Article Title: ARCHIVE | Criteria | Insurance | Life: New Methodology For Calculating The Convexity Risk In U.S. Life Insurer Risk-Adjusted Capital Adequacy Model Data: (EDITOR'S NOTE: —This article is no longer current. It has been superseded by "Analysis Of Insurer Capital Adequacy," which was published on April 22, 2009.) Standard & Poor's Ratings Services has adopted a portion of its financial product capital model (FPC) as a new methodology to calculate the convexity or gamma risk when applying its risk-based capital adequacy model to U.S. life insurance companies. The methodology will only be applied to portfolios of MBS (including collateralized mortgage obligations and pass-throughs), callable corporate bonds, and related hedge instruments. Commercial MBS (CMBS) and asset-backed securities (ABS), which are not affected by the new methodology, will continue to have static capital charges. Capital charges for CMBS remain at 2% for structures rated 'A' or higher and 4.5% for lower-rated structures. The capital charges for ABS remain 2% for home equity and manufactured housing and 1% for all others. The factor-based charges are not subject to Standard & Poor's expected capital adequacy multipliers. The changes to the existing methodology are being made to reflect more accurately the exposure life insurance companies might have to negative convexity related to portfolios of MBS, callable corporate bonds, and related hedges or fixed-income securities with imbedded options. The new methodology uses the dollar value of a 1 basis point (bp) move in rates (DV01) and an applied volatility (change in rates) as a benchmark for the expected change in market value (excluding gamma) and compares this with the company's projected modeled changes in market value given the same applied volatility. In addition, Standard & Poor's is standardizing the methodology it uses to determine the applied shifts in interest rates it uses to compute the exposure to convexity risk. For the 2002 valuation year, the MBS and callable corporate bond portfolio will be stressed with the following parallel shifts in interest rates: minus 125 bps, minus 100 bps, minus 1 bp, plus 1 bp, plus 100 bps, plus 150 bps, plus 200 bps, and plus 250 bps. The upper and lower limits were derived using a combination of the historical volatilities of changes in the yield of 10-year U.S. Treasury securities and qualitative views on economic factors and the interest rate environment. Standard & Poor's expects that the impact of these changes on the capital adequacy model will vary from company to company based on the actual securities they hold in their portfolios. In other words, the capital charge for a given portfolio could increase, decrease, or remain unchanged. The new methodology is effective immediately. The first part of this article provides an overview of how Standard & Poor's assesses convexity risk (gamma risk). The next two sections present a comprehensive description of the new methodology Standard & Poor's has adopted to assess the convexity risk associated with portfolios of MBS, callable corporate bonds, and related hedge instruments as well as a general example of the calculation of the expected risk-based capital applicable to this convexity risk. The article ends with a summary of the statistical analysis used to determine the stress scenarios. Applying Capital Charges For Convexity Risk In 1994, Standard & Poor's began analyzing insurers' investment portfolios to evaluate the inherent convexity risk. It has now refined its approach to analyze this category of risk. Convexity is a measurement of the nonlinear relationship between market values and changes in yield. For a given change in rates, the convexity relating to an insurance company's financial assets and over-the-counter (OTC) derivatives can be positive or negative and, therefore, can have a detrimental or beneficial effect on net market values. The methodology described in this article provides Standard & Poor's with a tool to analyze the detrimental impact of negative convexity associated with some asset classes while giving credit for offsetting hedge vehicles. Standard & Poor's recognizes that MBS and callable corporate bonds have outperformed certain other types of fixed-income assets during some historical periods based on the prevailing level of interest rates and credit cycle. Standard & Poor's does not have a particular bias against these or other asset classes. Rather, Standard & Poor's seeks to reflect the additional specific risk associated with each type of asset in its analysis of expected capital adequacy. Ideally, however, Standard & Poor's views diversification of sectors and asset types as favorable. In the past three years, the average allocation to MBS and ABS was 10%-25% of life insurance invested assets, and in many instances, this has enhanced the portfolio yield of these companies and expanded the universe of available securities. The full details of the models are available on Standard & Poor's Web site at www.standardandpoors.com ("U.S. Life Insurance Capital Adequacy Model Revised to Reflect New Regulations" published in February 2002, "Standard & Poor's Revises Its Risk-Based Capital Adequacy Model for Financial Products Companies," published in July

