%. Since the only readily available CPI-adjusted asset is the real return bonds, the −.7% spread represents the insurer's margin for low risk public bonds. Ignoring other considerations, the fact that non-indexed annuities have a .4% spread below Aa yields and indexed annuities have a .7% spread below available index-linked yields suggests that insurers expect to outperform Aa yields by .3% on the investments used to price non-indexed annuities.
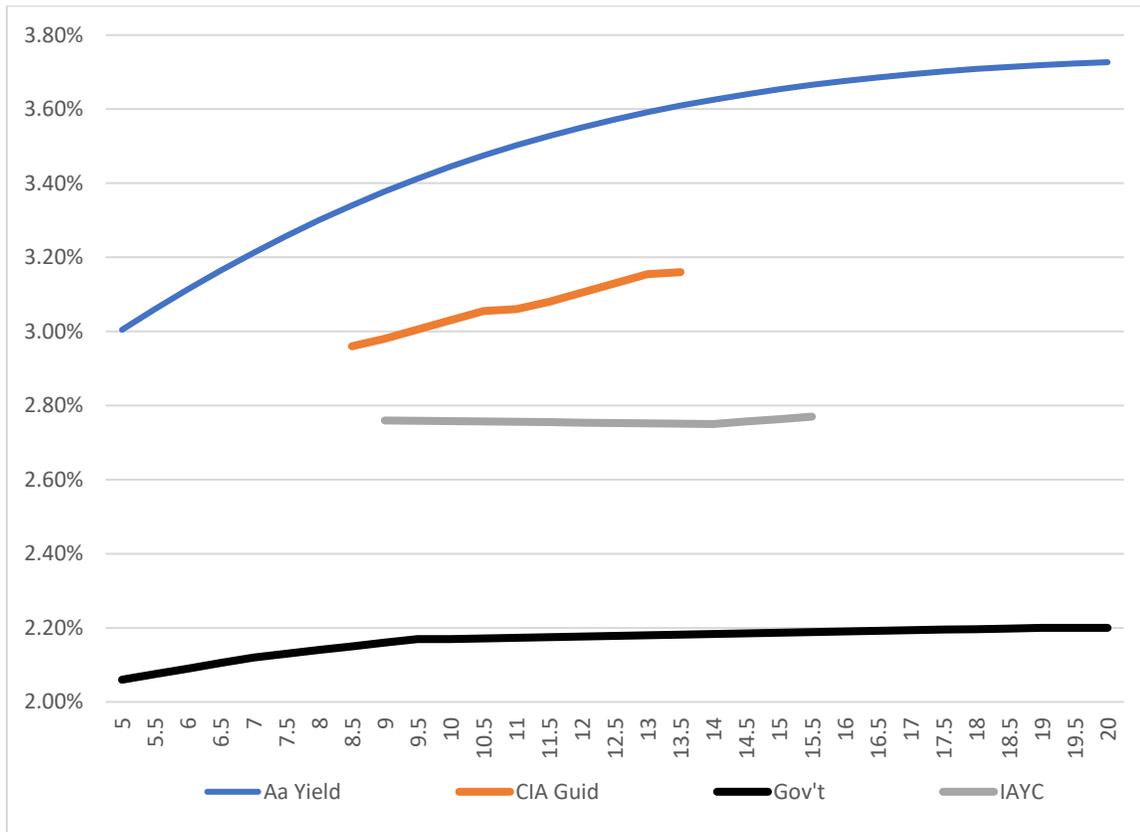
[3] Ibid.
[4] CIA, Setting the Accounting Discount Rate Assumption, p. 5.
[5] Charupat, Kamstra, and Milevsky, The Sluggish and Asymmetric Reaction of Life Annuity Prices to Changes in Interest Rates.

Figure 1
INTEREST RATES BY DURATION, JUNE 29, 2018

Sources: Fiera Capital[6], CIA, authors calculation (below), Bank of Canada[7]

Finally, we have extracted the interest assumptions underlying rates on individual single life annuities using quotes for males age 50 to 70 provided by CANNEX. This was based on $100,000 premium for a registered plan in Ontario. The average of the best three quotes were converted into rates and compared to rates computed using CPM2014vCP2014B mortality to determine the interest rate.[8] These rates are shown as IAYC (Individual Annuity Yield Curve) in Figure 1. Here expenses could be an important factor, although differences in mortality assumptions could also be a factor. The interest rates change a few basis points by duration. Using one rate for all life annuities might be a simplification. Another explanation is that uncertainty in the other assumptions, such as mortality, increases over time, offsetting the effect of higher rates at the longer durations.

