Episode 3: The Treasury Model

In episode 3 of the Everything GOES podcast, Daniel Finn and Dr. Andrea Barresi discuss the GOES Treasury model and how it differentiates from the AIRG Treasury model.

SEGMENT 1—OPENING

[Joe Golaszewski] Hi, and welcome back to the Everything GOES podcast, where we discuss the NAIC's upcoming transition from the Academy Interest Rate Generator scenarios to the new GOES scenarios. I'm your host, Joe Golaszewski. In earlier episodes, we focused on some of the basics of the transition—the what, the where, and the when of accessing or producing the requisite files. Now, we'll turn our attention to the how. In this episode, we're going to dive into the details of the treasury model.

Today, I'm joined by Daniel Finn and Dr. Andrea Barresi. Dan is a Managing Director at Conning, where he is head of the group responsible for generating these new scenarios. Andrea is also a Managing Director at Conning, and he heads our Quantitative Finance team. This team develops and maintains all of the GEMS models, which includes the continuous-time stochastic models, derivative pricing algorithms, calibration, and software development.

SEGMENT 2—TREASURY MODEL BASICS (1:14)

[JG] Andrea, we're glad you could join us today. Tell us about the GEMS treasury model that underlies the GOES scenarios.

[Andrea Barresi] The GEMS model is a three-factor extension to the well-known Cox-Ingersoll-Ross (CIR) modeling framework. We selected this model because it

- Produces realistic and stable interest rates
- Captures key factors that drive interest rate risk
- Produces a variety of real-world yield curve shapes: normal, inverted, and humped curve yield curves
- It can be used both in real-world and risk-neutral
- It uses well defined and efficient estimation procedures

[Dan Finn] Yeah, I think it's important for our listeners to note that, unlike the AIRG, the GEMS treasury model isn't projecting yield curves directly. Instead, as Andrea mentioned, it's modeling these future state variables.

[AB] The key elements of the model are three state variables. Their starting value is determined through inversion from the market curve. This step is part of the procedure that will give the best fit of the market curve. Once we have the initial state variables, GEMS stochastically simulates their evolution based on the model parameters, which are five for each state variable. The same set of parameters are also used to determine the yields, and many interest rate derivatives. As you can see, the model is rich but also parsimonious at the same time.

SEGMENT 2—NAIC TREASURY REQUIREMENTS (2:44)

[JG] Thanks Andrea. Now, I'd like to talk about some of the NAIC's treasury requirements, but I'm not sure where to start. Is it better to start with the initial curve fitting or the calibration targets?

[DF] Well, let me speak first to the calibration targets. If you remember back to post-financial crisis, and interest rates were low, almost zero for, you know, a decade or so, and so the regulators at the NAIC became concerned about what they were calling a "low for long"—think a Japan-type scenario where interest rates stay low for not just a few years but ten, twenty, thirty years. And then about 5 or 10 years ago now, they did a study where they asked life insurers, sort of, what would that do to their policies and found that it really was a major risk for many of the … the sort of policies out there given their guarantees. So one of the key calibration considerations for the new GOES scenarios was they wanted to be able to have enough low-for-long scenarios. But first we needed to define what low for long was. And the decision that was ultimately made in the calibration was, we were going to look at the 20-year yield, we were going to start it from the lowest level we saw, which was December 2020 at a little under 1½ percent. We were going to project for 30 years, and then we were going to look at the geometric average of the 20-year yield over that period.

And what the final calibration target is, is they want 5%, or 500 of the scenarios out of the 10,000, to have a level below 195. So you've got a lot of these scenarios that are staying low—it could pop up a little bit and come back down, or it could stay low, but on average they're staying at a very low level, and the the AIRG just wasn't able to do that.

At the same time, we didn't want to lose the ability to generate a return to the 80s, right? If we think about what was happening back that day, interest rates were double digits, very different environment. That was the one that the AIRG was largely calibrated to capture. So they want to have both low for long and these "return to the 80s" because there are different risks in that environment. You have to start worrying about things like disintermediation. So, our calibration tried to balance all these competing constraints into a single coherent calibration set of parameters.

