

Blog Digest:

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Overcoming Challenges with Modeling Complex Instruments

Industry Insight and Views
from the FINCAD Blog

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Introduction

Why Flexibility Matters

Low interest rates over the past decade have created a fierce search for yield, which means portfolio managers are becoming more creative when determining how to generate the returns needed to beat their benchmark. Many are exploring opportunities in new instruments and asset classes such as emerging markets and structured products, as this is where the yield tends to lie.

However, buy-side firms are often challenged by the fact that their portfolio and risk systems are ill-equipped to help them model complex instruments. Additionally, these systems make it difficult to add new trade types and currencies and adapt to market shifts, such as OIS discounting, negative rates and the upcoming LIBOR phase out (and resulting replacement).

As a result, buy-side investment managers are increasingly looking for portfolio and risk solutions that allow them to pursue new investment opportunities with ease by giving them utmost modeling flexibility. According to recent Greenwich Associates research, 55% of buy-side firms said they are planning a change to their risk systems with the goal of expanding into emerging markets, and more than 33% are looking at structured products. And 31% said that the biggest shortcoming of their current portfolio and risk technology was that it did not allow them to model curves the way they wanted. **This inherent lack of flexibility matters because it limits the buy-side's ability to enter new markets, utilize new products and trade with new counterparties—all revenue-generating and/or cost-saving activities.**

If you like what you see in this Blog Digest, then please visit www.fincad.com/blog to view additional blog content on key topics such as curve-building, risk management, trends in buy-side technology and more.

I. How to Overcome the Modeling Challenges of Hybrids

In the strictest sense, a hybrid is a derivative or security exposed to more than one asset class. For more practical purposes, hybrids are derivatives that are sensitive to correlations between underlyings, whether they are in one asset class or multiple.

An example of a traditional hybrid instrument would be a convertible bond, which is exposed to the value of the underlying equity, interest rates, and credit spread of the issuer. But hybrid modeling is also needed for portfolio-level risk analysis, even for portfolios of vanilla products. For instance, calculating a portfolio's CVA, to evaluate the effect of counterparty default risk, needs to take into account correlation and non-linear effects, and requires hybrid modeling.

The modeling of hybrids involves detailed analyses of various risk factors, their mathematical properties, and the interplay or correlation among them. The bottom line is that hybrids modeling is difficult. Many firms will create a bespoke model to handle each case separately. However, the need to write code each time a new hybrid model is needed can weigh heavy on a firm's resources.

Firms will often encounter a few common challenges when endeavoring to model hybrids. These can include:

- **Equity Calibrations Are Destroyed by Stochastic Interest Rates:** The pricing formulae for European equity options changes when interest rates follow a random process. Often this problem is solved by creating a special calibration setup when modeling hybrid instruments. The issue here is that a new pricing equation for equity options would have to be derived for every random process a firm wants to use for the price of the underlying equity. This could potentially increase staffing resource needs of the firm.

- **Need for Careful Analysis for a Consistent Measure:** Careful analysis of each hybrid model is required to correctly run a Monte Carlo simulation, since the simulation has to be performed relative to a single numeraire and using its associated probability measure. But the detailed analysis required for every combination of dynamics in a hybrid model has much potential for human error if done manually.
- **Inefficient Simulation:** Performing simulations on hybrids is often computationally intensive. This is because the drift term can be stochastic, so short time steps are required in the simulation. But with a careful setup, the drift term can often be eliminated, thereby allowing long time steps, giving much faster performance.

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II. The Secret to Success in MBS Modeling

It's no secret that mortgage-backed securities (MBS) have become a safer investment than they were in the years immediately following the crisis. Today investors are adopting more sophisticated trading strategies involving complex investments like MBS, and are generating significantly better returns in the process.

However, because MBS are unique and complex instruments, often market participants struggle with modeling them. As far as what term structure model to use for MBS, there is no single gold standard. You first need to consider whether your portfolio is purely MBS focused, or if you have both MBS and hedging instruments in the same portfolio. The LIBOR Market Model is popular among those with balanced books where there are hedges, swaps and swaptions. Whereas for purely MBS focused participants, a Hull-White model is commonly used.

What's most important is not the model you pick for MBS, but rather whether you are using the same modeling framework consistently across all securities in your portfolio. This is particularly true if you have MBS as part of your broader fixed income portfolio and you want to value and risk manage that portfolio in a holistic fashion. For valuation purposes, the value of being consistent shows up in your risk profiles and your exposures. Lack of consistency can have a big impact on hedge ratios. You may unknowingly be introducing risk into your hedging process by not paying attention to the kind of modeling assumptions you are making for your multi-asset portfolio.

Because MBS do introduce these specialized considerations, some firms may shy away from them. Often firms will struggle with building the complete MBS analytics system they need to cover all aspects of analytical demands. They find this task challenging due to a few different factors, including:

- a lack of expertise in MBS modeling,

- the high costs and time investment that go into acquiring and marshalling the necessary data,
- and the fact that calculations involved in MBS analysis are complex, leaving firms' systems unable to cope efficiently.

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III. The Three Keys to Future-Proof Curve-Building

As most of us well know, accurate curve-building is essential to the success of any derivatives business. But recently, erratic market behavior has forced firms to rethink their approaches to curve-building.

Over the last several years, we've seen rapid and, at times, volatile change happening in the capital markets. One noteworthy manifestation of this change has been the widening of interest rate basis spreads. The credit crisis of 08-09 saw many basis spreads blow up including, for example, the OIS-Libor basis. You may recall that at one point in 2008, the 3m USD Libor - Fed Funds spread shot up to over 400 basis points (bps) before settling back to just around tens or twenties of bps. This unforeseen event shattered the idea that Libor was a risk free rate.