Figure 2 shows quarterly annuity credit spreads and rates in the CIA's guidance. Credit spreads are less volatile than interest rates. The CIA's method, where the spread determined at the end of the last quarter is added to the government bond rate on the date of valuation, results in the liability rate that is very close to the date the assets are valued. The only error would be if spreads changed significantly between the last quarterly guidance and the date of valuation. For medium duration liabilities, the maximum difference

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[6] Fiera Capital Corp, CIA Method Accounting Discount Rate Curve
[7] Bank of Canada, Canadian Bond Yields
[8] While CIP2014vMI2017 might appear to be a better guess as to what rate Canadian insurers were pricing individual annuities, there is very little difference between these tables and any difference in rates would not be material to this analysis. The v indicates generational projection using scale MI2017. CIA Annuitant Experience Subcommittee—Research Committee. Canadian Insured Payout Mortality Table 2014 (CIP2014). p.17

between quarterly guidance is .2%. Note that as the yield curve flattened between 2015 and 2018, the annuity credit spreads by duration narrowed.[9]

Figure 2
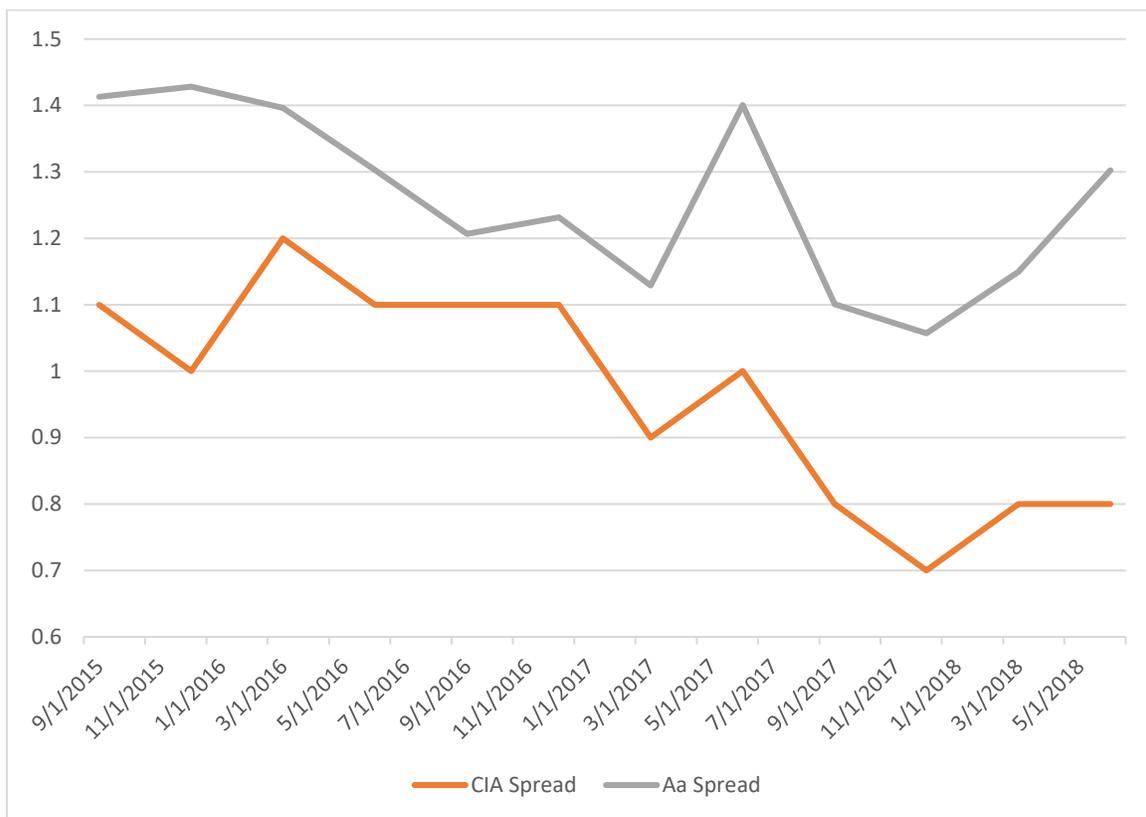CIA Guidance
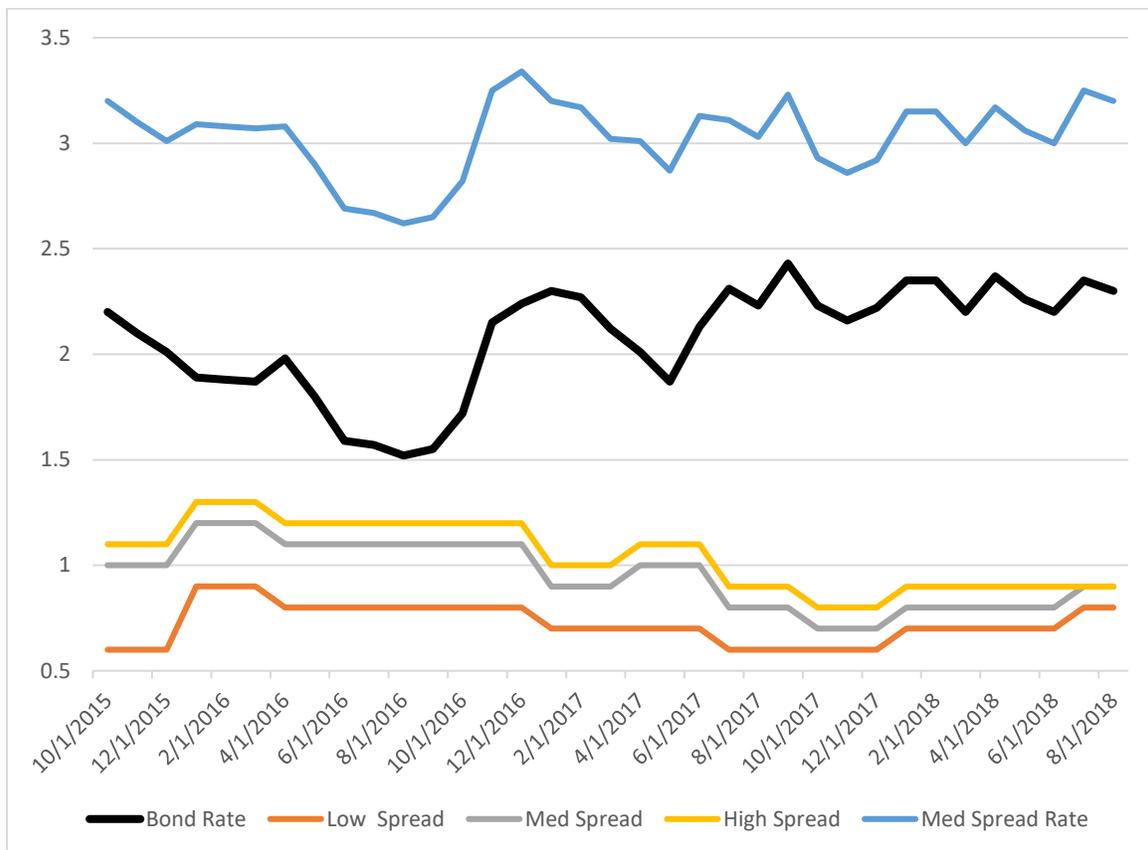
Sources: CIA, Bank of Canada

