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Modeling General Account Assets: An Introduction

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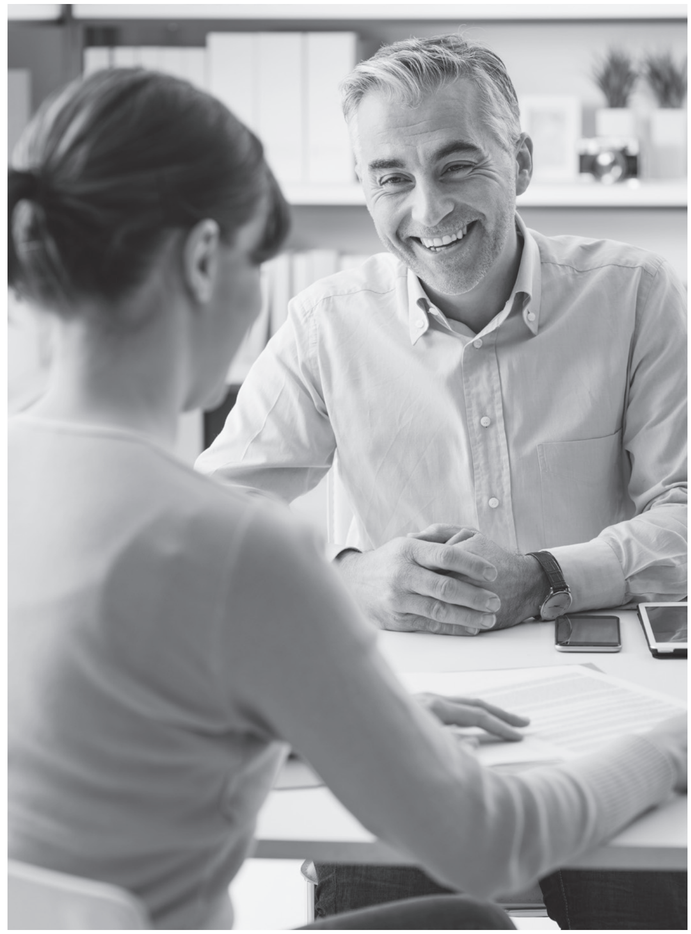

Hedging has turned the modeling of complex interest and equity derivative instruments into a hot topic over the past 15 years and properly so; the effectiveness of a hedging program contributes to the stability of an insurance entity, and any disconnect between assets and liabilities can cause an immediate and significant swing in earnings.

We should not lose sight, however, of the more traditional life insurance company general account (GA) assets—coupon-bearing instruments including bonds, preferred stocks and mortgages. As of 2015, U.S. insurers held about $3.9 trillion in bonds and $370 billion in mortgages.[1] These fixed-income assets make up about 75 percent of the GA balance sheet for all insurers combined—and the proportion for life insurers is historically higher. The return on these assets has to make good on the liabilities, drive crediting on interest-sensitive products, and contribute toward company expenses and shareholder value. While investment departments and asset managers should have better insight into asset behavior at the individual security level, it is only within an asset-liability management (ALM) model that the appropriateness of a portfolio can be ascertained for a particular company. So when we populate our models, we've got to get it right.

MODELING INDIVIDUAL SECURITIES: FIXED CASH FLOWS

A typical actuarial projection starts from a statutory (stat) point of view. This view determines regulatory capital requirements, distributable earnings, asset adequacy and appropriate benchmarks for crediting interest-sensitive general account products.

Most fixed income assets on the stat balance sheet use the constant yield method of accounting. Under this method, the yield (stat amortizing yield or book yield) is set at issue = IRR (internal rate of return) of the assets using the expected cash flows.

Yield (fixed at issue) = IRR ((– purchase price,) expected cash flows)

The key pieces of information necessary to model this kind of asset are:

- The nominal or par value
- The coupon rate
- The maturity date or schedule

Then, by definition, for each accounting period, the income on this asset is by definition

$$GII_t = BV_{(t-1)} \times \text{Yield}$$

Where:

GII_t is the gross investment income for the asset for time period t
BV_t is the statutory book value at the end of period t

This investment income has three components:

- Cash coupon payment. This is the actual coupon amount paid during the period.
- Change in accrued income. Coupon income is considered to be earned linearly between coupon payments; income is accrued linearly between coupon dates.
- Accrual of discount/amortization of premium.

This last item represents a change in book value. Any difference between the purchase price and the par value is amortized into income over the life of the asset on a schedule that preserves the constant IRR of the asset.

