Article Title: Criteria | Insurance | General: Methodology For Calculating The Convexity Risk In U.S. Insurance Risk-Based Capital Model Data: (EDITOR'S NOTE: —On Jan. 30, 2023, we republished this criteria article to make nonmaterial changes. See the "Revisions And Updates" section for details.) 1. S&P; Global Ratings has revised portions of its methodology for calculating charges relating to asset convexity risk in its U.S. insurance risk-based capital model. The methodology determines potential economic losses that rated insurance companies could experience relating to options embedded in their fixed-income portfolios. 2. This paragraph has been deleted. Scope 3. The revisions apply only to our ratings on U.S. insurance companies. Based on the characteristics of the assets non-U.S. insurance companies hold, we do not believe that convexity risk is material to non-U.S. insurance portfolios and will not apply the test to those companies. 4. S&P; Global Ratings applies its convexity risk methodology to portfolios of residential mortgage backed securities (RMBS) (including collateralized mortgage obligations and pass-through securities), callable corporate bonds, asset-backed securities (ABS) collateralized by home equity loans, and the hedge instruments used to mitigate such risk to determine our expected capital charges relating to convexity risk. Commercial mortgage backed securities (CMBS), RMBS collateralized by reverse mortgage loans, and ABS that do not have principal cash flows that are affected by the level of interest rates are not included in our convexity test. Summary Of Criteria Update 5. We are revising portions of our methodology for calculating charges relating to asset convexity risk in our U.S. insurance risk-based capital model. 6. We are changing the methodology we use to determine the interest rate stress scenarios by applying the Hull-White interest rate model framework through our interest rate model. We have also developed a revised methodology for measuring convexity that will be used when we are not able to apply our stressed rate movement at some or all points along the term structure in our downward rate scenario due to the low absolute level of rates. 7. The changes to the existing methodology for determining interest rate shifts are being made so our expectations for capital adequacy relating to convexity risk are more reflective of the existing interest rate regime. The changes we are making to our methodology for measuring convexity risk are expected to provide us with a better metric for such risk when applying our model in cases where interest rates need to be "floored" to avoid using negative rates. 8. This article provides an updated description of the full methodology S&P; Global Ratings uses to assess the convexity risk associated with portfolios of RMBS, callable corporate bonds, and related hedge instruments. A description of the methodology used to determine the stressed interest rate scenarios is included at the end of the article. We have included demonstrative example applications of our revised methodology in the appendices, which are applied to simple RMBS portfolios where OTC hedging instruments are used to mitigate risk. A glossary of terms, which provides greater transparency of certain portions of these criteria, is also included in the appendices. 9. This paragraph has been deleted. 10. This paragraph has been deleted. Methodology: S&P; Global Ratings' Evaluation Of Convexity Risk 11. The following methodologies provide a tool to analyze the potential detrimental impact of negative convexity associated with specific asset classes containing embedded options, in consideration of a company's hedge instruments. The result of the analysis is to provide a capital charge for convexity risk used in our risk-based capital model. Depending on the prevailing interest rate environment relative to our interest rate scenarios, we will apply one of two similar methodologies, the "full shift methodology" or "partial shift methodology." Under both methodologies, we measure the impact of negative convexity for a given rate shift by comparing the expected market movement of an option-free proxy portfolio and the portfolio's modeled market value (MV). The difference between these values is the basis for capital charges relating to convexity risk. 12. If the exposure metrics necessary to perform our convexity testing methodology on a particular company are not available, we apply a factor-based approach. Our factors are based on conservative assumptions reflective of insurance industry portfolio holdings for the types of RMBS, home equity ABS, and callable bonds the company is holding (see Appendix B for the factors). 13. S&P; Global Ratings periodically updates its series of upward and downward incremental stressed shifts in interest rates that provide the basis for the ratings stressed scenarios we use in our convexity risk-based capital modeling. We determine individual interest rate shifts for our 'AAA', 'AA', 'A', and 'BBB' stress scenarios. The scenarios comprise a series of incremental shifts and include a maximum upward and downward shift applied for each rating category. Our most recent stress levels are defined in our article "Refined Methodology And