The actuary could look at the change in the Aa yield curve spread over governments between those dates (at the liability duration) as an indicator of a material expansion or contraction in credit spreads. Figure 3 compares Aa yield curve credit spreads at duration 11 to the medium duration CIA credit spreads. While these credit spreads generally move in the same direction, there is not exact corresponding movement and the relative spreads change over time. Except for the situation of a 2008 credit spread blowout, CIA's methodology is an excellent approximation to insurer's pricing of group annuities.

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[9] Bank of Canada, Selected Government of Canada Benchmark Bond Yields. From August 2015 to August 2018, the difference in yield between two-year and long-term government of Canada bonds went from 1.81% to .18%.

Figure 3
CIA VS. Aa SPREADS MEDIUM DURATION (11)

Sources: Fiera Capital, CIA

2.2 United States

Unlike Canada, there are no educational notes on solvency valuations with quarterly rate updates in the United States. The most analogous, formally documented guidance available to all U.S. pension actuaries is Code of Federal Regulations Part 4044.[10] CFR 4044 prescribes an approach for calculating, in limited situations, liabilities of terminating private sector single employer defined benefit plans. CFR 4044 mandates not only interest and mortality but also expense and early retirement assumptions. Under the CIA method, the expenses and other assumptions are those used for the hypothetical groups.

To calculate CFR 4044 rates, the PBGC collects 14 sample male annuity rates for a range of ages (30 to 80) from participating insurers quarterly. In recent years, three to six insurers have participated. Outliers (generally rates 12.5% greater or less than the average at age 65) are eliminated. The interest rate is then extracted from these average annuity rates using the UP-94 mortality table with a static projection to the current year plus 10 using scale AA.[11] The rates are fitted to a select and ultimate rate where the rate changes in 20 or 25 years. In recent years, there has been very little difference between select and ultimate rates. An average of these rates and the previous quarter's rates are used to produce interest rates. This rate, along

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[10] "Allocation of Assets in Single-Employer Plans," Code of Federal Regulations, title 29, part 4044 (2018), *https://www.govinfo.gov/content/pkg/CFR-2018-title29-vol9/xml/CFR-2018-title29-vol9-part4044.xml*, (29 CFR 4044).

[11] 29 CFR 4044.53. In a static projection, the mortality rates are reduced for the number years in the projection. $Qx (1 − PRx) \wedge y$, Qx is the mortality rate at age x, Pr is the projection scale reduction at age x and y is the number of years in the projection. In a generational projection, each mortality rate in the future is reduced by the projection factor for that age for the number of years to reach that age. $Qx(1 − PRx)$, $Qx+1(1 − PRx+1) \wedge 2$ ... A 10-year static projection was used to approximate the effect of a generational projection for future mortality improvement beyond the year of valuation. See Totten, "Calculating Generational Mortality Rates."

with the same mortality basis and PBGC expense and early retirement assumptions is used in annuity valuations for the next quarter.[12]

Starting in 2017, the PBGC is using a yield curve for the valuation of its liabilities. The PBGC changed the mortality to RP-2014 with generational projection MP-2016.[13] The information available on the yield curve is from the 2017 actuarial report: "PBGC used forward yield curve interest factors which were derived from a recalibration based on the prices from the two most recent ACLI [American Council of Life Insurers] surveys (March 31, 2017 and June 30, 2017) to value PBGC's liabilities. The interest factors so determined for the September 30, 2017 valuation vary annually from 1.54% in year 1 to 2.44% in year 31 and beyond."[14] A proposal to revise Reg. 4044 to use this methodology is under consideration, possibly for next year[15].

The CFR 4044 interest rates to be used for July 1, 2018, to Sept. 30, 2018, were based on the average of rates calibrated to ACLI annuity price surveys received for Dec. 31, 2017, and March 31, 2018. Thus, the rates lag the market by six months on average. This lag is a shortcoming for this method's applicability to approximate current annuity prices. If there had been a significant change in interest rates during that period, the asset and liability values would be out of whack. A plan invested in a matched portfolio of high-grade bonds could develop spurious surplus or deficit. The Canadian method's lag is only a quarter's credit spreads, which would be minimal compared to possible changes in interest rates. The asset and liability valuations are close. The PBGC method has some advantages in using net rates and then adding expenses and early retirement subsidies, customizing the cost to the plan's characteristics. The elimination of outliers from the average, although rarely done, is another advantage.