2000, and "New Insurance Capital Model Embraces Trends in Risk Management" published in January 2002). Methodology—Standard & Poor's Convexity Risk Standard & Poor's methodology applies parallel rate shifts to the portfolio of MBS and callable corporate bonds. The magnitude of these shifts can vary from year to year, depending on the changes to the level and volatility of interest rates. Standard & Poor's is looking to isolate the prepayment and extension risks of these assets (i.e., the unpredictability caused by rate shifts that might or might not occur). It is assumed for purposes of this calculation that an insurer's assets are matched to its liabilities. The asset/liability management part of the rating process and other sections of the capital adequacy model separately address the duration-mismatch risk component between the assets and liabilities. It is important to look at the impact this charge has on Standard & Poor's view of the capital base, though this is not the sole determinant of how option risk might affect a rating on an insurer, and convexity risk is only one component of the overall financial strength rating process for insurance companies. Old methodology. In the past, Standard & Poor's created a synthetic asset from a basket of 'A' rated noncallable corporate bonds, which is duration-matched to the effective duration of the company's mortgage-backed portfolio. This synthetic 'A' asset is then priced with the same parallel shifts in the yield curve, which are typically plus 300 bps and minus 150 bps. These results are compared with the mortgage-backed portfolio at the same levels to derive the level of capital needed. That is, the market value of the mortgage-backed portfolio at year-end plus 300 bps is subtracted from the corresponding market value of the synthetic 'A' asset. The same equation is calculated for minus 150 bps. The greater of these two numbers is used for the capital charge. The magnitude of the shifts used in this calculation can vary from year to year, depending on year-end yield curves. New methodology. Effective immediately, the calculation of capital required for the convexity risks embedded in the MBS and callable portfolios of life insurance companies will be based on the revised methodology applied to calculate gamma risk for financial products in the Standard & Poor's FPC model. The capital charge is based on a quantification of a company's specific exposure to adverse nonlinear changes in the market values of these assets and OTC derivatives that occur as interest rates move. Although a portion of price gamma or convexity occurs due to the hyperbolic relationship between price and yield, the predominant source of negative price gamma (or negative convexity) for most insurance companies is typically the options embedded in their assets. To model interest rate convexity risk, the insurance company being analyzed provides Standard & Poor's with the net combined change in market value—including the OTC interest-rate derivatives—for several incremental upward and downward parallel shifts in interest rates. In addition, the company provides Standard & Poor's with the change in market value for a 1 bp parallel shift in the yield curve for both the up and down scenarios used to calculate the DV01 (change in market value for a 1 bp movement in interest rates). The shifts are computed using a statistical analysis of the historical volatility of the monthly changes to the U.S. 10-year treasury rates (see the last section of this article for more details). The incremental capital allocated for interest rate convexity risk is calculated by comparing the change in market value that is implied by the delta exposure (the DV01 value multiplied by the incremental parallel shift) with the actual modeled changes in value for each incremental parallel shift. Standard & Poor's recognizes that the use of the parallel shifts when analyzing interest rate convexity risk might produce somewhat different results than testing for this risk by shifting individual points along the curve. However, given the generally high degree of correlation among different points along the yield curve, the difference should not be significant. For each incremental shift, Standard & Poor's considers the total expected change in value for the range and then nets out the change in value implied from the delta exposures. Standard & Poor's considers the remaining incremental change in value to be a result of gamma. This methodology recognizes that gamma changes over the incremental ranges. The incremental change in value because of gamma is summed separately for the incremental downward rate shifts and the incremental upward rate shifts. The largest loss, if any, is determined for each yield curve based on the up and down rate scenarios. To determine the incremental capital adequacy for gamma for a given rating category, the absolute values of these losses for each yield curve are summed. Standard & Poor's will selectively use its internal systems to spot-test the individual exposure numbers. In addition, Standard & Poor's may independently analyze the company's hedging strategies. Example. As a simplified example, if a company's exposure showed an expected change in net market value for the combined portfolio of $10,000 dollars for a 1 bp shift upward, ignoring

