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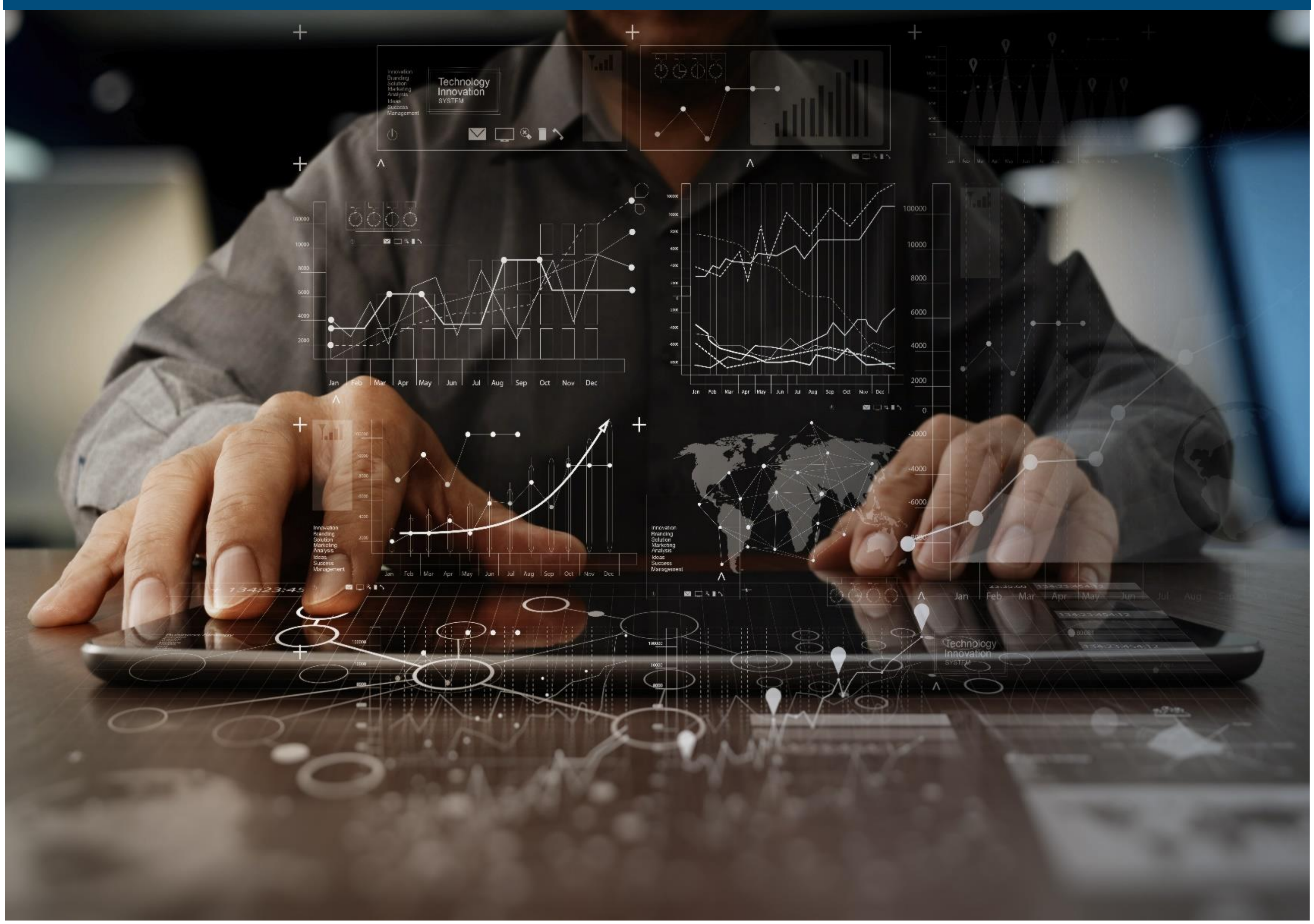
Investment Year Method

Aligning Renewal Credited Rates With Investment Strategy



May 2019

SOCIETY OF ACTUARIES

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Interest rates have fallen to levels not anticipated when deferred annuities and universal life products were originally designed, leaving many of these legacy policies crediting rates at guaranteed levels. Interest rate setting committees often set rates using rules of thumb, with little theoretical guidance about how renewal rates should be determined or transparency behind the actual process used. This research project is intended to address a practical application of the investment year method (IYM) under various interest rate environments that is fair to both policyholder and insurer. It is not meant to be the sole method but to generate discussion about alternative methods to find one that works best for a specific situation. It is hoped that this research will facilitate a discussion of existing, and potential new, products and how IYM methods might work with them in the future. Insurance is a trust product, with consumers relying on insurers to treat them fairly. This paper will provide one way to do this with respect to credited interest rates, using a single premium deferred annuity (SPDA) as an example.

Application to allocating investment returns for non-guaranteed elements, such as dividends, or more complex products like universal life and indexed annuities, would follow the same general process, so the examples that follow will focus on non-participating SPDA products as a simple example the practitioner can extend to other situations.

Background

This research project was funded by the Committee on Finance Research of the Society of Actuaries. The investment year method topic was removed from the SOA syllabus in 2014. Interest rates have fallen far enough that differences between the IYM and portfolio methods are minimal, or the policies are crediting the guaranteed rate. Eventually rates will rise above guarantees, and insurance products will consider using the IYM as an equitable alternative crediting strategy. This research is meant to provide a bridge to the past if someone chooses to cross it.

Research reports do not create themselves in isolation, and the researcher thanks Steve Hodges, Dennis Radliff, Nate Deboer, Rich Owens, Steve Siegel and Barbara Scott for their help peer reviewing the paper. Of course, all errors and omissions remain the responsibility of the author.

Researcher

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Executive Summary

Aligning interest credited to policyholders with the investment income earned by a life insurer is a key component to meeting client expectations, but it is not straightforward. While the policyholder sees all of their premium included in the account value, the insurer has to borrow from surplus to pay initial expenses and set up capital. The statutory reserve requirements help by accounting for surrender charges, but the company makes an investment when a policy is sold. It generates profits on that investment through collecting charges from non-guaranteed elements like mortality, expenses and investment spread. Combined, they pay for death benefits, expenses, interest credited, capital charges and profit. This paper will share one method to set renewal credited rates, formulaically estimating the asset rollover based on the needs of the liabilities using duration targets that vary based on year since issue. Since interest rates peaked in the early 1980s, the current generation of actuaries has no experience in a rising interest rate environment. Interest rate guarantees set in that era were often 4% or higher, and today's investments supporting these liabilities generally result in a credited rate tied to guarantees. Various methods have been used to adjust the credited rate over time. Most use formulas for guidance and are set by a committee. The experience gained from this process is less important when credited rates are already at the guaranteed rate so this skill set is being lost. It is the researcher's hope this paper will provide a starting point when the next generation of account value products is developed.

The investment year method (IYM) allocates premiums received from the policyholder into buckets that segment the cash based on when it was received. This approximates the actual times when assets are purchased that back the policy, providing intergenerational equity.

Examples are developed to demonstrate the IYM methodology, sharing various assumptions to consider when estimating asset returns and supportable credited rates.

Rates will continue to cycle, and the investment year method will provide a transparent method to earn the trust of policyholders that insurers are treating them fairly.

Section 1: The Basics of the Investment Year Method

Traditionally, credited interest on account value (or participating) products was allocated using the portfolio method, taking the investment income from all general account assets and allocating it based on statutory reserves or some other metric. Often, an average reserve was calculated on a quarterly basis to allocate the earned investment income, and investment expenses and other charges were deducted using the same method. The metrics were converted to percentages for the administrative system to credit interest to individual policies.

The investment year method for crediting strategy attempts to better align the amount credited to a client with the amount earned by an institutional investor. This is accomplished by developing a crediting strategy that replicates the investment strategy. This method sets the credited rate in advance, often at the beginning of a policy year. This adds a layer of complexity over some group products that credit interest after the fact.

For an insurance company, this applies to any product with an account value, primarily individual deferred annuities and universal life. For this paper, we will focus on general account products backed by asset portfolios that also legally support other policies. This paper will not discuss separate account products that exclusively back specific products like variable annuities and equity indexed life insurance.