Prior to 2009, the PBGC did a calculation annually using an average of the June 30 and Sept. 30 surveys. The rates were adjusted monthly using changes in a bond yield index (originally Moody's Aa and A rates). Since the rates were published in advance, the rates for the current month would be the rates for two months earlier. With the financial crisis in 2008, where credit spreads increased dramatically, the need for more frequent valuations became apparent. Figure 4 shows monthly rates at 10 years for Treasuries and high-quality market (HQM) corporate bonds going back to 2005.
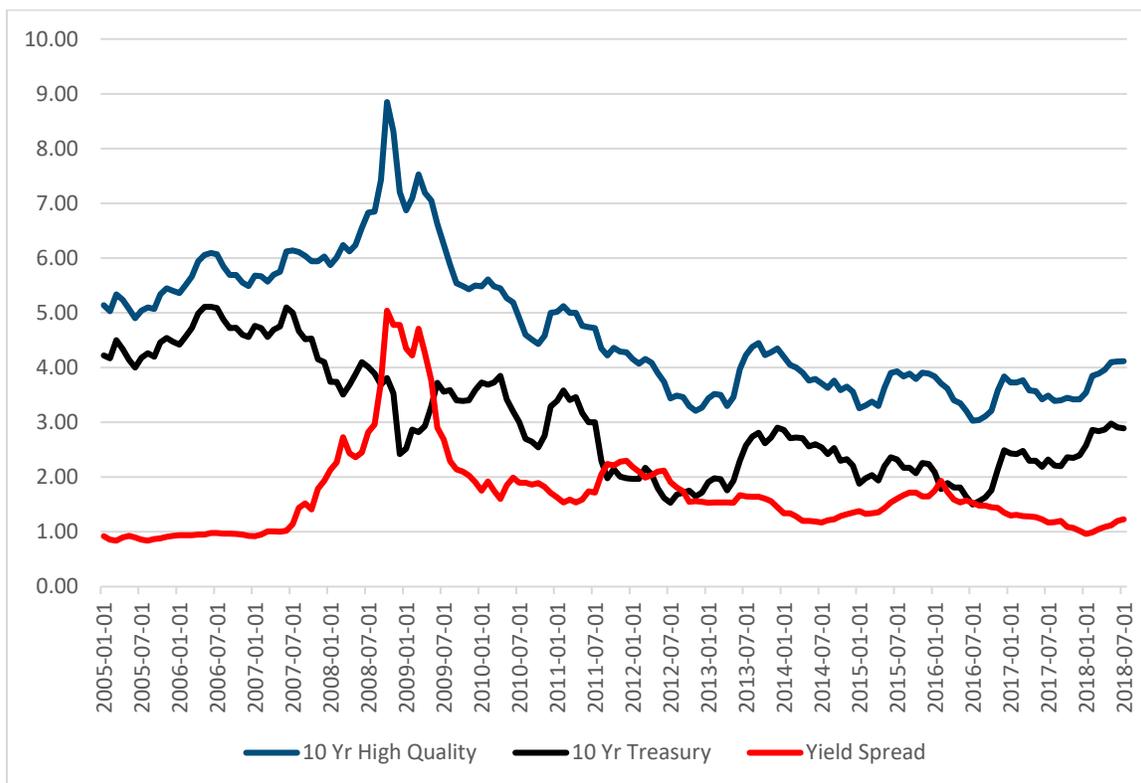
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[12] PBGC, Derivation of Interest Factors in PBGC's Liability Valuation Methodology p. 4 ff.
[13] SOA, RP-2014, and SOA, MP-2016.
[14] PBGC, 2017 Actuarial Report, p. 14.
[15] PBGC Regulatory Agenda https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201810&RIN=1212-AA55

Figure 4
10-YEAR YIELD SPREADS

Source: United States Treasury Resource Center, Interest Rate Statistics

Turning to other approaches, the FTSE Pension Discount Curve and Liability Index (formerly Citi Pension Liability Index and Citi Pension Discount Curve)[16] is calculated based on a universe of AA rated corporate bonds from the FTSE U.S. Broad Investment-Grade Bond Index (USBIG) and the yields of the Treasury model curve. This index was developed for accounting standards.

The Treasury HQM corporate bond yield curve was constructed to calculate Current Liability for single employer pension plans.   It contains bonds of the three highest ratings—AAA, AA and A. Most of the bonds are A, making this a slightly lower credit than the FTSE.

