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Duration Calculations: Why Netting Cash Flows Can Lead to Poor Decisions

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While duration is a primary tool in the ALM toolkit, it can provide misleading results in some instances. The duration metric describes the sensitivity to interest rate changes for a stream of cash flows. A large duration means the present value changes very quickly with interest rates. The effective duration metric incorporates changes in cash flows due to interest rate changes (e.g., prepayment speed of a residential mortgage or lapse rate of a deferred annuity). These can be segregated into cash outflows (including claims, expenses and commissions), cash inflows (premium), and asset cash flows (coupons, dividends, and principal repayments). Duration metrics are generally calculated to provide a constraint to the asset manager and measure product line interest rate risk.

Infinite Duration

A price behavior curve demonstrates the present value of the cash flows at various levels of interest rates, showing components as well as the overall value across various interest rate scenarios. Duration measures the slope of the tangent line to the value curve at a specific point. It is estimated by calculating three values. Curves higher and lower than the base are used. The duration is the difference between these two generated values divided by the base value (assuming the high/low curves span 100 basis points). Convexity is ignored in this calculation, so smaller differentials from the base curve improve the accuracy of the result.

A product that develops a reserve for prefunding can lead to an anomaly. Insurance examples are traditional whole life, long-term care, and disability income. Results can be misleading when the insurance net cash flows change signs. While the initial value is positive, eventually the present value of remaining cash flows becomes zero and then negative. At points close to the zero value the duration becomes absurdly large and eventually infinite when the value is zero. Telling the asset manager that his benchmark duration is 1,000 or more is not a desired solution.

The traditional way to look at duration constraints is to compare the asset duration to the duration of the net product line cash flows. This can result in the problem just described. If you compare the cash out (liability) duration to a weighted average of the durations for the premiums and assets you will avoid this issue, and understand your block of business better too.

Let’s use examples to demonstrate this point.

Value of liability cash flows = 10	Duration of liabilities = 5
Value of premium cash flows = 10	Duration of premiums = 5
Value of net product line cash flows (premium – liability) = 0	

The present value of the liability cash flows and premiums are equal, so the product line net value is 0. No matter what the value of the product line cash flows are when shocked (up and down), the duration calculation will involve dividing by zero. The reported duration will be infinite even though the cash flows in (premiums) equal the cash flows out. While the result is obvious when the duration is greater than 100, it is not always so clear as this point is approached.

Setting Constraints

An interesting strategic tool is a natural result of choosing to look at these cash flows separately. It provides additional flexibility within an investment strategy.

Let's expand our example to demonstrate this point.

Value of assets =10	Duration of assets = 6
Value of liability cash flows = 20	Duration of liabilities = 5
Value of premium cash flows = 10	Duration of premiums = 4

The present value of the premiums and assets are equal, so the weighted average duration when you combine them is 5, which matches the liabilities.

Now let's work backwards to set an asset duration constraint. Say we define our asset benchmark using the liability duration of 5 and our tolerance is 0.5. Solving for a weighted duration of 4.5 at the low end and 5.5 at the high end, with premium duration of 4, gives a range for the asset duration from 5 to 7. The insurer can adopt a deliberate mismatch and reflect this in the parameters provided to the asset manager. In this example, perhaps the insurer would narrow the calculated range down from 5-7 to 6.25-6.75. This is higher than the original asset duration of 6 but retains the overall desired risk profile. Historically, investing a little further out on the yield curve has been a value added decision.

Summary

Isolating the cash flows due to premiums from the liability cash flows provides a number of positive results.

- Asset target durations are not overstated
- Investment strategy flexibility is enhanced
- Analysis is improved

Constraints provided to asset managers are better understood by both sides, allowing a more optimal solution.

Book Review – ERM: Straight to the Value

Disclosure: both Donna Galer and I are affiliated with Hanover Stone Solutions and have co-authored several articles for the Society of Financial Examiners (SOFE).

ERM: Straight to the Value is an excellent choice to round out your risk education. I come at ERM from a financial background (actuary/insurance), so the qualitative view of this book is very helpful as it approaches risk from a different (yet correct) view than I do. It balances the quant view quite nicely. As risk maturity evolves it would be worth a reread periodically, since there are insights for all levels of risk experts. This book will help you to focus your efforts, improving decision making and accountability. I highly recommend it.

Consistent with other good ERM books, the focus is on making better decisions through a focused methodology to prioritize value added accountability. While capital allocation is not discussed, it is always in the background. Looking at risks at the aggregate level is discussed but methods of doing so are not.

Diversity of thought brings multiple viewpoints to a discussion, including those that are contrarian. One downside is that risk is viewed as something to mitigate. No business would ever be transacted if this was really correct. To do a transaction involves one party adding volatility – the entire business model of an insurer is to accept volatility for a price. Keep in mind that diversification is the only true free lunch. Risk is reduced in aggregate and returns remain a weighted average of the individual projects.

Toward the end of the book the focus turns to culture, the most important component of a successful ERM process. If the higher ups don't support contrarians, ERM will not work. The lowest level employees should be encouraged to say something if it doesn't look or smell right. Not only will this reduce risk but helps succession planning. Strategic ERM is the new buzzword from the big consulting firms. I reread my brochure from 2006 recently and many of these ideas were already there. It's not new but it is important.

In my view, ERM supports capital allocation and the decision making process. It is driven by culture. Straight to the Value does not say this directly, and the authors tend to look at risks individually, but it is an excellent book that will add value to all who read it.

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