There are two general methods used to allocate investment income, and the terminology is also used for crediting interest to policyholders. The portfolio method uses the same rate across all policies backed by a set of assets, or a specific portfolio segment, independent of when the policy was purchased. IYM aligns the income with a characteristic of the asset, generally when it was purchased. Liabilities are then mapped to these segments based on when premiums were received from a policyholder, forming buckets. Assets are then allocated to these buckets, representing the period when the original asset was purchased, even if a matured asset has been replaced. Buckets are rebalanced over time as net cash flows increase or decrease the policyholder's account value.

Account value products pass through net investment earnings to the consumer through the crediting rate methodology. This technique "unbundles" expense, risk and profit charges with the expectation of being equitable to the policyholder. Insurers will often include a distinct mortality charge for a life insurance policy and a spread fee charged in basis points,[1] a per-policy fee or per-thousand-of-face-amount fee to cover other expenses and risk charges. The policy is priced to meet a hurdle rate return on investment that incorporates the cost of holding capital. The methods described can be extended to variable and fixed indexed products, but the reader is left to contemplate those products once they have the basics of general account products in hand.

Since the credited rate must be set in advance, an insurer will create consensus about initial and renewal credited rates using an interest rate setting committee composed of product managers, investment professionals and often representatives of the corporate staff involved in asset-

[1] One basis point (bp) is the same as .01%; this terminology is typically preferred by investment professionals. These fees are charged based on the account value in an individual policy.

liability management. Actuaries may participate in various roles. Membership may be driven by logistical factors like the area responsible for implementing the credited rates into the administrative system. While these decisions often require negotiation between competing incentives, a team providing a place to start based on thorough modeling of various options can influence the process using logic and transparency. From there, competitive pressures may force the process to deviate from a theoretical basis.

1.1 IYM for Allocation of Investment Income

The investment year method can also apply to the investment process when allocating investment income. For example, if an insurer allocates investment income to business lines using the portfolio method,[2] when rates are rising, lines that are not growing are subsidized and, when rates are falling, growing lines are subsidized.

IYM better coordinates business lines with the investment earnings from assets purchased for that line. This approach aligns reserve development methods under a principles-based reserving methodology, which ties strategies to the risk of an insurance product as a company has implemented them, without having to set up a separate segment for the product line or a separate account. IYM crediting strategies help to align actual investment earnings with interest credited, improving transparency of earnings.

[2] The portfolio method differs from the investment year method in that every bucket credits the same rate.

Section 2: IYM Review

2.1 Historical Use of the Investment Year Method

The investment year method technique for allocating credited interest has been around in various forms for many years. Prior to the 1970s, the methodology had been used to credit interest in arrears for some products. Since the last time interest rates spiked, in the early 1980s, consumers have demanded pass-through products to share in the higher earned investment income for retail products.

A good source to learn about IYM crediting strategies can be found in the *Record of the Society of Actuaries* from the 1989 annual meeting.[3] It provides a good overview of the method and, along with the researcher's personal experience, forms a basis for the rest of this section.

If interest rates stay in a relatively narrow corridor, additional analysis is typically not warranted. Next, this paper will discuss why doing the analysis matters.

2.1.1 Synchronization of Credited Rates and Investment Strategies

When a life insurance company seeks to pass through to a customer an equitable amount aligned with the investment income earned and allocated to the associated line of business, there are a number of methodologies and challenges involved. In its simplest form,

Credited rate = Net earned rate — Pricing spread.

The *net earned rate* is net of investment expenses and may attempt to spread defaults and liquidity risk over the life of the policy by converting them to a basis point (bp) charge. The allocation is often based on statutory reserves, while interest is credited to a policyholder's account value. Calculating the gross earned rate has many complexities not contemplated here, mainly due to asset complexity and how the accounting system handles accruals and the timing of cash flows.

The pricing *spread* is a rate that converts charges to a percentage expressed as a basis point reduction. Much of the spread represents an average of the present value over its lifetime of all expenses and compensation paid to originate the policy. This includes the salaries of any sales staff, commissions, direct-to-consumer mailing cost, advertising and policy maintenance expenses. It could be level or vary by year since issue, and considers the expected growth in account value. It is often set at a level to earn the pricing target rate (e.g., return on investment, present value of distributable earnings) and so incorporates both a profit margin and capital charge.

The *credited rate* awarded is often set after a healthy discussion between those investing for the product, those selling the product and those seeking to ensure profitability of the product. Their incentives do not align. The investment team may receive a bonus each year based on how much

[3] Alpert, Frank J., Peter Hepokoski, and P. Andrew Ware. Synchronization of Crediting Rates and Investment Strategies. Panel Discussion at the New York Meeting of the Society of Actuaries, Oct. 22–25, 1989. *Record of the Society of Actuaries* 15, no. 3B:1427–55. *https://www.soa.org/library/proceedings/record-of-the-society-of-actuaries/1980-89/1989/january/RSA89V15N3B2.PDF*.

returns exceed their benchmark, so they may lean toward a low credited rate. The sales team is rewarded for high sales, so they want high credited rates for new policies. Profitability metrics are higher when credited rates are lower.

Since the credited rate is set in advance, the formula shown here is a theoretical, or supportable, rate to describe this process. Charges are typically set level across the life of the policy.

Credited rate (all charges reflected in basis points) =
Gross investment rate – Investment expense charge –
Charge for expected defaults – Liquidity charge – Pricing spread

where,

Pricing spread = Expense charge + Charge for compensation/commission +
Charge for policy marketing/issue + Policy maintenance charge +
Profit margin + Capital charge.

If the theoretical credited, or supportable, rate calculated in this way remains above the guaranteed rate, and the product avoids high lapse rates and asset extension risk due to material interest rate increases (convexity), then the product should be profitable. The modeler should regularly compare the investment strategy with the assumptions used to ensure they are consistent with the actual practices followed.

2.1.2 Lapse Rates

If policies stayed in force for a specific number of years and then were repaid to the client, maintaining equity between policyholders and insurer would be much easier. In products backed by an account value, policyholders typically (some tie surrender charges to the length of an initial interest rate guarantee) have an embedded option to lapse (fully or partially) at any time, subject to a surrender charge (which may be waived for small amounts). This charge can be a percentage of the account value, a fixed dollar amount or tied to the market value of the assets (deemed to be) backing the policy. A typical lapse rate formula used for asset adequacy testing of deferred annuities has been

$$Base\ lapse\ rate + A \times [Max(0, Market\ rate - Credited\ rate)]^B - C \times Surrender\ charge$$

where

- *Base lapse rate* varies by years since issue and includes mortality
- *A, B* and *C* are constants based on experience or sophisticated guesses (since periods of rising interest rates have not generated enough data points to be credible); for the next generation of products, lapse data will have been collected, moving this assumption (hopefully) toward an experience study and away from an educated guess
- *Market rate* is the rate a policyholder can get with a newly issued policy (or from a competing product like a certificate of deposit)
- *Credited rate* is the current credited rate of the policy

- *Surrender charge* is the percentage rate the policyholder would have to forfeit of the account value to lapse the policy, and typically grades to zero over several years

The differential between the market rate and credited rate matters only if it is positive, so the excess lapses occur only when the policyholder could receive a higher credited rate by lapsing and reissuing the policy. The formula does not generate lapses lower than the base rate.[4] The surrender charge acts to dampen the impact of higher rates available in the market. The insurer can choose to credit a higher rate than is supportable by available assets in order to minimize lapses. This also reduces profitability but may enhance the relationship with distributors. A low credited rate will increase lapses and may force the insurer to sell assets to meet cash flow needs. An insurer who matches the highest credited rate in the market may be pricing to the worst returns available. Importantly, as the policy ages, the appropriate credited rate may not be the same as a new policy with a longer investment strategy. Crediting strategies that use components of each are often used, complicating the analysis. Much like mortgage refinancing rates, there is likely a differential between current credited rates and those available in the marketplace that balances lapses with profitability.