There are consultants that have indexes and other information on group annuity pricing. Mercer publishes pension discount yield curve and index rates in the United States monthly.[17] Aon publishes analysis of insurer pricing, Aon Annuity Tracker[18]. Brentwood Asset Management's website has current interest rates for various types of group annuities.[19]

Funding agreement note issuance programs (FANIPs) became popular in the 1990s as an alternative to guaranteed investment contracts (GICs). Under a FANIP, the insurer issues funding agreements to a special purpose corporation that in turn issues bonds backed by these instruments. The bonds are rated the same as the insurer's claims paying rating. Thus, an AA insurer would issue bonds at an AA bond rate. This has led

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[16] SOA, FTSE Pension Discount Curve
[17] Mercer, "Pension Discount Yield Curve and Index Rates in US," August 2018, *https://www.mercer.us/our-thinking/wealth/mercer-us-pension-buyout-index.html*
[18] Aon, "2018 U.S. Annuity Settlement Market Update" April 2018, p. 10
[19] Brentwood Asset Advisors, "Current Group Annuity Rates," *http://www.brentwoodllc.com/*

to a rationalization of GIC pricing. If an insurer had a high yielding/low required capital investment, it could be funded through a FANIP instead of a GIC bidding war. The same applies to group annuities. Unless large underwriting gains were expected, there would be no reason to offer a better rate on a group annuity contract even with a special asset and competitors' underpricing. At one time, AA ratings were required to be considered a safe annuity provider. However, with the downgrade of the U.S. government and the financial crisis, this standard has moved toward A with many providers split rated. Thus, the HQM index is closer than the FSTE to the rates at which these FANIPs could be issued.

Figure 5 compares FTSE Pension Discount and HQM on June 29, 2018, with PBGC rates. A Treasury yield curve is included for comparison. The anomaly of PBGC rates pricing through Treasuries may be partially due to the lag in rates. The rates on June 29, 2018, are based upon the average of survey rates between March 31, 2018, and Dec. 31, 2017. On Jan. 2, 2018, the 10-year treasury yielded 2.46%, which is below the PBGC rate of 2.53%. Difference in mortality assumptions between the insurers and PBGC is also a factor. Mortality improvement has been much higher than predicted by scale AA. Thus, the PBGC mortality rates are higher than current mortality at important ages.[20]

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[20] SOA, 2011–2014 Group Annuity Mortality Experience Report. p. 7

Figure 5
YIELD CURVES, JUNE 29, 2018
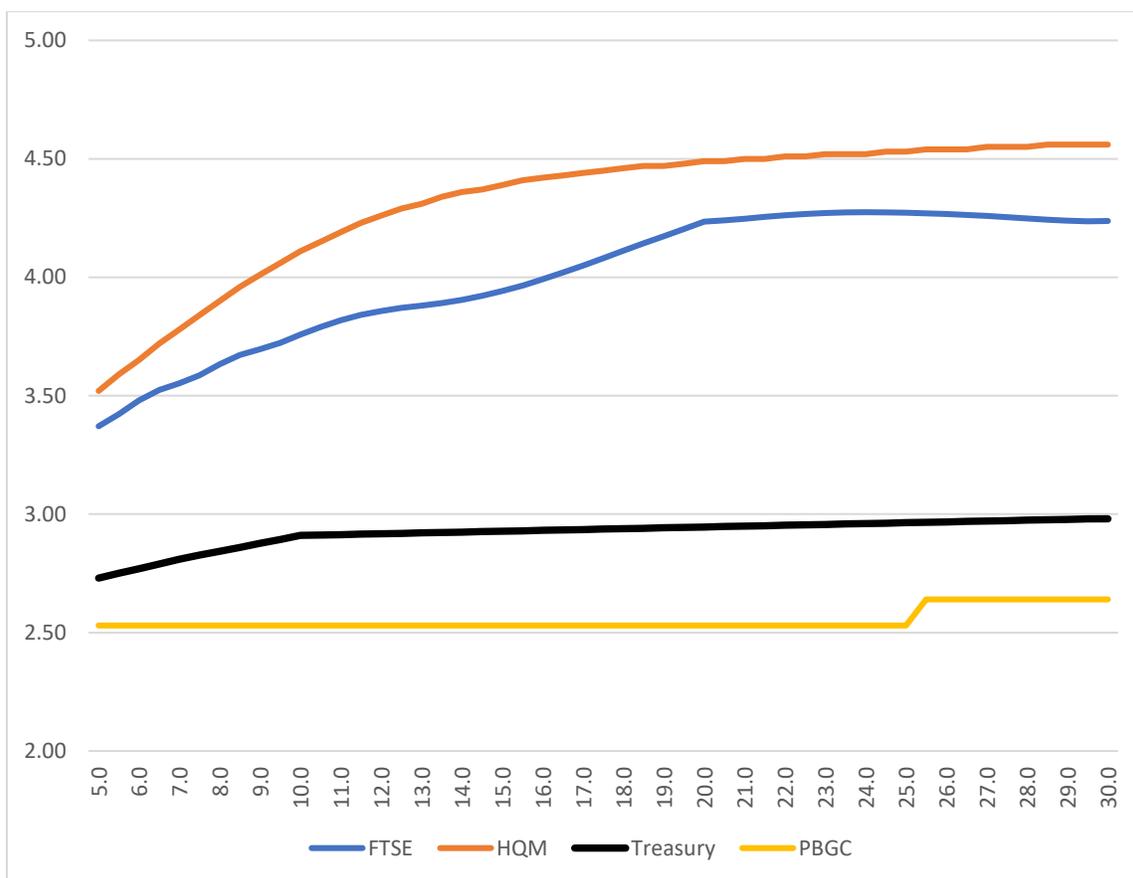
Sources: United States Treasury, SOA(FTSE) , 29 CFR 4044 Appendix B

If the CIA methodology for approximating group annuity prices were to be employed in the U.S., it would be most effective if many insurers participate in the quarterly survey.