Another change has been greater regulation around margining. This has included the need to clear through central counterparties, and upcoming requirements to post margin for non-centrally cleared derivatives. These changes impact discount curves because of the funding rate implied by the collateral (e.g., OIS).

Yet a third example of upheaval in the markets is the emergence of negative interest rates, which have been increasingly adopted in a rather unconventional effort to revive the economy. The dip into negative rates territory has presented some challenges for financial organizations, because many of their systems have been designed to assume non-negative rates.

What all of this uncertainty means is that it is becoming more necessary for firms to adopt a curve-building approach that is adaptable and resilient in the face of change. To accomplish this goal, ensure your curve-building framework has the following key characteristics:

1. Use of Generic Concepts: Using generic concepts in your framework simplifies the curve-building problem by breaking it down into pieces of a puzzle. Each part of the

puzzle can then be solved separately. Additionally, the pieces can be swapped out with minimal effort, and without impacting other parts of the solution.

- 2. Risk Enabled Framework:** The quantification of risk is nearly always a core requirement in applications that use curves. As such, a robust curve-building framework must be designed with risk in mind, providing the ability to calculate risk efficiently, both in terms of numerical results and performance.
- 3. Consistency:** A robust curve-building framework should have consistency, in the sense of self-consistent modeling and arbitrage-free pricing. It should also be able to enforce consistency across the enterprise, helping you eliminate silos.

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IV. The LCH-CME Basis and the Need for Multi-Curve Construction

Many of us are now quite familiar with the standard narrative of “dual curve” bootstrapping – how in the good old days before the credit crisis, there was the One True Curve and the One True Price for a swap, how everyone funded at LIBOR and life was pretty simple.

Of how, in the wake of the Lehman Brothers collapse in September 2008, the Libor-OIS basis widened to 365bps, from typical values of 10bps, and the subsequent regulatory upheaval, leading (among many other things) to cleared swaps. And of how swap pricing underwent nothing short of a revolution, with the advent of OIS discounting – two curves not one.

This tale is broadly true. Our industry has struggled, and often continues to struggle with OIS discounting and the wider problem of building and using curves effectively. A lot of money and effort was spent on comprehensive system overhauls to cope with the new order, and change continues. Multi-currency CSAs, negative interest rates in Europe, and FVA continue to put pressure on every firm’s curve-building analytics.

You can be forgiven for wondering when the curve-building rollercoaster is going to end. Recent events in the world of cleared swaps have added yet more complexity into the mix. A swap cleared at LCH.Clearnet has had a slightly different market rate than the same swap cleared at CME Group for a long while, but the difference was so slight (around 0.1bps) that nobody really cared. In 2015, however, this basis widened to close to 2bps. That translates to 2 million dollars over the life of a 10-year, 1 billion notional swap, which is significant.

A variety of market forces are behind this difference, but among them is likely a buildup of directional exposure in dealer books at CME, which has managed to attract predominantly asset managers wanting to swap out fixed bond coupon income for

floating. It’s worth pausing for a moment here to take stock – “swap prices subject to market forces” feels like a very long way from the One True Price of old. Of course, what’s going on here is what has been true from the start – that risk-neutral valuation, based on eliminating arbitrage, only places constraints around the range of admissible prices. The rest is up to market forces.

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V. Overcoming Negative Rates Modeling Challenges

Life with negative interest rates is nothing new. In fact, negative rates have been around for many years. But things didn't get serious until 2014 when the European Central Bank (ECB) set the Deposit Facility Rate (DFR) below zero. This was the first time negative rates had been used as a direct measure to stimulate the economy, and the first time they had directly affected the Euro.

Fast forward to March 2015, and a significant portion of Euro zone government debt had negative yields. Today, rates are moving up, but negative rates haven't disappeared.

Negative interest rates continue to present challenges - specifically pricing and managing risk of rates derivatives and bonds with models that assume non-negative rate dynamics can be difficult. For this reason, today's blog post will point you to our most popular and helpful resources that give practical tips on overcoming the common challenges of modeling negative rates.

- 1. Best Practices for Mastering Negative Rates.** Europe's great negative interest rate monetary policy experiment has caused some stormy weather over the past few years. Both small shops and large institutions alike have spent a lot of money and effort updating, fixing, and re-engineering libraries, spreadsheets, and systems to cope with the change. But it needn't be this difficult. In this on-demand webinar, experts discuss the context for negative rates and the best approaches to modeling them, including: building curves and model requirements for negative rates, modeling vanilla swaptions and modeling rates exotics. Learn more by viewing the [on-demand webinar](#).
- 2. Mastering Negative Rates eBook.** The dip into rates less than zero has meant that the process of pricing and risk managing derivatives and bonds has become more complex. This is namely because most firms' models and systems have been designed

to assume non-negative rate dynamics. In this eBook, we will explore some of the specific risk management issues brought about by negative interest rates and offer proven tactics for overcoming them. [Learn more.](#)

- 3. Managing Swaptions in the Face of Negative Rates.** Negative interest rates were originally intended to be only a temporary measure for accelerating the economy. However, we are now a few years into this experimental monetary policy, which shows no signs of ending. In this post, FINCAD's Russell Goyder, PhD, gives five reasons why Shifted SABR has emerged as the market standard for modeling swaptions impacted by negative interest rates. Goyder explains how shifted SABR helps market practitioners model the volatility cube and capture the smile dynamics—providing the ability to accurately price and hedge derivatives. [Learn more.](#)

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