2.1.3 Higher Order Implications

The investment strategy is defined by the liabilities, but this is somewhat circular reasoning since the lapse rate depends on the scenario and current credited rate. Often, an insurer will price an account value driven product using a level spread across all years, but this does not really reflect the optionality afforded the policyholder. Especially once the surrender charge has been reduced to zero, the policyholder's option is consistent with a duration very nearly zero. They can request the account value at any time. For annuities, this is the policyholder's primary consideration, but for the holder of a life insurance policy, their insurability (or rather a lack thereof) would come into play as an additional dampener to lapse the policy. While this means that lapses are lower than anticipated, the policies remaining would be expected to have higher mortality experience since they could have moved to a new policy if they were insurable.

Representative of typical pricing analysis, the paper from the 1989 SOA annual meeting describes three interest crediting strategies.[5] For the pure earned rate less pricing spread strategy, the product's convexity (see 2.1.3.1 for details) makes it perform poorly when interest rates move from initial levels. Copying the market credited rate allows better performance, and combining the methods does the best as initial lapses are reduced and future spreads are captured that would have been lost. The investment strategy impacts profitability, and especially the volatility of results. A matched strategy will reduce variation, while tail scenarios can do really well, or really poorly, if management bets that the investment duration should be set higher or lower than the liabilities.

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[4] The next generation of products should revisit this type of formula. It does not recognize the higher retention rate found as rates reduce, especially when they reach the guaranteed rate. Experience study data collection should also get another look as the formula reflects what the lapse rate would be if rates stayed the same but should be segregated by interest rate trends.
[5] Alpert, Hepokoski, and Ware. Synchronization of Crediting Rates.

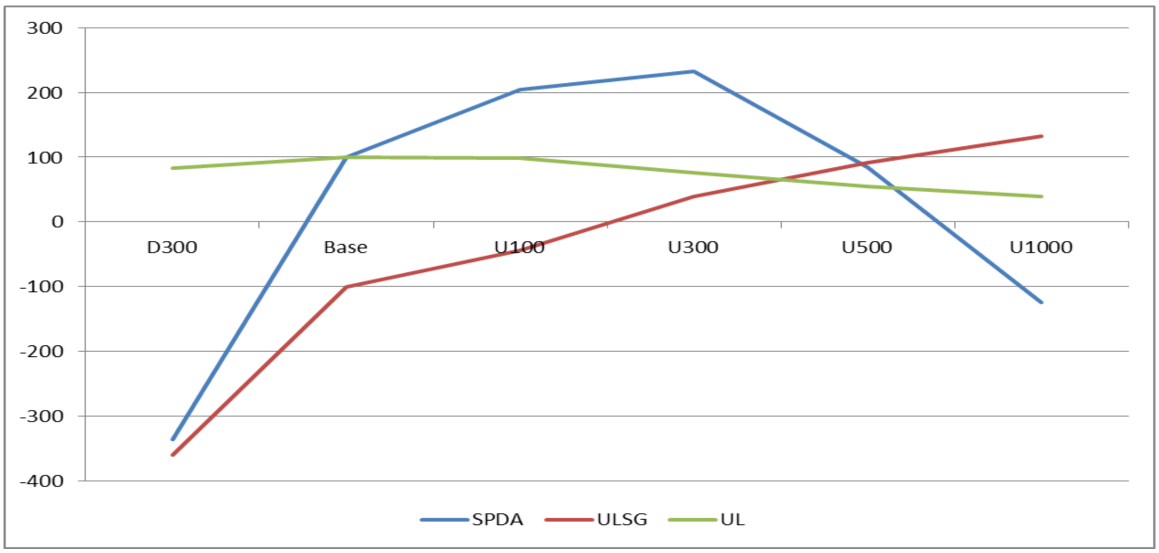
2.1.3.1 Scenarios as Proxy for Stochastic Simulations

In Figure 1, taken from an earlier paper by the researcher,[6] three common products sold by life insurers are modeled. An in-force block is built for a single premium deferred annuity (SPDA) product, a basic universal life (UL) product and a UL product with secondary guarantees (ULSG).

If the result measuring value is generally a straight line as interest rates change, like the UL result in Figure 1, then a linear relationship (first derivative) can estimate intermediate results. However, if the graph looks like the letter "U," then convexity (second derivative) must also be considered for intermediate results. The SPDA result in Figure 1 is a good example, driven in this case by the policyholder's option to lapse the policy, along with asset optionality.

Figure 1

Value: Discounted at Scenario-Specific 10-Year Treasury Rate



Source: Rudolph, Max, Randy Jorgensen, and Karen Rudolph. 2015. Transition to a High Interest Rate Environment: Preparing for Uncertainty. Society of Actuaries report. *https://www.soa.org/research-reports/2015/research-2015-rising-interest-rate/*.

These six scenarios do a good job demonstrating higher order metrics like convexity. The metric used in this case is present value of distributable earnings (PVDE). The base scenario is normalized to 100 (or –100 if the base scenario is negative), and the other scenarios simply increase or decrease the initial yield curve. D means down and U means up, so U300 means every point on the initial (base) yield curve is increased by 3%, or 300 basis points. The UL product has less interest rate risk and is still profitable even if rates rise 10%. The ULSG product acts like an interest rate option, with the value nearly linearly increasing with each rise in the initial yield curve. SPDA reflects a highly convex product, earning solid profits if rates rise from current low levels (even if it is a spike of several percentage points). It does poorly when large interest rate spikes occur (high lapses occur as assets are sold at a capital loss) and when interest rates fall and policyholders retain their policies for the guaranteed rate.

[6] Rudolph, Max, Randy Jorgensen, and Karen Rudolph. 2015. Transition to a High Interest Rate Environment: Preparing for Uncertainty. Society of Actuaries report. *https://www.soa.org/research-reports/2015/research-2015-rising-interest-rate/*.

In fact, a simulation model will make an initial guess at the credited rate, run the assets and liabilities through a first pass, adjust the credited rate, repeating until the difference between the projected credited rate and the current pass credited rate is within a defined tolerance.

2.1.4 Alternative Analysis

Efficient frontier analysis can be performed around these alternative strategies. This would allow a model to compare the existing portfolio with various new purchase strategies to determine which would best meet objectives while conforming to any constraints.

This analysis could use any of the firm's preferred metrics. These might include present value of profits (PVP), PVDE or market value of surplus, among many others.

2.1.5 Risks

Risks held in insurance policies can be tracked using the National Association of Insurance Commissioners' (NAIC) risk-based capital (RBC) methodology.[7] These risks are differentiated by contingency risks, which differ for life/health insurers and casualty companies. Shown here is the information for a life/health insurance company. For an individual policy, or product line, charges are added together, often with a diversification benefit adjustment.

- **C-1.** Credit risk (likelihood of an asset defaulting or a rating downgrade)
- **C-2.** Pricing risk (volatility of mortality or morbidity results)
- **C-3.** Interest rate or disintermediation risk (base profitability assumptions do not hold as interest rates change)
- **C-4.** General business, operational and strategic risk (a catchall for risks that are hard to quantify but important to understand)

An SPDA is sold as an investment product and competes with bank products like certificates of deposit and money market funds. The distribution method matters for lapse rate sensitivity assumptions, with annuities sold through stock brokers noted for their sensitivity to increasing rates. These products are generally shopped with new companies when the surrender charge reaches zero (and new commissions are paid).

A UL product sold without secondary guarantees has low surrender values in the early policy years, providing lower incentive to lapse.

When products with different duration requirements are sold by the same company, a decision must be made about segmentation. Insurers can informally segment their assets to reflect liability traits and must make conscious decisions when small portfolios contain multiple products.

[7] https://www.naic.org/cipr_topics/topic_risk_based_capital.htm

2.1.6 Preparing for Uncertainty

The paper mentioned in Section 2.1.3.1[8] addressed the importance of scenario planning around interest rate analysis and considered reasons rates could increase or decrease in the future from their current levels. The following section updates some of the highlights.

Interest rates are impacted by far reaching issues like supply and demand, monetary policy, fiscal policy, regulations, trade policy, capital policy and technology. There are so many complex interactions that it is not surprising to find unexpected results. Stress tests—in the direction rates are expected to go, as well as in the opposite direction and randomly in no particular direction—are important to understand the nuances of the exposure in a block of business.