For public plans, which often have CPI annuities, there is no required calculation of plan termination liability and the accounting standard uses assumed returns on investments. The interest rate for plan termination liabilities would likely be close to zero, as in Canada.

Section 3: Individual Annuities

Unlike group annuities, there is no need for guidance to estimate prices for individual annuities. In the United States and Canada, there are several websites were quotes can be obtained for individual annuities. Indeed, the problem is too much data. There are many websites, companies and annuity types in this market. Given that an exact price of an annuity can be easily determined, why use an estimation method?

3.1 Canada

CANNEX maintains a complete database of individual annuity quotes for both the United States and Canada. In Canada, there are 10 to 11 companies providing quotes. Inputs would include amount of premium, ages and genders, single or joint life, death benefits (such as certain periods or cash refund), tax status of the funds (e.g., registered) and province of residence. A monthly annuity is the output.

Other sites providing quotes include:

- Life Annuities, *https://lifeannuities.com/calculator.html*
- Sun Life of Canada, *https://www.sunlife.ca/ca/Learn+and+Plan/Tools+and+Calculators/Annuity+Calculator?vgnLocale=en_CA*
- RBC, *https://www.rbcinsurance.com/annuities/annuity-calculator.html*

3.2 United States

The United States has more sites and more providers offering quotes on individual annuities than Canada. CANNEX has a database of providers in the U.S. Inputs would include amount of premium, ages and genders, single or joint life, death benefits (such as certain periods or cash refund), tax status of the funds (e.g., qualified) and state of residence. A monthly annuity is the output.

 The following is a sample of websites that provide quotes:

- Immediate Annuities, *https://www.immediateannuities.com/*
- Charles Schwab, *https://www.schwab.com/public/schwab/investing/accounts_products/investment/annuities/income_annuity/fixed_income_annuity_calculator*
- Go2Income, *https://www.go2income.com/CustomizeYourAnnuity.html*
- New Retirement, *https://www.newretirement.com/services/annuity_calculator.aspx*

Section 4: Group Annuity Pricing Survey and Model Company

4.1 Group Annuity Survey

Sixteen insurers, identified as currently active in the U.S. group annuity closeout market, are listed in Appendix A. Pricing actuaries at these companies were contacted by the SOA. Ten agreed to participate with the assurance that their responses would be confidential. These 10 include all the major companies in this market. The following is a summary of these responses:[21]

- **Mortality assumptions.** In the 2001 survey[22], eight companies used variants of the GAM while two used the RP. The mortality improvement was scale AA. In this survey, no companies used GAM for pricing and only one company used scale AA for mortality improvement. Many companies used internally developed mortality assumptions, which were closer to the RP-2014. Three companies used the RP. Most companies used the MP-2017 or variants of this scale for improvement. A couple of companies used Social Security Administration (SSA) data to develop mortality improvement assumptions. Only one company had assumptions that were close to the Reg. 4044 bases (UP-94

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[21] The survey questions are contained in Appendix B.
[22] Modugno, 30-Year Treasury Rates & Defined Benefit Pension Plans pp. 4-6

projected 34 years using scale AA). Most said their assumptions were closer to the PBGC Annual Report[23] basis (RP-2014 projected generationally using MP-2016). Unlike the 2001 survey, most companies are underwriting mortality using different assumptions based upon industry, ZIP code, collar and annuity size. Many companies would use plan-specific mortality data if credible.

- **Interest assumptions.** Seven companies use a yield curve for pricing, while two use rates that vary by duration. Five use rates from investments, which in one case was compared to an index rate. Three use indexes and the remaining two use yield on an assumed investment portfolio.

- **Expense assumptions.** None of the companies had different expenses for buy-ins, but many do only buyouts.[24] Three companies had assumptions that were like the PBGC's. The others that gave details used per life charges, percent of premium or interest rate reductions to reflect expenses.

- **Early retirement assumptions.** In the current low interest rate environment, subsided early retirement factors have become much less important. Indeed, in some cases, the subsidies are negative (i.e., result in gains). One company mentioned that they were more concerned about late retirement increases than early retirement. Of the eight companies pricing early retirement subsidies, three used assumed retirement ages, while five used retirement scales. Six companies consider plan experience in choosing early retirement assumptions.

- **Optional forms, including lump sums.** Most companies would price these based upon experience. Some would decline cases with too many lump sums or other subsidized options that could not be modeled.[25]

- **Special circumstances.** Size (too big or too small) was given as a reason to decline by many companies. Administrative complexity, too many lump sums or other optional forms that were difficult to model, disability benefits if not based on Social Security, COLAs and too many deferred were reasons for declination. Of companies indicating a minimum size requirement, the lowest was $20 million.

4.2 Model Company Pricing

For comparing to the PBGC method, a model of insurer pricing was built based upon the foregoing survey, NAIC risk-based capital requirements, assumed expenses and return on capital/profit charges. For an investment strategy, a duration matched portfolio of NAIC 1 (A or higher) rated publicly traded bonds was chosen as represented by the ICE Bank of America Merrill Lynch Corporate A bonds 15+ (C8A3). This has an effective duration of 14, which is representative of a buyout with both retired and non-retired lives.[26]

Redundancies are applied to NAIC capital charges giving a total required surplus of 3%.[27] The target after tax return on this surplus is 10%, and surplus earns 4% pre-tax, and the tax rate is 21%.[28] The required spread rounds to .30%. We have added .20% for overhead and investment management expenses, .05% for asset

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[23] PBGC, 2017 Annual Report.