[AB] In the future, if adjustments are needed to the targets, there are a number of recalibration features built into the software. These tools will allow seamless adjustments of items like mean yield level and mean reversion speed, as well as distributional properties like the "low for long" that Dan discussed.

[DF] Yeah, and it's important to note that those types of changes would not be made lightly. We've gone through this process for several years to get all of the calibration targets. So, going forward, the current draft is that the GOES model governance will look at that periodically—currently on a 5-year time cycle—and see whether or not any adjustments need to be made, and if there are, then we would tap into those tools, those recalibration tools that Andrea talked about to allow us to meet the new targets. But only if they're warranted, right? We're not automatically going to change the current model, but we do have the flexibility in this new process to revisit them as as warranted.

[AB] The NAIC's initial curve fitting methodology is different than the GEMS standard initial curve fitting. Conning software clients will know that the Conning method always uses the 3-month rate, selects two other pivot yield maturities via an optimization process, and has some built-in tests to ensure the resulting initial state variables are valid. For the NAIC, my team built an alternative fitting method that requires the pivot points to be 1 month, 5 year, and 30 year. This new method also looks at more points on the curve.

[JG] Okay, so that's interesting that they require a different fitting methodology. What's the rationale behind that?

[DF] So, over this five-year period that we've been having, we've been doing field tests, and we've been looking at a wide range of different conditions. Particularly recently, there have been a lot of very odd curves. And so the question became, in this whole initial fitting process, is, what is the best fit? What do we mean by having a fit that aligns? So, the GEMS model, as Andrea mentioned, has three states. That means it can have, sort of, three movements in it: we can move the level, we can move the slope, we can create curvatures in it. But the ones we've seen recently have had a number of different curves: it drops down, and it goes back up, and it comes back down, and has a lot of wrinkles all over it. So, in those discussions with the industry, as we started looking at different ways to fit these interesting curves, the basic consensus was that we ended up deciding that fitting the long end of the curve was more important than necessarily fitting the entire curve. So, the GEMS standard parameterization process looks at the entire curve and weights those together. This new process puts more weight on the long end of the curve, with the idea being that these life policies are very sensitive to what's happening on the longer end of the curve—same reason we use the 20 year for the low for long and for the significant values. So, we created this new fitting methodology that puts more weight on those, creates a better fit on the long end with the recognition that that may sacrifice some on the short end.

Another key component is building in the dynamic flooring. We have to make sure that the numbers that are coming out after the flooring represent the the correct value, which means we have to strip things off that are not in the standard GEMS. And lastly, as with the standard GEMS, we need to make sure that the state variables that are produced here are all positive, because, as part of the Cox Ingersoll Ross, the volatility is related to those state variables. Thus, we built all these new features into try and capture the nature of, "What are these scenarios being used for?"

SEGMENT 3—DIFFERENCES BETWEEN THE MODELS (9:08)

[JG] Okay, so to recap what we've learned about the treasury model so far, GOES uses a 3-factor extension of the Cox-Ingersoll-Ross model calibrated so that at least 5% of the simulated paths meet the "low for long" criteria and with an initial treasury-yield-curve fit that emphasizes the 1-month, 5-year, and 30-year maturities. What are some of the key differences between this and the AIRG model insurers are currently using?

[DF] So some of the key changes that companies will notice are obviously the low-for-long targets. This ability to generate scenarios that are low for an extended period of time, that's simply not possible in the AIRG. But you'll also notice that we've implemented a new methodology for calculating the mean reversion targets. It's called the PEW, which puts more weight on recent history. It

still weights the entire history that we've got, back to the 1950s, it just puts more weight on the on the current … and in today's environment, that's actually producing a slightly higher target. So that's going to create more upside and more downside in the distributions when you compare the GOES to the AIRG. You'll also notice that there's a lot more variability. We've tried to make sure that the model is capable of producing the sorts of changes that we've seen in late 2018, 2019, where interest rates dropped and then stayed low and then ultimately rose. We want to be able to make sure that the the simulation can capture those, and the AIRG just simply wasn't able to to do that.

[AB] We were just talking about the initial curve fitting. The AIRG model fits two maturities, 1 year and 20 year, while GEMS fits three—1 month, 5 year, and 30 year. One implication of this is that both models produce normal and inverted yield curve shapes, but with three degrees of freedom, the GEMS model is able to produce yield curve shapes with humps and butterflies.