Some interest rates around the world are currently negative. Many commonly used scenario generators do not anticipate this environment. Governments are actively stimulating the economy through fiscal and monetary policy. We are in new territory. New solutions are needed.

2.1.6.1 Why might interest rates go up?

Many practitioners have been waiting for interest rates to cycle up for many years. Here are some reasons they may finally be right.

- Rates cycle: they have bottomed out after a long drop and so will continue to “bounce.”
- The Federal Reserve Bank has started to unwind previous stimulus, so a continuation would naturally increase interest rates to an equilibrium rate higher than today’s.
- The federal government has run deficits for many years, as have most other countries. Historically, this has eventually led to higher interest rates.
- Many countries, including the United States, entered a currency war following the financial crisis where central banks sought to export deflation by devaluing their domestic currency. This was an attempt to grow exports and add domestic jobs, but when practiced by multiple countries simultaneously can lead to a spiral of uncertainty. More recently, central banks have begun to unwind this monetary stimulus, with unexpected consequences as tightening occurs at varying speeds and fiscal stimulus remains. When the ratio of debt to gross domestic product becomes high (as it is now in many countries), this increases the likelihood of a financial crisis. Specific triggers and timing are impossible to pinpoint. The timetable depends on trust in the financial system and cognitive biases. Markets in their extremes are driven by fear and greed.

2.1.6.2 Why might interest rates stay low or fall further?

While few are currently concerned about rates falling, these risks are much more threatening to savers like insurers and so demand scrutiny. Here are some arguments to think about.[9]

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[8] Rudolph, Jorgensen and Rudolph. Transition to a High Interest Rate Environment.

[9] Many of these comments are recounted in Gordon, Robert J. 2016. *The Rise and Fall of American Growth: The U.S. Standard of Living Since the Civil War*. New Jersey: Princeton University Press.

- Supply and demand dictates that interest rates do not rise without growth.
- Growth may revert to the low rates (near zero) found prior to the Industrial Revolution.
- The velocity of money is at generational lows. This inhibits monetary policy effectiveness.
- Japan has had low rates for over 25 years. Rates do not necessarily mean revert to higher levels on a regular schedule.
- Demographic trends show aging populations and, in many developed countries, those populations have peaked (or will soon). The average age of these countries continues to increase. Absent changes in migration policies to increase young entrants, or increases in fertility rates, this will continue. The elderly tend to spend on services rather than growth-driving manufactured products.
- The cost of overuse of scarce resources and polluting the planet, ignored by accounting regimes in the past, could be recognized, slowing growth. Accounting shortcomings could be due to ignoring the depletion of scarce resources, negative externalities caused by prior or current pollution and release of carbon into the atmosphere, financial misalignments of assets and liabilities like unfunded public pensions or aberrations due to mark-to-market accounting.
- Trade policies and positive international relations since World War II have encouraged growth. Unwinding those policies are likely to have the opposite effect.

When interest rates are low, savers have a tendency to reach for yield, buying alternative asset classes and accepting additional credit and equity risk. These risks are often outside the expertise of internal staff.

2.1.6.3 Best practice stress testing

Companies tend to rely on regulatory scenario tests rather than devising their own based on unique exposures. Modelers can leverage the required tests with a few more that stress specific risks, layering deterministic scenario results graphically on top of sorted stochastic results to provide useful information about the current environment. They may also consider clustering, when multiple risk events happen over a short period of time.

2.1.6.4 Impact on insurance products and other savings tools

From today's base of low nominal interest rates, nearly all products benefit from a slow rise in rates. Some, like long-term care or payout annuities, that do not include policyholder account values may also perform well when rates rise quickly. Other products will experience losses when forced to sell assets to meet requests for funds. Lower rates are a different story, with challenges due to underlying nominal interest rate guarantees.

Products that do not credit interest to an account value see changes in investment income flow directly to their income statement. For an account value product crediting rates well above the guaranteed rate, a change in investment income will resemble a pass through allowing the insurer's income to be stable. Life insurance profitability is more complicated since higher credited rates reduce the net amount of mortality risk (face amount less account value). Mortality charges rarely create exactly the same level of profit as investment spread does. Surprising results can occur. Account value products with a theoretical rate below the guarantee will see changes in investment income pass through to the bottom line.

In a world where portfolio rates move lower than current rates, new products will evolve. Due to perceived poor prior treatment of policyholders as rates fell, it's likely some type of transparency will be needed to satisfy the public that they are getting what they were promised. Insurers may respond with products that pledge a credited rate driven by a benchmark or make it more like a separate account. Participating products may also become more popular as they would be expected to pass through any excess interest earned.

2.1.6.5 How insurers can prepare now

Deterministic scenarios are better at testing adversity than stochastic scenarios. Capital requirements developed for the NAIC claim to go out beyond the 95th percentile but use volatility assumptions from normal operating periods. It is better to look back historically to find scenarios that challenge a firm's survival based on current risk exposures. The period surrounding a war or financial crisis can illuminate hidden risks. Predictive modeling may help modelers develop scenarios based on unique risk profiles. Combining another event with a pandemic, weather or volcanic event, or cure for cancer, may show the risk manager where risks lie.

Risk managers who focus primarily on slowly increasing interest rate scenarios will gradually lose credibility if that scenario does not play out and it becomes obvious they presented only the best case scenario.

2.2 Issues Using the Investment Year Method

IYM can provide a challenge logistically for reporting financial results. Coding can be an exacting process for account value-driven products, with computer runtime that extends longer each time it is updated if past calculations are not saved. A database that saves simple pieces of information like the date a rate is first used, the product form, band (or tier), issue date, premium received, age and other information can quickly bog down a processing system when a cash accumulation value is needed for a policyholder request or reserve calculation. When these products were originally developed, the quarterly reserve calculations for deferred annuity and universal life policies were calculated from first principles each time, resulting in an ever increasing runtime issue and extreme pressure on what was for many already the critical path to reporting financial results. Today, intermediate values are saved that make the process more manageable.

When a new policy is issued, the accounting implications look different to the policyholder than to an insurer. For a deferred annuity, the client often provides a single deposit and the entire deposit appears to the policyholder to be placed in an account and start earning interest. For the insurer, it is more complicated. There are expenses to issue the policy, capital to set up and commissions to be paid. This reduces the amount actually invested at the time of issue and requires the product line to borrow from corporate surplus to avoid basis risk between assets and liabilities. The investment spread needs to account for this. It is more complicated for a universal life policy since it usually has a recurring premium. The initial cash outflows and accruals set up are often greater than the initial premium received. We think of account value products as easy to understand, but they are anything but that for the insurance company. To the policyholder, who receives a credited rate applied to the account value driven by premiums paid and previous credited interest, the transparency is clear but not aligned with the actual logistics of the product.

Another challenge is to keep track of all the buckets that have been created, potentially one for each week or month, including renewal periods, and split by product and band. It can become a huge file that is hard to work with. This makes it important to use relational databases to split up the information as much as possible, so the credited rate file has only the information it needs and ties to other databases. It can also save space and confusion by rolling rates into bigger buckets, perhaps combining 12 calendar months or even a portfolio rate for all policies in that category after a certain period of time. When consecutive buckets have the same credited rate, it makes sense to roll them together so they do not later diverge. There has been an opportunity to consolidate buckets over the past several years as credited rates have converged with the guaranteed rate for many products.

Credited rates can be calculated without considering guarantees with the floor applied only at the end of each cycle. This method will leave rates at the guaranteed level longer than if the guaranteed rate was saved as the rate to be averaged with the new supportable renewal rate.

Consistency between small segments can be challenging even when agreeing in advance that the process is only a proxy for what would happen in a perfect world. Some portfolios may not include any assets purchased for a given bucket, or may have initially and later had those assets called or mature. It is important to qualitatively keep track of consistency between similar segments, perhaps combining them at some point. In reality, an empty bucket is raiding an asset purchased in another segment or another bucket in the same segment. Attempts should be made to periodically balance the book values in an asset segment with the liabilities held (often statutory reserve, but could be GAAP reserve, account value or required assets = statutory reserves plus capital).

