An OAS Primer

Option-adjusted spread (OAS) is used for relative value analysis of interest rate contingent securities with varying optionalities. A security is valued over a large number of future interest rate paths and the expected price is calculated, incorporating volatility and recognizing the security's scenario-dependent cash flows along each interest rate path. The OAS is the constant (excess) spread over the Treasury curve that equates the security's theoretical price to its current market price. To obtain an OAS for a security with contingent cash flows, we build upon a series of models described below.

First, we need a spot Treasury curve — a yield curve indicating the price and yield of a single cash flow maturing at any point in the future. At Goldman Sachs, we use two such curves. In the agency and corporate markets, by convention we use a spot curve adjusted so that the present value of all the cash flows of each on-the-run Treasury security matches its market price. We sometimes call this the on-the-run curve. *The debenture OAS is measured by using the average excess spread of the security above the on-the-run Treasury curve.* In the Treasury and mortgage markets, we use a spot curve that on average reflects as well as possible the market price of all non-callable Treasury securities; we call this our Treasury spline or simply the off-the-run yield curve. *The mortgage OAS is measured by using the average excess spread of the security above the off-the-run Treasury curve.* To compare agency debentures with mortgages, we must state their spreads off the same curve; therefore, we adjust the debenture OAS to account for the richness of the on-the-run Treasury securities.

Second, we need to model the uncertainties of future interest rates. At Goldman Sachs, we use a binomial tree approach based on the Black-Derman-Toy interest rate model, which separates time into discrete components (usually two to five times a year; in mortgages it is monthly). This allows a short-term rate to fluctuate up and down by equal percentages around an implied forward rate with equal probability, to reach new levels given by a yearly volatility assumption. The interest rate model has been designed so that the expected prices of single cash flows still match the Treasury spot discount curve. At each node in the binomial tree, the price of a currently callable Treasury is the minimum of the call price (usually 100) and the present value of the security obtained by averaging the present values of the two nodes in the immediate future and discounting them at the current node's short-term rate. No refunding costs are considered, as we assume the agencies will be extremely efficient in the active management of their debt. Pricing a callable agency bond on such a Treasury-based tree would generally produce a price that is higher than its market value. The Treasury discount curve needs to be adjusted upward by 10-30 bp to reflect the credit spread of agencies with respect to Treasury securities and for any liquidity differential. The OAS is the number of basis points that the Treasury discount curve needs to be adjusted upward until the theoretical price calculated using the interest rate tree matches the market price of the security.

The first and second steps on the previous page are all that it takes to value callable agency securities. A third step is necessary to value mortgages because of the difference in option exercise between mortgages and agency debentures. The agencies exercise embedded options very efficiently. Homeowner exercise of the embedded options, however, must be estimated using prepayment models and is reflected in the mortgage OAS, along with model uncertainty and credit risk. The homeowner generally has the option either to prepay (call) the mortgage, thereby shortening the mortgage, or to prepay less than expected (an inherent put option), thereby lengthening the mortgage. When homeowner exercise becomes consistent and predictable, then mortgage OAS becomes a very accurate gauge of value.

The prepayment model must evaluate the behavior of homeowners' payments over time as a means of projecting cash flows at each point in a future interest rate simulation path. And, unlike agency debentures, mortgage prepayments depend on the past history of prepayments, making them path-dependent. The current Goldman Sachs prepayment model was introduced in June 1994 in a publication entitled "Mortgage Prepayments: A New Model for a New Era," by Gregg Patruno. Our model includes a set of three sensitivities that focus on the major uncertainties in the borrower's decision-making process: refinancing, relocation, and cusp sensitivity.

Refinancing is generally the most important mortgage prepayment option, and also the most complicated because the composition of a mortgage pool changes over time as the most rate-sensitive homeowners exit the pool. We model the refinanceability of a mortgage pool in terms of the fraction of homeowners who are "Ready, Willing, and Able" to refinance. Homeowners are "Willing" to refinance if their after-tax savings incentive is high enough to meet their requirements, which vary considerably for different individuals. Whether homeowners are "Able" to refinance depends on non-interest-rate variables, such as their credit situation, cash and time resources, and individual temperament. Finally, of the mortgagors Willing and Able to refinance, only a fraction will actually be "Ready" to prepay during any given month, while most tend to postpone the transaction. We define the refi sensitivity of a mortgage security as the percentage impact on price for a 10% increase in the future pace of monthly refinancings — in other words, how much the value would decline if refinancing in general became 10% faster in every scenario.

A second component in our prepayment model is the relo factor. It takes care of relocation payments, which also include defaults, cash paydowns, and certain equity-takeout refinancings. Relocation is influenced by both economic factors (such as home equity levels, mortgage rates, and tax deductibility, all of which affect the affordability of "trading up" to a larger home) and noneconomic factors (such as seasonality and the age of the loan). The relo sensitivity of a mortgage security is the percentage price impact if future relocations became 10% faster in every scenario.

Finally, the cusp sensitivity measures the percentage change in price for a 25 bp increase in future prepayment incentives. This would capture the impact of the introduction of a lower coupon mortgage program, such as balloons, or the impact of mortgage bankers lowering the cost of refinancing.