[24] Buyouts, also called closeouts, refer to purchases of annuities for the entire plan, typically for plan termination. Buy-ins refer to purchases of annuities by an ongoing plan as an investment. These would usually be limited to inactives (retired or terminated vested).

[25] Cases where a one-time lump sum is offered at plan termination, the anti-selection could be handled by adjusting the mortality assumptions.

[26] ICE Data Services, "Bank of America Merrill Lynch Global Indexes," C8A3.

[27] NAIC required capital C1(asset default) = .4% plus C2(underwriting/mortality) = .77% with 2.5 redundancy (needed for a highly rated company), American Academy of Actuaries, "Life RBC Formula.xls," LR002, 024, *www.actuary.org/files/Life%20RBC%20Formula.xls* (accessed Sept. 15, 2018), and NAIC, "Valuation Manual." The comparable S&P capital would be higher at about 5%. Standard and Poor's, Refined Methodology, p. 35.

[28] Target return consists of 7% cost of capital (10-year Treasury yields plus 4%) plus 3% for shareholder value-added.

defaults[29] and .10% for administrative expenses[30], giving a total spread of .65% off the A bond rate. We have ignored surplus and tax strain, which are no longer an issue. For mortality, the RP-2014 was projected using MP-2017 generationally.

Figure 6 compares the model company's pricing rate (ICE A −.65%) to the PBGC rates and the FTSE AA yield on June 29, 2018. Treasury yields are there for comparison. As expected, the model pricing rate is inside the AA rate (averaging .45% lower). However, it's higher than the PBGC rates[31], averaging 1.2% higher than the PBGC initial rate. This is due in part to the lag in the PBGC rates. These rates are the average from two to three quarter ago. During periods of rising interest rates, PBGC rates will lag the current market. Another reason is that the insurers participating in the survey may be using more conservative mortality assumptions.

To examine this, the cost for $1,000 per month for life for a healthy male annuitant age 65 was calculated on the PBGC and model company basis. The PBGC basis is UP-94 projected scale AA static 34 years at 2.53% for 25 years and 2.64% thereafter. The effect of the 11 basis points higher rate after 25 years adds about 1 basis point to the initial rate or 2.54%, which gives a cost of $182,490. The rate for the model was developed by interpolating C8A3 (15+ years) with duration 14 and C7A3 (10 to 15 years) with duration 9 to match the liability duration of 10, giving 4.3%.[32] The model uses RP-2014vMP-2017 at 3.65%, giving a cost of $169,490. The price difference of 7.5% equivalent to .75% in interest rate at duration 10. This leaves .36% attributable to mortality. The PBGC rates are based upon an average of the rates on March 31, 2018, and Dec. 31, 2017. Using the average of the model rates on those dates gives a net rate of 3.11%, .54% lower, making the lag the more important factor.

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[29] Moody's, Annual Default Study, p. 105.

[30] Administrative expenses assume an average per participant liability of $30,000 $30 per participant per year. The overhead and investment expense assumption reflect typical allocation for large ($25 million and over) cases.

[31] In Figure 6 PBGC1 is the initial rate, PBGC2 is the rate after 20 or 25 years

[32] On Sept. 28, 2018, C8A3 (duration 14) = 4.48% while C7A3 (duration 9) = 4.26%. These rates were calculated by adding option-adjusted spread (OAS) from the ICE website to the government bond rate at the duration. The duration of a 65-year-old male annuity is 10 years and so the rate was calculated by interpolating: 1/5 x 4.48% plus 4/5 x 4.26% = 4.30%.

Figure 6
RATE COMPARISON
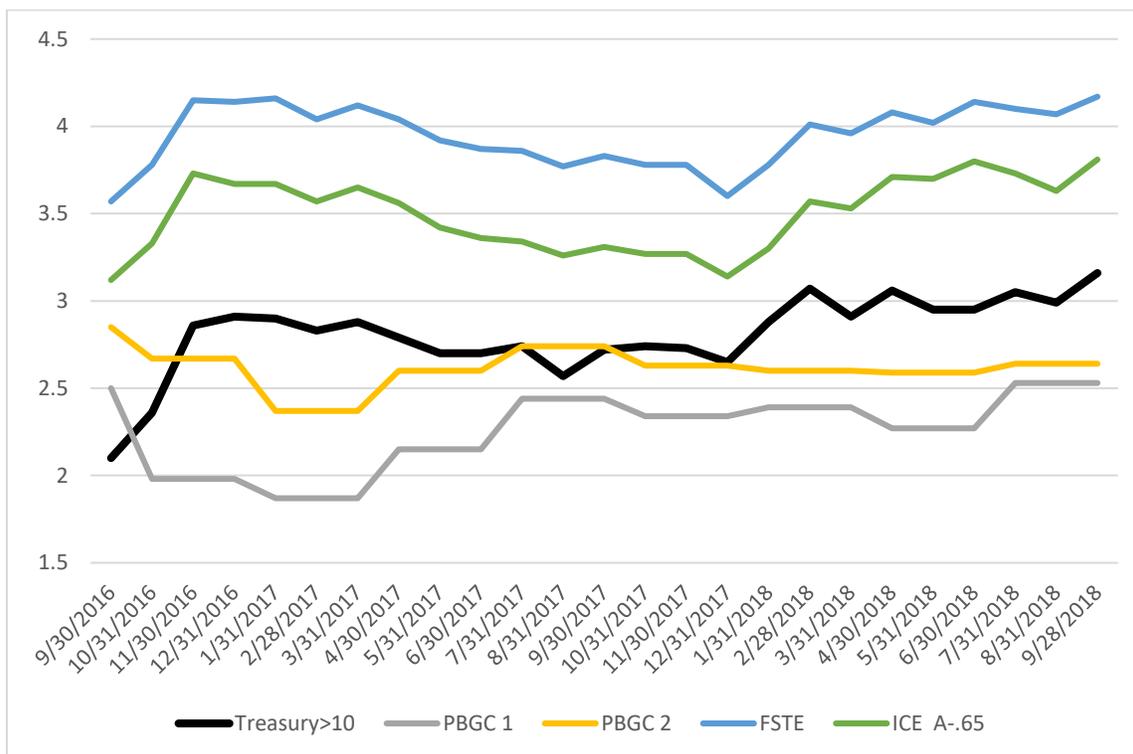
Sources: ICE Merrill Lynch BofA (C8A3), United States Treasury, SOA(FTSE) , 29 CFR 4044 Appendix B