An actively traded portfolio makes this harder as the assets are not expected to be held to maturity. As long as any capital gains or losses are kept with the bucket and amortized into income over time, there is no impact beyond the logistical issues. But if assets are sold for a capital gain and the gain is released to the product line immediately, the policyholder is not being treated equitably.

2.3 Intergenerational Equity

Account value-driven products were originally designed as a response to the spike in interest rates in the 1970s, followed by the A.L. Williams mantra: “Buy term and invest the difference.” Whether this was a reasonable thing for most consumers to contemplate, or was really a sales technique to sell term insurance with no guidance on investing, is out of scope of this paper. Deferred annuity and universal life policies were perceived as similar to separate accounts for the policyholder, treating them fairly with respect to the investments made at the time of premium receipt. However, this promise is based on trust. There are no guarantees the policyholder will be credited rates based on a fair interpretation of the investment returns, and there is confusion about what a fair interpretation means too.

Some insurers write participating whole life, with expectations set using conservative assumptions and dividends paid if investment earnings and other non-guaranteed elements result in higher potential profitability. They often use a single portfolio rate for all policies, arguing that policyholders who maintain the policy throughout the cycle are treated fairly. They subsidize new business when rates are falling and are subsidized when rates are rising. It is hard to imagine that they will not react with new products to sell to new customers when rates begin to rise. Marketing teams will demand it.

When rates next rise, consumers will look for research to see if prior policyholders were treated fairly. Examples will be produced where renewal interest rates were taken to the guaranteed rate very quickly. Companies and regulators will receive bad publicity over this research. Methods will be needed that provide transparency and equity. Both participating and non-participating products will go under the microscope for transparency and treating policyholders equitably.

Subsidization can be direct or indirect, conscious or unconscious. Using a portfolio rate is clearly a direct and conscious decision, but other forms of subsidization are more subtle. Always rounding down or having supportable renewal rates that are lower than new business rates are less transparent.

A technique used to manage interest rate risk is asset-liability management (ALM), where effective duration calculations for assets and liabilities are compared to note their sensitivity to interest rates. This includes changes in cash flows of the assets or liabilities due to changes in interest rates. Sometimes convexity and other higher order metrics are also generated, especially if options to surrender liabilities or prepay assets are present. The risk manager must be careful to be sure the metrics are consistent between assets and liabilities as various duration and average life calculations are often used interchangeably.

A product feature that protects the insurer but negates the optionality which comes with surrender is a market value adjustment, where a surrender request is reduced or increased based on the movement in interest rates since issue using an index. If interest rates have risen or the insurer has to sell an asset, the asset will have a lower value; this is passed through to the policyholder like it would in a separate account. This calculation is approximated based on the change in an index interest rate and so carries basis risk.

2.4 Interest Rate Environments

It is challenging to model account value products across a variety of environments. When interest rates are rising, the interest credited rate must stay within a range of the earned rate or surrenders will increase, and the further behind you fall, the faster the lapses accelerate. The formula in Section 2.1.2 recognizes this. At some point, lagging credited rates will be featured in a *USA Today* article and surrenders will increase even faster. The opposite occurs when rates fall, and, when the credited rate drops to the guaranteed rate, the duration of the block gets very long. Those who calculate partial durations can use this relationship as a check of their model. There is no incentive to leave if they are receiving a higher credited rate guaranteed than can be received elsewhere. The formula does not provide for negative excess lapses, so the modeler may want to consider an alternative. Until there is experience to measure, it is unclear if these persisting policies will catch up with cumulative lapses later in the contract.

The American Academy of Actuaries developed a tool, with some parameters later adjusted by the NAIC that creates stochastic interest rates over a 30-year period.[10] Many companies use this tool for asset adequacy, capital adequacy and pricing, but many are just starting to think about how it acts under various starting conditions. When rates are above the mean reversion factor, it should work reasonably well, but when rates are low to start, this creates challenges and may lead to poor decisions if not understood. The current period, where rates are low (back "up" to nearly 3% for the 10-year Treasury and negative in some parts of the world) and credit spreads are tight, creates challenges. The economic scenario generator (ESG) is based on multiplicative factors that are always positive and so does not create negative rates. Yield curve interpolation techniques that unwind the curve using spot rates and forward rates have the same issue. This ESG mean reverts, keeping it from staying in an extreme low (or high) environment for very long. This works well unless you start in an extreme environment, which is, unfortunately, where we are today. In my 2015 research paper,[11] slow-up scenarios were determined to be best case across a variety of products. A deterministic scenario that rose 3% immediately was approximately equal to the median of a set of stochastic scenarios using the NAIC scenario generator. This ESG does not generate reasonable tail scenarios starting from today's environment. This does not mean it should not be used for regulatory purposes, but that companies managing these product lines should also create stress tests based on their own deterministic scenarios for their internal risk management.

When rates drop below the supportable rate for new business, companies are likely to adopt lower rates for renewals. The effective duration of the liabilities lengthens at the same time, as policyholders are less likely to lapse, so insurers can earn excess profits if the supportable rate stays close to the guarantee. Profits nosedive quickly when rates fall below the guaranteed level, and insurers have tried to increase other charges as the spread shrinks.

2.5 Application to Portfolio Management

One of the most interesting realizations in actuarial science comes when the student realizes account value products, sold to consumers as spread products, are much more than that. When modeling for pricing or an in-force block, these products must take into account charges for expenses, mortality, commissions, profit and capital. Rarely does analysis simplify to the difference between two rates related to gross investment income earned and credited.

In addition, the insurer must determine how much to invest for these products. Remember that the policyholder is being credited interest based on their cash accumulation value, which is generally higher than the statutory reserve. Here are some options to consider:

- Statutory reserves
- GAAP net reserves
- Cash surrender value
- Cash accumulation value

[10] Full disclosure: The researcher is past chair of this group and remains on the committee.
[11] Rudolph, Jorgensen and Rudolph. Transition to a High Interest Rate Environment.

- Required assets = statutory reserves + required capital

In the long run, each grades to something based on the cash accumulation value, so starting out below that means you have to catch up at some point.

Section 3: Renewal Credited Rate Methodology

Supportable credited rates may differ between new money and renewal. This difference may be due to longer duration (and generally higher yielding) assets purchased at issue, and allocating higher yielding assets to bolster new sales (higher earned spreads flow through to the new money credited rate). Both of these techniques increase new money versus renewal rates within a segment.

Account value products can be modeled, with a realistic investment strategy, at various points in their life. In this example, a representative block of policies would be modeled starting at year 0 (issue), end of year 1, year 2 and so on. The block is run, by itself, with assets appropriate to that point in time. For example, at issue, the assets would all be newly purchased, while at year 1 most would be a year since purchase and so have a shorter time to maturity and a shorter duration (assuming constant interest rates). Each block would generate the effective duration appropriate to the current environment. This means that if you are in a low interest environment, the liability duration would be longer than if rates were higher. The opposite is true for assets. As an example, a residential mortgage is issued at 8%. Now, if rates have dropped to 4%, the likelihood of refinancing has gone up due to the expected savings for the homeowner. The asset shortens. All this optionality is included in the result as the model is run with both assets and liabilities. This would generate an effective, or option-adjusted, duration. For simplicity, this paper discusses Macaulay duration, which simplifies the calculation by assuming cash flows are fixed.

The Macaulay duration is the weighted average of a bond’s cash flows:

$$Macaulay\ duration = \frac{\sum_{t=1}^{n} \frac{t \times C}{(1+y)^t} + \frac{n \times M}{(1+y)^n}}{Current\ bond\ price}$$

where C represents the coupon payment, M is the principal paid at maturity, and y is the yield.

Each of these variables can vary based on the value of t.

Macaulay duration is often presented graphically as a teeter-totter, with events represented by the discounted value of the cash flows. For a single cash flow at the maturity date, the Macaulay duration would be the same as the number of years to maturity. For multiple cash flows, the discounted values would be weighted using the time to the cash flow event. A cash flow stream that paid out 1 at points 1, 2, 3, 4 and 5 would have a Macaulay duration slightly less than the midpoint of 3 due to the discounting.