Assumptions For Analyzing Insurer Capital Adequacy Using The Risk-Based Insurance Capital Model," published June 7, 2010. 14. In our analysis, we consider the net combined modeled MV for their combined portfolios of RMBS, home equity ABS, and callable bonds at each of the stressed incremental shifts. 15. In most instances, we apply our full shift methodology where each point along the yield curve is shifted by the full magnitude of our incremental stress shifts when determining the change in the portfolio MV. In other words, we apply a parallel shift of equal magnitude across the entire term structure. In cases where the current level of rates is low and applying parallel shifts across the entire yield curve would produce negative rates, our partial shift methodology will be applied. Evaluation Of Convexity Risk: Full Shift Methodology 16. When using the full shift methodology to determine convexity risk, we first consider the average absolute change in the MV of the modeled portfolio for a 1 basis point (bp) parallel up and down shift across the entire yield curve (parallel shift DV01). The parallel shift DV01 provides the sensitivity of the portfolio to small changes in interest rates isolated from the impact of potential changes in cash flows. A more detailed description of the parallel DV01 is provided in the glossary in Appendix C. 17. For each of the incremental rate shifts, we calculate a parallel DV01 (delta) implied MV by taking the difference between the current MV of the portfolio and the product of the parallel DV01 and the corresponding basis point shift. 18. We then subtract the consecutive DV01 implied MVs to determine the incremental change in DV01 implied MVs. This delta implied change provides a proxy for the change in MV in the absence of convexity. We then calculate the difference between the incremental change in DV01 implied MV and the incremental change in modeled MV for each shift, which we consider to be a measurement of incremental convexity or gamma. 19. The potential aggregate stressed losses relating to negative convexity are determined for each direction by separately summing only the incremental adverse changes in value relating to convexity (i.e. negative values) for the series of incremental upward and downward rate shifts. The total capital charge for convexity risk is based on the largest potential aggregate stressed loss measured in either direction associated with the ratings commensurate rate shifts. The full shift calculation can be represented formulaically as follows: 20. We do not include values where incremental convexity is positive relating to the purchase of hedges or otherwise, in the aggregation. The positive convexity measured over the incremental periods relating to hedge strategies, if any, will be zeroed out or neutralized. As a result, credit for positive convexity occurring as larger absolute shifts are applied will not provide a benefit to incremental convexity occurring when lower absolute shifts are applied. Our objective is to calculate the worst potential modeled losses associated with either the upward or downward movements in each of the stressed scenarios. 21. In other words, in cases where the company would experience a loss relating to negative convexity if interest rates move less than the fully stressed magnitude within the scenario, we will not give credit for the benefit from gains in options value under larger shifts within the stressed scenarios. This also provides our rationale for applying a series of incremental shifts rather than one large shift. 22. We will include the benefit of OTC and exchange-traded interest rate derivatives (options) specifically designated to hedge the convexity risk associated with a company's asset portfolio in our analysis. The impact of such hedges are included in the measured net incremental changes in portfolio value if we expect the same or a similar hedge strategy will remain in place over the one-year annual time period that we are capturing in our analysis based on our understanding of their current practices and historical utilization of hedging. A more detailed discussion of how hedge instruments are treated in our model is included in Appendix D. 23. Appendix A provides an example calculation that illustrates an application of our full shift approach to an example portfolio. Evaluation Of Convexity Risk: Partial Shift Methodology 24. In instances where the level of interest rates is such that applying our full incremental shift equally across all the relevant points on the term structure would produce negative interest rates, we will apply our partial shift approach to determine the capital charge for convexity in our model. (See Appendix D for additional explanation.) 