convexity, it would expect a market value change or loss of $1,000,000 for a 100 bps shift ($10,000 multiplied by 100). However, if after a 100 bps shift is applied and the modeled change in combined market value (loss) is actually $1,500,000, the additional loss of $500,000 would be attributed to negative convexity. The incremental capital allocated for interest rate gamma risk is calculated by comparing the net change in market value for the combined MBS and OTC derivatives portfolio that is implied using the DV01 for the initial 1 bp parallel shift (delta exposure) with the actual modeled changes in value for each incremental parallel shift provided by the company. For each incremental shift, Standard & Poor's considers the total expected change in value for the range and then nets out the change in value implied from the delta exposures. The remaining incremental change in value is considered a result of price gamma. Standard & Poor's uses incremental shifts—rather than one large shift—because the final incremental shift typically incorporates only a partial shift relative to the shifts provided by the companies. Furthermore, incremental shifts allow analysis of the gamma characteristics relating to a company's hedge strategies (i.e., how in-the-money or out-of-the-money they are). The incremental losses in market value because of gamma are summed separately for the incremental downward rate shifts and the incremental upward rate shifts. The largest aggregate loss, if any, is determined based on the up and down rate scenarios. The incremental capital adequacy for gamma for a given rating category is the summation of the absolute values of these losses in the worst-case directional rate scenario. For example, suppose a company has an MBS portfolio with a market value of $32 million as of year-end. For simplicity purposes, the assumption is that the statement value is equal to the market value. The company reports an expected total loss in portfolio-modeled market value of $200,000 for an upward parallel rate shift of 100 bps and an additional loss in market value of $600,000 for the incremental upward shift of 101 bps-150 bps. The company also expects a total gain of $300,000 for a downward parallel rate shift of 100 bps and an additional loss in market value of $100,000 for the incremental downward shift of 101 bps-150 bps. The DV01 value based on the average between the upward and downward parallel shifts of 1 bp is $1,000. Therefore, the expected loss for a 100 bps upward movement in rates, based on the initial DV01 value, would be $100,000 ($1,000 multiplied by 100). For 100 bps upward movements, the difference between the expected loss and the company reported projected loss is a loss of $100,000. Therefore, the net capital required is $100,000. The next step is to calculate the net incremental effect for the upward 150 bps scenario. The expected loss (delta exposure) is $50,000 (50 bps multiplied by the DV01 value). However, the company is projecting an incremental loss of $600,000. The net incremental capital charge is the sum of the total expected changes in market value and netting out the change expected from the delta exposure, which is $550,000 ($600,000 minus $50,000). The total capital charge for interest rate risk gamma (convexity) would be calculated as follows: Sum all the net incremental losses and (not netting them with the incremental gains for the two groups) the up shifts and the down shifts scenarios. Then, the largest negative exposure between the two groups is selected and divided by the total market value of the amount modeled by the company. The resulting ratio is applied to the statement value of the portfolio as of the end of the valuation year. In this example, it was assumed that the maximum shift was plus/minus 150 bps. For the up shift's group, the exposure to negative convexity risk in this MBS portfolio is $650,00 ($100,000 in the first positive 100 bps shift plus $550,000 in the next positive 50 bps shift). For the down shift's group, the exposure to negative convexity risk in this MBS portfolio is $150,00 ($0 in the first positive 100 bps shift plus $150,000 in the next positive 50 bps shift). The risk-based capital factor for the MBS portfolio illustrated in this example is 2%. This factor is calculated by dividing the largest exposure between the two groups, $650,000 (the greater of $650,000 and $150,000), by the year-end statement value, $32 million. In cases in which a company uses out-of-the-money negative gamma hedging strategies, it is possible that if the initial incremental rate shifts produce negative gamma (losses due to gamma) and the latter shifts produce sufficient positive gamma, the gamma considered over the entire range of shifts is positive (i.e., if one large shift were used, the company would appear to have no exposure from negative gamma). An actual occurrence of the larger shifts that cause the out-of-the-money options to gain significant value are statistically less likely, and these strategies may not provide a benefit to the company for smaller rate movements. Standard & Poor's methodology of adding only the incremental losses and not netting them with the incremental gains was designed to measure convexity risk in consideration of this.