The position of the fulcrum, the single point that balances the weighted discounted cash flows, is a proxy for the duration.

The duration calculation provides a proxy for the length of the liability, and assumes the insurer uses a buy-and-hold strategy. It is a weighted average and assumes fixed cash flows, so multiply the result by 2 to see about how long a matched portfolio of assets would play out if maturing in equal amounts each year. If the duration is 5, the expected remaining cash flows will appear equally over about 10 years and the amount expected to roll over in the current year is 10% $(\frac{1}{2 \times 5})$. This may seem odd, since many bonds pay a coupon periodically and principal only at maturity but, when combined into a portfolio, will give reasonable results. While logical for most products, a reasonableness test should be applied (e.g., an endowment product may have cash flows that pay out all at once rather than smoothly over time).

This method assumes credited rates are updated for the following period (often a year, but updates could be more frequent in early durations and less often in later durations—eventually one could roll all policies and buckets into the portfolio method if there is little new policy activity) using expected duration calculations to estimate the rollover of assets for that block. Various scenarios have been developed as examples. A product with a duration of 5 at issue would expect 10% (1 divided by twice the duration) of the assets to rollover by the end of year 1 so the credited rate would move 10% toward the new money rate. For year 2, the expected duration would be calculated, with the rollover estimated, and so on. It is a reasonable calculation that is flexible and can be compared to actual rollover rates over time. These factors would be updated periodically based on movements in interest rates.

3.1 Examples

The examples presented are designed to highlight the methodology and not to be typical of the current or any prior market.

Example 1 (shown in Figure 2)

The new money supportable rate = 5-year constant maturity Treasury (CMT) + 80 bp credit spread for AA bonds – 140 bp pricing spread (round to near 25 bp).

If the 5-year CMT at issue was 7.00%, then

New money supportable rate = 7.00% + .80% – 1.40% = 6.40% (rounded to 6.50%).

The renewal supportable rate = 3-year CMT + 80 bp spread for AA bonds – 140 bp pricing spread (round to near 25 bp).

If the 3-year CMT is 2.85%, then following a 4.00% parallel shift down of the yield curve (so the 5-year CMT is now 3.00%, as shown in Figure 2) then

Renewal supportable rate = 2.85% + .80% – 1.40% = 2.25%.

For each year since issue, a model determines the duration of the liability which has aged to that point (these can be set at issue or developed annually if results are expected to vary). A weighted average of the current credited rate and the renewal supportable rate for the following year is used to set the credited rate for year 2:

- Current credited rate 6.50%, set at issue as described above
- Duration of liability after 1 policy year = 3.4
- Duration of liability after 2 policy years = 3.1
- Duration of liability after 3 policy years = 2.8
- Duration of liability after 4 policy years = 2.5
- Duration of liability after 5 policy years = 2.2
- Duration of liability after 6 policy years = 1.8

- Duration of liability after 7 policy years = 1.6
- Interest rate guarantee = 1.5%

Calculations for the weighted average of the current credited rate and renewal supportable rate are shown in Figure 2.

$$\text{Year 2 credited rate} = \left\{ \mathit{Current\ credited\ rate} \text{ x } \left[(1 - (\frac{1}{2\text{x}D_1})\right] + \mathit{Supportable\ renewal\ credited\ rate} \text{ x } \left(\frac{1}{2\text{x}D_1}\right)\right\}$$

where D_1 is the duration of the liability after 1 policy year

$$= \left\{ 6.50\% \text{ x } \left[(1 - (\frac{1}{2 \text{ x } 3.4}))\right] + 2.25\% \text{ x } (\frac{1}{2 \text{ x } 3.4})\right\}$$

$$= 6.50\% \times .85 + 2.25\% \times .15 = 5.86\%, \mathit{which\ rounds\ to}\ 5.75\%.$$

Year 3 credited rate =

$$= \left\{ 5.75\% \text{ x } \left[(1 - (\frac{1}{2 \text{ x } 3.1}))\right] + 2.25\% \text{ x } (\frac{1}{2 \text{ x } 3.1})\right\}$$

$$= 5.75\% \times .84 + 2.25\% \times .16 = 5.19\%, \mathit{which\ rounds\ to}\ 5.25\%.$$

Initial rounded results (constant 3-year CMT after year 1) for renewal credited rate starting with year 2 are 5.75%, 5.25%, 4.75%, 4.25%, 3.75%, 3.25% and 3.00%.

Interpretation:

- Rates earned by new purchases in this example have fallen 4.15% since issue (from 7.80% to 3.65%).
- Rates earned by the assets drop 75 bp, then 50 bp per year for 5 years, then 25 bp.
- Rates are still above the interest rate guarantee of 1.5%.
- Rates are still above the supportable renewal rate of 2.25%.

Figure 2

Example 1 Weighted Average of Current Credited Rate, Renewal Supportable Rate Calculations

Renewal Crediting Strategy	**Supportable rates**	**5 yr CMT**	**AA spread**	**Pricing spread**		Supportable rate				
	New Money	3.00	0.80	1.40		2.40				
Input items		**3 yr CMT**	**AA spread**	**Pricing spread**						
Output items	**Renewal**	2.85	0.80	1.40		2.25				
Renewal credited rates	**End of Year**	1	2	3	4	5	6	7		
utilizing effective duration to weight	**Duration**	3.4	3.1	2.8	2.5	2.2	1.8	1.6		
Renewal Rate weighting	**Assumed Rollover**	15%	16%	18%	20%	23%	28%	31%	inverse of 2 x duration	
	Current Credited Rate		Recommended Renewal Rate (before rounding)							
Renewal supportable rate	6.50	2.25	2.25	2.25	2.25	2.25	2.25	2.25		
	6.50	5.86	5.82	5.74	5.65	5.52	5.31	5.18		
	6.25	5.65	5.61	5.53	5.45	5.33	5.13	5.01		
	6.00	5.44	5.40	5.33	5.25	5.14	4.95	4.84		
	5.75	5.23	5.19	5.12	5.05	4.95	4.77	4.67		
	5.50	5.01	4.98	4.92	4.85	4.75	4.59	4.49		
	5.25	4.80	4.77	4.71	4.65	4.56	4.41	4.32		
	5.00	4.59	4.56	4.51	4.45	4.37	4.23	4.15		
	4.75	4.38	4.35	4.30	4.25	4.18	4.05	3.98		
	4.50	4.16	4.14	4.10	4.05	3.98	3.87	3.80		
	4.25	3.95	3.93	3.89	3.85	3.79	3.69	3.63		
	4.00	3.74	3.72	3.69	3.65	3.60	3.51	3.46		
	3.75	3.53	3.51	3.48	3.45	3.41	3.33	3.29		
	3.50	3.31	3.30	3.28	3.25	3.21	3.15	3.11		
	3.25	3.10	3.09	3.07	3.05	3.02	2.97	2.94		
	3.00	2.89	2.88	2.87	2.85	2.83	2.79	2.77		
	2.75	2.68	2.67	2.66	2.65	2.64	2.61	2.60		
	2.50	2.46	2.46	2.46	2.45	2.44	2.43	2.42		
	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25		
	2.00	2.04	2.04	2.05	2.05	2.06	2.07	2.08		
	1.75	1.83	1.83	1.84	1.85	1.87	1.89	1.91		
	1.50	1.61	1.62	1.64	1.65	1.67	1.71	1.73		
	1.25	1.40	1.41	1.43	1.45	1.48	1.53	1.56		
	1.00	1.19	1.20	1.23	1.25	1.29	1.35	1.39		
	0.75	0.98	0.99	1.02	1.05	1.10	1.17	1.22		
	0.50	0.76	0.78	0.82	0.85	0.90	0.99	1.04		
	0.25	0.55	0.57	0.61	0.65	0.71	0.81	0.87		
Resulting credited interest rates		**6.50**	**5.75**	**5.25**	**4.75**	**4.25**	**3.75**	**3.25**	**3.00**	
not adjusted for guaranteed rate of 1.5%										

Example 2 (shown in Figure 3)

Treasury rates spike up at the end of year 1 to 9.25% supportable renewal rate. The initial credited rate is 6.50%; all other assumptions remain the same.