25. The stressed rate movements we apply in our model are based on movements in the 10-year Treasury security. As a result, in low interest rate environments where an upward sloping yield curve exists, it might not be possible to shift all the points along the curve by the full magnitude of our ratings stressed incremental shifts when determining the modeled change in MV for the asset portfolio in the declining rate scenario. 26. The partial shift methodology is the same as the full shift methodology described earlier, except we replace the parallel DV01 implied MV with the partial DV01 implied MV or the difference between (1) the current MV of the portfolio and (2) summation of the products of the actual incremental shifts applied and the partial DV01s at each point across the term structure. This can be represented formulaically as follows: 27. Partial DV01 values measure the change in value of the portfolio given a 1-bp change in rates at a specific point on the yield curve and can be derived from key rate or partial durations. The actual incremental shifts applied are the lower of the ratings targeted stressed shifts and the starting yield at each point along the yield curve. The modeled MV will also reflect the actual applied shifts at each point along the yield curve. 28. When applying our partial shift approach, a company's partial DV01 values at key points along the yield curve typically includes the one-, three-, six-, 12-, 24-, 36-, 48-, 60-, 120-, 240-, and 360-month points. However, based on the risk points available for us to analyze for the company, fewer points can be used, but this will result in our calculated capital charge being higher (more conservative) because the absolute value of the DV01 implied MV will be larger and smaller, when the downward and upward shifts are applied, respectively. If partial DV01s are not available for a company, we will determine their capital charge for convexity risk by applying our full shift methodology described earlier, which will also result in a more conservative capital charge. 29. Appendix A provides an example calculation that illustrates an application of our partial full shift approach to an example portfolio. Methodology: Determining The Interest Rate Stress Scenarios 30. Our applied yield curve shift scenarios are based on historical movements of the 10-year Treasury note, which is considered to be a driver of mortgage rates and the expected prepayments on RMBS securities. Based on the remaining term to maturity of callable bonds across the insurance industry and the high correlation that exists around that area of the yield curve, we also consider it to be a significant driver of the risks we are attempting to capture relating to other types of embedded options, such as call features. Our implementation follows the Hull-White model framework. Appendix A: Example Convexity Capital Calculations 31. In the following examples, our model for determining expected capital adequacy relating to negative convexity is applied to the following simple portfolio containing RMBS and a hedge instrument. The hedge instrument is included to provide additional clarity in demonstrating our methodology and provides an example strategy to mitigate the impact of potential slowdowns in prepayments in the scenario where rates rise. Lastly, the following asset portfolio consists only of pass through RMBS. It is designed for illustrative purposes only, and the results might not reflect actual charges we have observed across the industry. The only difference in the composition of the portfolio in the two examples is that we have assumed two different strikes on the hedge instrument (swaption) to reflect the different rate environments. Table 1 Example MBS Portfolio ($ 000s) ISSUER SECTOR TYPE CURRENT FACE/NOTIONAL AMOUNT COUPON (%) WAL (YEARS) FHLMC MBS Pass through 783 4.00 4.21 FNMA MBS Pass through 499 6.00 2.50 FNMA MBS Pass through 327 5.00 1.94 FNMA MBS Pass through 1,000 4.00 7.73 FNMA MBS Pass through 1,000 3.00 5.16 N/A OTC Derivative Pay fixed swaption 1,000 7.12/6.12* 1 x 10 *Strike of 7.12% in Example 1 and 6.12% in Example 2. N/A—Not applicable. Example 1: Full shift methodology is applied with full incremental rate shift scenarios Table 2 Example 1: Expected Capital For Convexity Risk FULL RATE SHIFTS APPLIED ACROSS TERM STRUCTURE ($ 000S) Parallel DV01* 1.427 TERM (MONTHS) 1 3 6 12 24 36 60 84 120 360 Yield (%) 2.45 2.48 2.52 2.66 3.21 3.78 4.72 5.41 5.98 7.03 (A) (B) (C) (D) (E) (F) (G) (H) = (E) - (G) (I) SCENARIO SHIFTS (BPS) MODELED MARKET VALUE MBS PORTFOLIO MODELED MARKET VALUE HEDGE INSTRUMENT MODELED MARKET VALUE COMBINED PORTFOLIO MODELED INCREMENTAL MV CHANGE