If your model allows you to sell assets to raise funds, or if you need to report market value metrics, you will need to calculate a market value for each security as it rolls forward. In reality, the market value of an asset at any point in time is based on more factors than could realistically be captured in a model, so we use approximations based on the market value as of the inventory date.

Our models will generally calculate market value at any given point in the projection as the present value at that point in time of all cash flows projected beyond that time. The discounting should be based on the spot curve of interest rates at that point in the model, applicable to an asset of similar rating. However, at time 0, frequently this approach will not come acceptably close to the given initial market value (MV). Reasons for this discrepancy include:

- The model may not have yield curves corresponding to every credit quality; for example, a model may have two or three credit classes to which all of the more detailed asset ratings are mapped.
- The market may have different views of sectors or individual issues within a given credit rating, and this may impact the initial quoted market value.
- There is not complete and deep market information for full yield curves by credit rating, and the investment managers may be using different data points and interpolations to the spot curve than the ALM model.

In projecting an initial market value of a security, a common approximation is to calculate a "residual spread" at time 0 in the model. For example, we may find that to match the starting MV for a particular security, we need to discount the projected cash flows at a rate implied by the AA-rated curve + 7 basis points (bp). In this case, each time we calculate a market value for this asset going forward, we would use the AA curve at that point in time and add the 7 bp calculated at time 0.

ASSETS WITH UNCERTAIN CASH FLOWS

Some assets have less certain cash flows than others. For example, bonds may be issued as callable with a call penalty depending only on the date of call. Mortgage-backed securities pay off based on the behavior of the underlying mortgage pools.

In recent experience, payoff of callable bonds seems to be related more closely to credit of the issuer or other issuer-specific factors than to the interest rate environment. However, it is prudent to assume that if you have granted an option, it may be used against you. Your model should reflect that assets are less likely to prepay when you would like them to (i.e., when rates go up) and are more likely to prepay when you want them to stick around—when rates go down. There are two common ways to model this prepayment behavior:

- Compare the coupon on the asset to the comparable coupon on a new asset of similar nature. If the new money coupon is much lower, assume the issuer is more likely to repay the old notes and issue new ones.
- Compare the amount necessary to pay off the asset (par + prepay penalty) to the hypothetical market value of the asset if not prepayable. If the payoff amount is significantly less than the market value of the scheduled cash flows, assume the issuer will prepay.

Given the lack of market data over the last few years to validate modeled prepay behavior, especially dynamic behavior, this would be a good assumption to stress test if your portfolio has significant holding of these assets.

Mortgage backed securities (MBS) and collateralized mortgage obligations (CMOs) are rather difficult to model. The cash flow patterns are dependent on the behavior of the underlying pool (or pools) of mortgages, and it is unlikely that in-house administrative systems will contain a whole lot of information about those pools. CMOs also have many tranches with complex rules governing the cascade of cash flows from the underlying mortgage pools. Two approaches for modeling these assets:

- Use an external vendor (BondEdge, Intex, Wilshire) that collects information on the pools and asset structure. Some may allow control of prepayment assumptions. You can populate these systems with your scenarios, and they will generate projected cash flows, asset balances and even market values, to feed into your ALM model. These models will be wrong and should be stress tested if material; for example, run with different prepay speed parameters to get some kind of confidence interval.
- Create a synthetic model. Calibrate some combination of fixed and floating rate bonds, mortgages or even simple CMOs (if available in your modeling platform) to replicate the yield, average life, duration and (maybe) convexity of your MBS portfolio, as reported in Bloomberg or some other market-pricing tool.

Book values for such assets should ideally reflect an "unlocking" each time the best estimate of the cash flows change; go back to the purchase date, string together the cash flows that have already happened with the projection of future cash flows, and, using this string of values, compute what your current book value should be now (e.g., how much accrual of discount/amortization

of premium should have already been reflected). Our models will generally not go to this level of detail—at each period, we will mostly take the beginning of period BV as a given, and then calculate the string of future book values by looking at the cash flows going forward.

Market prices for interest-sensitive assets would ideally be calculated by generating more paths at each node, modeling the cash flows on each path and discounting. This can slow any computer or grid of computers to a crawl, and should be used sparingly—at least consider how material market values are to your model. A single path at each point, consistent with the current scenario, may be adequate depending on the options built into your portfolio. Other approaches may involve closed-form models (e.g., the Black 76 model) to approximate the value of the option built into these assets at each point.