Dan, does the AIRG produce negative interest rates?

[DF] No, it doesn't, and that was one of the key considerations. Again, if you think back to when it was designed, back in the mid-2000s, the concern was much more on the upside, and so there are essentially hard floors built into the AIRG that doesn't allow it to produce negative interest rates. In the the new GOES scenarios, with the combination of this added volatility and the slow mean reversion, we're actually producing a number of those. And in particular, the final calibration produces about 3% of the scenarios—so about 300 out of the 10,000—where the one-year yield will be negative—slightly higher frequency at the shorter, slightly lower, with pretty much no negative yields out past 20—but we do see a large number of of negative yields compared to the AIRG.

[JG] So, negative interest rates haven't occurred in the US since the 1940s, though the Federal Reserve has explored the potential. If you're allowing rates to go negative, is there any limit to how low they can go?

[DF] Yeah, that's a great question, Joe, and there's been a lot of industry discussion about this very point. We've tested a few flooring mechanisms. Essentially, when you create this combination of volatile interest rate movements with slow mean reversion, you can get some pretty wide distributions on both the upside and the downside. So, the flooring mechanism which we ultimately landed on we're calling the dynamic generalized fractional floor, or dynamic GFF. In the software we're calling it the Soft Yield Floor. What it's going to do is simulate the rate using the native three-factor affine model, and in any case where it drops below 40 basis points, we're going to adjust that simulated rate. And the amount of this of the adjustment will vary. It starts at 20%, right below 40%, and then gradually decreases. And the goal there was to get to that 3% probability in the steady state, so we've calibrated it so the slope of that reduction allows the one-year yield third percentile to be roughly zero in the steady state.

[AB] This option is now available to all GEMS software users as a "Soft Yield Floor" switch in the Treasury parameters. Further, when the Soft Yield Floor is enabled, and the user selects the real-world dynamics calibration tool, the treasury curve initial fitting methodology automatically switches to the NAIC fitting method.

SEGMENT 4—THE IMPACTS OF THE DIFFERENCES (14:06)

[JG] Thanks Andrea. Dan, can you give us an idea of how these differences will impact company's results?

[DF] Sure. The best source for this information is the model office testing results and analysis decks that Oliver Wyman put together for the NAIC—you can find these on the NAIC website—in, you know, quite a bit of detail of what they were testing. And we plan on covering a lot of that in a future podcast.

One of the key takeaways is that the CTE70 results are roughly where the reserve calculations are quite comparable, but that once you get further into the tail, the GOES results become more adverse than the AIRG. So, I think it's important to recognize that our expectation at Conning is that this is going to be built into future versions of the valuation manual. The goal here was not necessarily to increase reserves, it was simply to create scenarios that capture that sort of risk. So, we're expecting that there may be changes in the valuation manual to try and mute the impact of these fatter tails.

For those who are interested in a higher level discussion of the impacts on the change, you can also check out a white paper series that Conning has created. In particular, the first one in that series, which you can find on the software and services section of conning.com, covers the impact of these changes on several of the bond asset classes. So, think your intermediate governments and your your long corporates, and how that could potentially impact the results that you're going to see for your reserves and capital.

[JG] Okay, and where can our listeners learn more about the new treasury model?

[AB] We continue to refresh the documentation that will be available on the naic.conning.com/scenariofiles website. The draft

documentation posted for the field tests will soon be replaced with detailed information about the treasury model, including the specifics of the initial curve fitting as well as the mechanics of the soft floor.

SEGMENT 5—CLOSING (16:11)

[JG] Great, thanks Andrea, and thanks for joining us on the podcast today; it's always fun talking to the people behind the models. And, as a reminder, our listeners can always contact us with specific questions by e-mailing naicscenarios@conning.com.

In this episode of Everything GOES we've had a primer on the GOES treasury model, and we've spoken to some of the differences users will find between the GOES and AIRG treasury rates. In our next episode, we're going to continue the model deep dive with a look at the differences between equity models.

Until then, thanks for listening, and keep on modeling!

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