Initial rounded results are 6.50%, 7.00%, 7.25%, 7.50%, 7.75%, 8.00%, 8.25% and 8.50%.

Interpretation for this pop-up scenario:

- Credited rates have increased 2.00% since issue.
- Rates increase 50 bp for 1 year, then 25 bp.
- Rates are still below the supportable renewal rate of 9.25%.

Figure 3

Example 2 Weighted Average of Current Credited Rate, Renewal Supportable Rate Calculations

Renewal Crediting Strategy	**Supportable rates**	**5 yr CMT**	**AA spread**	**Pricing spread**		Supportable rate				
	New Money	10.00	0.80	1.40		9.40				
Input items		**3 yr CMT**	**AA spread**	**Pricing spread**						
Output items	**Renewal**	9.85	0.80	1.40		9.25				
Renewal credited rates	**End of Year**	1	2	3	4	5	6	7		
utilizing effective duration to weight	**Duration**	3.4	3.1	2.8	2.5	2.2	1.8	1.6		
Renewal Rate weighting	**Assumed Rollover**	15%	16%	18%	20%	23%	28%	31%	inverse of 2 x duration	
	Current Credited Rate			Recommended Renewal Rate (before rounding)						
Renewal supportable rate	6.50	9.25	9.25	9.25	9.25	9.25	9.25	9.25		
	10.00	9.89	9.88	9.87	9.85	9.83	9.79	9.77		
	9.75	9.68	9.67	9.66	9.65	9.64	9.61	9.60		
	9.50	9.46	9.46	9.46	9.45	9.44	9.43	9.42		
	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25		
	9.00	9.04	9.04	9.05	9.05	9.06	9.07	9.08		
	8.75	8.83	8.83	8.84	8.85	8.87	8.89	8.91		
	8.50	8.61	8.62	8.64	8.65	8.67	8.71	8.73		
	8.25	8.40	8.41	8.43	8.45	8.48	8.53	8.56		
	8.00	8.19	8.20	8.23	8.25	8.29	8.35	8.39		
	7.75	7.98	7.99	8.02	8.05	8.10	8.17	8.22		
	7.50	7.76	7.78	7.82	7.85	7.90	7.99	8.04		
	7.25	7.55	7.57	7.61	7.65	7.71	7.81	7.87		
	7.00	7.34	7.36	7.41	7.45	7.52	7.63	7.70		
	6.75	7.13	7.15	7.20	7.25	7.33	7.45	7.53		
	6.50	6.91	6.94	7.00	7.05	7.13	7.27	7.35		
	6.25	6.70	6.73	6.79	6.85	6.94	7.09	7.18		
	6.00	6.49	6.52	6.59	6.65	6.75	6.91	7.01		
	5.75	6.28	6.31	6.38	6.45	6.56	6.73	6.84		
	5.50	6.06	6.10	6.18	6.25	6.36	6.55	6.66		
	5.25	5.85	5.89	5.97	6.05	6.17	6.37	6.49		
	5.00	5.64	5.68	5.77	5.85	5.98	6.19	6.32		
	4.75	5.43	5.47	5.56	5.65	5.79	6.01	6.15		
	4.50	5.21	5.26	5.36	5.45	5.59	5.83	5.97		
	4.25	5.00	5.05	5.15	5.25	5.40	5.65	5.80		
	4.00	4.79	4.84	4.95	5.05	5.21	5.47	5.63		
	3.75	4.58	4.63	4.74	4.85	5.02	5.29	5.46		
Resulting credited interest rates		**6.50**	**7.00**	**7.25**	**7.50**	**7.75**	**8.00**	**8.25**	**8.50**	
not adjusted for guaranteed rate of 1.5%										

Example 3 (shown in Figure 4)

Treasury rates rise 50 bp per year after a drop at the end of year 1; the initial credited rate is 6.50%.

Initial rounded results are 6.50%, 6.00%, 5.50%, 5.25%, 5.00%, 5.00%, 5.00% and 5.25%.

Interpretation for this slow-up scenario:

- A big drop in year 1 dominates.
- Credited rates decreased 1.25% since issue but bottomed out and started to rise.
- Rates don't increase until year 8.

Figure 4

Example 3 Weighted Average of Current Credited Rate, Renewal Supportable Rate Calculations

Renewal Crediting Strategy	**Supportable rates**	**5 yr CMT**	**AA spread**	**Pricing spread**		Supportable rate				
	New Money	3.00	0.80	1.40		2.40				
Input items		**3 yr CMT**	**AA spread**	**Pricing spread**						
Output items	**Renewal**	2.85	0.80	1.40		2.25				
Renewal credited rates	**End of Year**	1	2	3	4	5	6	7		
utilizing effective duration to weight	**Duration**	3.4	3.1	2.8	2.5	2.2	1.8	1.6		
Renewal Rate weighting	**Assumed Rollover**	15%	16%	18%	20%	23%	28%	31%	inverse of 2 x duration	
					Recommended Renewal Rate (before rounding)					
Renewal supportable rate	2.25	2.75	3.25	3.75	4.25	4.75	5.25	5.75		
	6.50	5.94	5.98	6.01	6.05	6.10	6.15	6.27		
	6.25	5.73	5.77	5.80	5.85	5.91	5.97	6.10		
	6.00	5.51	5.56	5.60	5.65	5.71	5.79	5.92		
	5.75	5.30	5.35	5.39	5.45	5.52	5.61	5.75		
	5.50	5.09	5.14	5.19	5.25	5.33	5.43	5.58		
	5.25	4.88	4.93	4.98	5.05	5.14	5.25	5.41		
	5.00	4.66	4.72	4.78	4.85	4.94	5.07	5.23		
	4.75	4.45	4.51	4.57	4.65	4.75	4.89	5.06		
	4.50	4.24	4.30	4.37	4.45	4.56	4.71	4.89		
	4.25	4.03	4.09	4.16	4.25	4.37	4.53	4.72		
	4.00	3.81	3.88	3.96	4.05	4.17	4.35	4.54		
	3.75	3.60	3.67	3.75	3.85	3.98	4.17	4.37		
	3.50	3.39	3.46	3.55	3.65	3.79	3.99	4.20		
	3.25	3.18	3.25	3.34	3.45	3.60	3.81	4.03		
	3.00	2.96	3.04	3.14	3.25	3.40	3.63	3.85		
	2.75	2.75	2.83	2.93	3.05	3.21	3.45	3.68		
	2.50	2.54	2.62	2.73	2.85	3.02	3.27	3.51		
	2.25	2.33	2.41	2.52	2.65	2.83	3.09	3.34		
	2.00	2.11	2.20	2.32	2.45	2.63	2.91	3.16		
	1.75	1.90	1.99	2.11	2.25	2.44	2.73	2.99		
	1.50	1.69	1.78	1.91	2.05	2.25	2.55	2.82		
	1.25	1.48	1.57	1.70	1.85	2.06	2.37	2.65		
	1.00	1.26	1.36	1.50	1.65	1.86	2.19	2.47		
	0.75	1.05	1.15	1.29	1.45	1.67	2.01	2.30		
	0.50	0.84	0.94	1.09	1.25	1.48	1.83	2.13		
	0.25	0.63	0.73	0.88	1.05	1.29	1.65	1.96		
Resulting credited interest rates		6.50	6.00	5.50	5.25	5.00	5.00	5.00	5.25	
not adjusted for guaranteed rate of 1.5%										

Example 4 (shown in Figure 5)

Treasury rates drop 75 bp to 1.50% supportable renewal credited rate. The starting rate 6.50%; all other assumptions remain the same.

Initial rounded results are 6.50%, 5.75%, 5.00%, 4.25%, 3.75%, 3.25%, 2.75% and 2.25%.

Interpretation for this pop-down scenario:

- Credited rates decreased 4.25% over 7 years.