Conclusions

The CIA's quarterly guidance in the form of an educational note on group annuity pricing for solvency valuations provides an excellent approximation to group annuity prices in Canada. It could work in the United States, assuming sufficient insurer participation. Currently less than half of the insurers in this market provide sample indicative rates to ACLI for the PBGC survey. Without sufficient insurer participation, the CIA method of pricing three hypothetical annuity quotes will not work in the U.S. This also points to a potential future problem in Canada—decline in participation over long time periods. Back in the 1980s, there were efforts to encourage insurers to participate in the PBGC survey and participation was better.

Encouraging more insurers to participate in the ACLI/PBGC survey could lead to a more robust approach. Perhaps a website can be set up where rates could be entered by participating companies. A study comparing actual pricing on closeouts to PBGC pricing completed in 2000 could be repeated to validate PBGC methodology.[33]

There is no need for an estimation of individual annuity prices in either the United States or Canada since these are readily available on websites. The same companies that treat sample indicative group annuity rates as closely guarded secrets publish on the internet exact buyable quotes for any age or benefit for individual annuities. The mortality and expenses may be different, but the underlying investments for individual and group annuities should be the same. A method of using individual annuity rates downloaded from the

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[33] Oliver and Schlappich, "PBGC Plan Termination Cost Study."

internet to estimate group annuity pricing could be developed using historical individual annuity quotes. The stickiness of individual annuity quotes needs to be factored into the algorithm. This could be a future SOA research project.

Appendix A: Companies in the Group Annuity Closeout Market

Insurer Enterprise	U.S. Life Insurance Group Assets (Billions)	Ownership	Market Entry	Ratings
Prudential	$589	Public	Pre-2012	AA–/A1
MetLife	$432	Public	Pre-2012	AA–/Aa3
New York Life	$317	Mutual	Pre-2012	AA+/Aaa
AIG (American General)	$285	Public	Pre-2012	A+/A2
MassMutual	$247	Mutual	Pre-2012	AA+/Aa2
Principal	$186	Public	Pre-2012	A+/A1
Pacific Life	$132	Mutual	Pre-2012	AA–/A1
Athene	$69	Public	Post-2012	A/NR
Securian (Minnesota Life)	$45	Mutual	Post-2012	AA–/Aa3
Western and Southern	$43	Mutual	Post-2012	AA–/Aa3
OneAmerica (American United)	$36	Mutual	Post-2012	AA–/NR
Mutual of Omaha	$30	Mutual	Pre-2012	AA–/A1
Mutual of America	$20	Mutual	Post-2012	AA–/NR
CUNA Mutual	$18	Mutual	Post-2012	A/A2
Great American	$7	Public	Pre-2012	A+/A2
Legal & General American (Banner)	$4	Public	Post-2012	AA–/NR

Aon[34]; LOMA; Ratings: S&P/Moody's

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[34] Aon, "2018 U.S. Annuity Settlement Market Update" April 2018 p.5

Appendix B: Group Annuity Pricing Survey

The questions:

1. **Mortality.** What basis and how do you project for future improvement? In preliminary bids, do you use different assumptions by group (hourly) or plan-specific assumptions? Do the current PBGC assumptions (1994GAM projected 34 years AA) or possible future assumptions (RP-2014 projected generationally MP-2016) appear close to your assumptions?
2. **Interest.** Do you use a yield curve or assumptions that vary by duration? Do you use transfer pricing (i.e., use an index)? Do you use special investments in settings preliminary rates?
3. **Expenses.** Do the PBGC assumptions ($10,000 + $200/life + 1%) reflect your method? Are there any distinctions between buy-in and buyout annuities?
4. **Early retirement.** Do you use a retirement scale or assumed retirement age? Do you factor in plan-specific data?
5. **Optional forms.** How do you handle optional forms including lump sums?
6. **Special circumstances.** Have you encountered situations in which you would refuse to bid on a group annuity or your answers to our questions would be different (e.g., indexing, very large or very small groups, disability benefits, survivor benefits for individuals not named as a contingent annuitant at purchase)? Please briefly describe those situations.

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