Furthermore, to receive credit for positive gamma, all the incremental shifts must produce gains from positive gamma, which allows Standard & Poor's to avoid giving credit for out-of-the-money option strategies that might not benefit the company unless a significant tail-event movement in interest rates occurs. The calculation of the incremental capital charge for convexity risk for the illustrative book is detailed in the table. Convexity Risk—Calculation of Incremental Capital Charge for Illustrative MBS Book SIMULATED DOWNWARD SHIFTS (BPS) SIMULATED UPWARD SHIFTS (BPS) MARKET VALUE CHANGE IN PORTFOLIO ($) DOWN 150 DOWN 100 UP 100 UP 150 Company’s modeled market value $32,200,000 $32,300,000 $31,800,000 $31,200,000 Expected incremental change in market value $50,000 (DV01 * 50) $100,000 (DV01 * 100) ($100,000) (DV01 * 100) ($50,000) (DV01 * 50) Company’s modeled incremental change in market value ($100,000) $300,000 ($200,000) ($600,000) Unexpected gain or loss related to gamma ($150,000) $200,000 ($100,000) ($550,000) Summation of losses in directional scenario (sum of the incremental losses only) ($150,000) ($650,000) $650,000 (MAXIMUM OF THE ABOVE TWO VALUES) FACTOR USED IN THE CAPITAL ADEQUACY MODEL = 2% (I.E., $650,000/YEAR-END STATEMENT VALUE OR $32 MILLION). BASED ON DV01 VALUE OF 1,000 FOR A 1 BP PARALLEL SHIFT. MARKET VALUE OF THE ILLUSTRATED MBS PORTFOLIO IS ASSUMED TO BE $32 MILLION AS OF YEAR-END. Methodology to Determine the Interest Rate Stress Scenarios As mentioned in the introduction, for the 2002 valuation year, the MBS and callable corporate bond portfolio will be stressed with various parallel shifts in interest rates. The scenarios are minus 125 bps, minus 100 bps, minus 1 bps, plus 1 bps, plus 100 bps, plus 150 bps, plus 200 bps, and plus 250 bps. The maximum and minimum shifts were determined using a combination of a statistical analysis of historical volatilities in monthly changes of the 10-year U.S. Treasury rate and qualitative views on current economic factors and interest rate environment. Statistical analysis. The statistical analysis consists of computing the annualized mean and standard deviation of the monthly changes in the U.S. 10-year Treasury rate. Three main historical periods are considered in this calculation: 1 year, 5 years, and 10 years. The 10-year Treasury rate as of year-end 2002 was stressed by 2.5 standard deviations up and down for each of these periods to determine the shifts. Standard & Poor's begins by analyzing the five-year period's result and adjusts these results up or down based on the one- or 10-year volatility as well as its views on the current economic conditions. Standard & Poor's rate shifts were determined after considering the current yield volatility of 17.69% on the 10-year U.S. Treasury note, the security that is most closely linked to prepayments on MBS.