Some assets may allow for prepayments but with "make whole" provisions, which calculate a prepayment penalty that on some basis should make you indifferent to the issuer prepaying. In these cases, you may be able to justify ignoring the prepay provision in the model.

DEFAULTS

Defaults may typically be modeled as a decrement impacting book, market, par and all future cash flows. For example, a 1 percent default would come through as a proportionate reduction in the amount of the asset you are holding. In this methodology, the default rate assumption should be set to reflect your total expectation of credit losses.

A more complex approach would be to model the incidence of default, combined with some recovery behavior. For example, you may assume there is a 2 percent probability of default at a point in time, but after default, there may be an assumption of a 50 percent recovery of face value after a two-year holding period. In the interim, you may hold the defaulted value of the asset with no coupon. While this mechanism may be closer to reality than directly modeling a default cost, it requires more complex assumptions. It does, however, let you reflect that different categories of bonds may behave very differently upon default, taking into account the legal structure of the bond, the underlying sector and even the economic scenario being run.

Finally, you may want a full credit model, which reflects credit transitions, write-downs and write-ups, as well as modeling cash flows. This would be ideal for risk-based capital (RBC) calculations, and could allow a better reflection of all the events that can change the value of an asset. On the downside, I don't know of any modeling system that can do this out of the box—I would be glad to hear if such a thing exists. I have tried to layer this logic onto model output with a spreadsheet-based approach, but that quickly proved unwieldy beyond a two- or three-year time horizon.

ASSETS WITHIN AN ALM MODEL

A boss early in my career drilled into me this truism, and I've tried to pass it on to everybody who has come through my shop:

$$\Delta BV = NII + CG - CF$$

That is to say, the change in the level of assets (ΔBV) in a model (or in reality!) can be completely explained by

- **Net investment income (NII)**. This is the earnings on those assets, for example, coupon or accrual of discount less investment fees charged.
- **Capital gains (CG)**. In the stat world, this would mean realized capital gains; for example, defaults will decrease the pool of assets.
- **Cash flows (CF)** in and out of the pool. Adding money to the pool will increase your level of assets; pulling money out will decrease it.

This seems like an obvious check on the model but can require considerable investigation into the output variables supplied by your modeling system. For example, in some models, the definition of net investment income may already incorporate capital gains, while in others, these are reported separately. Working through an asset roll-forward is a good exercise in understanding the model as well as validating it.

In an ALM model, the cash flows looked at from the asset side should be the same as those from the liability side, except for the sign. Again, this seems like simple common sense; once you model premiums and deposits, benefits, expenses, taxes and stockholder dividends, any positive cash flow should go into your asset pool, and any shortfall will be provided from your existing asset portfolio. But once again, demonstrating this holds true can be tricky. Complicating factors can include:

- Policy loans. These generate investment income but are usually modeled with the liabilities—they are part of the liability inventory, and assumptions as to their growth and repayment are best applied within the contract from which they arise. Furthermore, while in reality, the growth in policy loans is frequently cashless (policy loan interest is capitalized within the policy up to the point of a policy lapse or claim), the model may model payments in cash.
- Transfers between general and separate account (SA). If you are modeling GA assets, this is a cash event—funds move between the company's general account and the policyholder separate account funds. How explicit is the liability model set up in these terms?
- Modeling simplifications. Some liabilities may be modeled using simplifications; for example, a product feature may be modeled as simply an earned spread rather than a full model reflecting interest and crediting. This may be sufficient for some purposes (e.g., analysis at the product level), but will leave you missing key information when trying to put together a full balance sheet projection for a company.
- I've glibly assumed you can categorize various funds as either GA or SA. However, your generally accepted accounting principles (GAAP) presentation may be different than your stat presentation; there may be funds in your green blank (statutory SA statement) that look, taste and smell enough like GA assets that GAAP includes them as part of the GA. This leaves you the option of performing different projections for each accounting basis or having a layering process to get from one to the other—and this can quickly get rather convoluted.

This article has only begun to scratch the surface of asset modeling topics. Reinvestment strategy and portfolio management within a model merit their own articles, and many of topics upon which this piece glances are also worthy of a deeper dive.

If you have any thoughts on future articles, or (even better) would like to share your insights on one of these topics, I would encourage you to get in touch with me to include in a future issue. ■

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ENDNOTE

1 Capital Markets Bureau, "U.S. Insurance Industry Cash and Invested Assets at Year-End 2015," National Association of Insurance Commissioners (NAIC) Capital Markets Special Report, June 6, 2016, *http://www.naic.org/capital_markets_archive/160606.htm.*