Figure 5

Example 4 Weighted Average of Current Credited Rate, Renewal Supportable Rate Calculations

Renewal Crediting Strategy	**Supportable rates**	**5 yr CMT**	**AA spread**	**Pricing spread**		Supportable rate				
	New Money	2.25	0.80	1.40		1.65				
Input items		**3 yr CMT**	**AA spread**	**Pricing spread**						
Output items	**Renewal**	2.10	0.80	1.40		1.50				
Renewal credited rates	**End of Year**	1	2	3	4	5	6	7		
utilizing effective duration to weight	**Duration**	3.4	3.1	2.8	2.5	2.2	1.8	1.6		
Renewal Rate weighting	**Assumed Rollover**	15%	16%	18%	20%	23%	28%	31%	inverse of 2 x duration	
				Recommended Renewal Rate (before rounding)						
Renewal supportable rate	2.25	1.50	1.50	1.50	1.50	1.50	1.50	1.50		
	6.50	5.75	5.70	5.60	5.50	5.35	5.10	4.95		
	6.25	5.54	5.49	5.40	5.30	5.16	4.92	4.78		
	6.00	5.33	5.28	5.19	5.10	4.97	4.74	4.61		
	5.75	5.11	5.07	4.99	4.90	4.77	4.56	4.43		
	5.50	4.90	4.86	4.78	4.70	4.58	4.38	4.26		
	5.25	4.69	4.65	4.58	4.50	4.39	4.20	4.09		
	5.00	4.48	4.44	4.37	4.30	4.20	4.02	3.92		
	4.75	4.26	4.23	4.17	4.10	4.00	3.84	3.74		
	4.50	4.05	4.02	3.96	3.90	3.81	3.66	3.57		
	4.25	3.84	3.81	3.76	3.70	3.62	3.48	3.40		
	4.00	3.63	3.60	3.55	3.50	3.43	3.30	3.23		
	3.75	3.41	3.39	3.35	3.30	3.23	3.12	3.05		
	3.50	3.20	3.18	3.14	3.10	3.04	2.94	2.88		
	3.25	2.99	2.97	2.94	2.90	2.85	2.76	2.71		
	3.00	2.78	2.76	2.73	2.70	2.66	2.58	2.54		
	2.75	2.56	2.55	2.53	2.50	2.46	2.40	2.36		
	2.50	2.35	2.34	2.32	2.30	2.27	2.22	2.19		
	2.25	2.14	2.13	2.12	2.10	2.08	2.04	2.02		
	2.00	1.93	1.92	1.91	1.90	1.89	1.86	1.85		
	1.75	1.71	1.71	1.71	1.70	1.69	1.68	1.67		
	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50		
	1.25	1.29	1.29	1.30	1.30	1.31	1.32	1.33		
	1.00	1.08	1.08	1.09	1.10	1.12	1.14	1.16		
	0.75	0.86	0.87	0.89	0.90	0.92	0.96	0.98		
	0.50	0.65	0.66	0.68	0.70	0.73	0.78	0.81		
	0.25	0.44	0.45	0.48	0.50	0.54	0.60	0.64		
Resulting credited interest rates		**6.50**	**5.75**	**5.00**	**4.25**	**3.75**	**3.25**	**2.75**	**2.25**	
not adjusted for guaranteed rate of 1.5%										

3.2 Additional Complexity

Beyond the basic premise of setting the credited rate at the beginning of the policy year, before any investment experience for the year has been realized, there are any number of ways this process could become more complex. The investment strategies should reflect what is expected to be purchased, or at least a benchmark used to price the product. They could vary more frequently as the policy ages, especially if the level of interest rates has changed. The example focuses on the principal rollovers but would be trued up each quarter to the chosen metric (e.g., account value, statutory reserves) or would look at experience for historical asset reinvestments.

Other risks, such as accepting dump-ins, a market value adjustment, and allowing policy loans, are also beyond teaching the basic method that occurs here.

The primary complexity is a large move in interest rates that makes asset or liability convexity too big to ignore. The effective duration could change non-linearly in that case, but that would become difficult to manage due to the number of moving parts relative to what is actually done by the investment team. You can't buy a distinct asset for every policy, and investments are committed long before the renewal credited rate is set.

3.3 Asset Rollover

The assumed rollover is the weighting used for the current supportable renewal rate, averaged with the current credited rate. Figure 6 shows, for a specific year, when the assets are expected to have been originated.

For example, at the end of year 1, 15% of the original assets would have rolled over and new assets purchased, and 85% of the originally purchased assets would remain. A year later, 71.4% of the original assets remain, 12.6 of the 15 (84%) of the assets purchased at the end of year 1 remain, and 16 assets are purchased.

This example assumes the bucket remains at 100. In reality, new premiums and investment income typically enter a new bucket, while surrenders and charges are cash flows out of the most recent bucket.

Figure 6
Asset Origination by Year

SPDA credited rate	End of Year	1	2	3	4	5	6	7	
using weighted average of remaining duration	Duration	3.4	3.1	2.8	2.5	2.2	1.8	1.6	
Renewal Rate weighting	Assumed Rollover	15%	16%	18%	20%	23%	28%	31%	inverse of 2 x duration
		Principal remaining from original purchases							
End of year	0	1	2	3	4	5	6	7	
Assets purchased in year 1	100.00	85.00	71.40	58.55	46.84	36.07	25.97	17.92	
Assets purchased in year 2		15.00	12.60	10.33	8.27	6.36	4.58	3.16	
Assets purchased in year 3			16.00	13.12	10.50	8.08	5.82	4.02	
Assets purchased in year 4				18.00	14.40	11.09	7.98	5.51	
Assets purchased in year 5					20.00	15.40	11.09	7.65	
Assets purchased in year 6						23.00	16.56	11.43	
Assets purchased in year 7							28.00	19.32	
Assets purchased in year 8								31.00	
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	

Section 4: Conclusions

Rates cycle. Although they have been in downward decline for nearly 40 years, they have recently bounced off their lowest levels and many expect this trend to continue. One way to simplify the interest rate crediting process, making it transparent to policyholders, would be to follow a formulaic approach to setting rates. This paper has shown one method that can be defended as reasonable and equitable. There are others. This legacy knowledge from the 1980s is quickly retiring, so this paper is an attempt by someone who was new to the life insurance industry at that time to document a theoretical process before it is lost. There is no reason to reinvent the wheel when product designs can start with what has been considered previously and improve it.

By creating a proxy for the remaining time to maturity of the existing assets, an approximation can be made for how much will need to be reinvested. The accompanying spreadsheet on the SOA website can be studied or modified for other examples.

Appendix A: Additional Reading

In a 1998 article for the Investment Section's *Risks and Rewards* newsletter, Tom Grondin discusses alternative measures for allocating investment income to better align credited rate with earned income:

> Grondin, Thomas M. 1998. Portfolio Yield? Sure But … *Risks and Rewards*, no. 39. *https://www.soa.org/library/newsletters/risks-and-rewards/1998/march/rar-1998-iss30-grondin.pdf.*

A 1979 *Record of the Society of Actuaries* includes a session titled "The Investment Year Method," with speakers Dan McCarthy, Thomas Skiff and Tom Sutton. The speakers apply IYM to their crediting rate strategy and talk about an important risk topic of that generation, policy loan strategies. They make clear that the method is a proxy for the investment strategy and that the earned and credited rates will not be exactly what was priced for. They note the strategy can also be applied to participating policies, and that a balance must be reached between such precision as to be a logistical nightmare and so broad as to replicate the portfolio method.

> McCarthy, Daniel, Thomas Skiff and Thomas Sutton. The Investment Year Method. Panel Discussion at the New Orleans Meeting of the Society of Actuaries, April 2–3, 1979. *Record of the Society of Actuaries* 5, no. 1:103–122. *https://www.soa.org/library/proceedings/record-of-the-society-of-actuaries/1975-79/1979/january/rsa79v5n16.aspx*.

Donald Cody wrote a paper for the SOA 50th anniversary monograph in 1999 titled "An Expanded Financial Structure for Ordinary Dividends" that looks at dividends using an IYM strategy.

> Cody, Donald D. 1999. An Expanded Financial Structure for Ordinary Dividends. *Society of Actuaries 50th Anniversary Monograph*, M-AV99-1. *https://www.soa.org/library/monographs/50th-anniversary/financial-reporting-section/1999/january/m-as99-1-03.pdf*.

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