IN PORTFOLIO DV01 IMPLIED MV¶ DV01 IMPLIED INCREMENTAL CHANGE IN MV GAIN/LOSS RELATED TO CONVEXITY LOSSES RELATED TO CONVEXITY +260 3,131.6 44.7 3,176.4 (27.9) 3,244.1 (35.7) 7.8 -- +235 3,169.8 34.4 3,204.2 (11.8) 3,279.7 (14.3) 2.4 -- +225 3,185.4 30.7 3,216.1 (32.5) 3,294.0 (35.7) 3.2 -- +200 3,224.3 24.2 3,248.5 (27.6) 3,329.7 (21.4) (6.2) (6.2) +185 3,254.9 21.3 3,276.2 (63.1) 3,351.1 (50.0) (13.1) (13.1) +150 3,323.9 15.4 3,339.2 (87.9) 3,401.1 (71.4) (16.6) (16.6) +100 3,418.3 8.8 3,427.2 (100.1) 3,472.4 (71.4) (28.7) (28.7) +50 3,522.8 4.5 3,527.3 (89.8) 3,543.8 (71.4) (18.5) (18.5) +1 3,613.7 2.0 3,615.7 (1.4) 3,613.7 (1.4) 0 3,615.1 1.9 3,617.1 3,615.1 -1 3,616.6 1.9 3,618.5 1.4 3,616.6 1.4 -50 3,720.9 0.7 3,721.6 104.5 3,686.5 71.4 33.2 -- -100 3,773.3 0.2 3,773.5 51.9 3,757.9 71.4 (19.5) (19.5) -160 3,793.0 0.0 3,793.0 19.5 3,843.5 85.6 (66.1) (66.1) -200 3,793.5 0.0 3,793.5 0.5 3,900.6 57.1 (56.6) (56.6) -215 3,798.3 0.0 3,798.3 4.8 3,922.0 21.4 (16.6) (16.6) -240 3,807.1 0.0 3,807.1 8.8 3,957.7 35.7 (26.8) (26.8) *Parallel

DV01 for asset portfolio = absolute value of (3617 - 3614)/2. ¶(f) = Current MV of MBS portfolio - DV01*(a). Table 3 Capital Charges For Full Incremental Rate Shift AAA AA A BBB Maximum upward rate shifts (bps)* +260 +235 +225 +185 Sum of losses in Up scenarios¶ (83) (83) (83) (77) Maximum downward rate shifts (bps)* -240 -215 -200 -160 Sum of losses in Down scenarios§ (186) (159) (142) (86) Capital charge ($) 186 159 142 86 Capital charge (%) 5.13 4.39 3.93 2.37 *These applied shifts are for demonstrative purposes only. Actual shifts will be published by Standard & Poor's annually. ¶Sum of losses from +50 bps to maximum upward shift. §Sum of losses from -50 bps to maximum downward shift. Chart 1 32. The example above shows an application of our convexity model to the simple portfolio above where our stressed parallel shifts are applied across the entire yield curve when determining the incremental change in the value of the portfolio. In the example, the yields corresponding to each point along the curve are larger than the targeted downward shifts. Therefore, our full targeted shifts can be applied. The modeled MV for the combined portfolio of assets and hedge instruments based on the scenario parallel shifts appear in Column (d). The modeled MVs are provided by the companies we analyze and are part of information we request in our survey. We then subtract the consecutive values in Column (d) to determine the modeled incremental changes in MV in Column (e). 33. The next step is to determine the parallel DV01 value by dividing the absolute value of the difference between $3,616.6 and $3,613.7 by 2, or $1.45. Hence, in the absence of convexity, the value of the sample portfolio would be expected to change by $1.45 given a 1-bp parallel shift in interest rates. The DV01 implied MVs in Column (f) are calculated by taking the difference between (1) the current MV of the RMBS portfolio and (2) the product of the stressed incremental shifts and the parallel DV01 value. This provides the expected portfolio MV in the absence of convexity. The consecutive values in Column (f) are subtracted to determine the DV01 implied incremental changes in MV based on incremental rate movements. 34. The next step is to determine the incremental gains or losses relating to convexity by subtracting the DV01 implied incremental changes from the modeled incremental changes in MV. Finally, the charges for convexity are determined by calculating the absolute value of the sum of the incremental losses in the up and down scenarios and determining the largest directional aggregate loss. The charges commensurate with each ratings category are determined by the corresponding maximum shift applied. In the example, the convexity charges are $186, $159, $142, and $86 (in thousands) for the 'AAA', 'AA', 'A', and 'BBB' categories, respectively. Example 2: Partial shift methodology is applied with partial incremental rate shift scenarios Table 4 Example 2: Expected Capital For Convexity Risk FULL RATE SHIFTS NOT APPLIED ACROSS TERM STRUCTURE ($ 000S) RISK POINTS (MONTHS) 1 3 6 12 24 36 60 84 120 360 TOTAL Partial DV01 ($)* (0.00) (0.00) (0.01) 0.05 0.11 0.21 0.31 0.30 0.38 0.06 1.406 TERM (MONTHS) 1 3 6 12 24 36 60 84 120 360 Yield (%) 0.08 0.11 0.16 0.29 0.84 1.41 2.35 3.04 3.62 4.67 —TERM (MONTHS)— 1 3 6 12 24 36 60 84 120 360 CONTINUED BELOW (A) TARGETED SHIFTS (BPS)¶ —APPLIED SHIFTS (BPS)§— +260 +260 +260 +260 +260 +260 +260 +260 +260 +260 +260 +235 +235 +235 +235 +235 +235 +235 +235 +235 +235 +235 +225 +225 +225 +225 +225 +225 +225 +225 +225 +225 +225 +200 +200 +200 +200 +200 +200 +200 +200 +200 +200 +200 +185 +185 +185 +185 +185 +185 +185 +185 +185 +185 +185 +150 +150 +150 +150 +150 +150 +150 +150 +150 +150 +150 +100 +100 +100 +100 +100 +100 +100 +100 +100 +100 +100 +50 +50 +50 +50 +50 +50 +50 +50 +50 +50 +50 +1 +1 +1 +1 +1 +1 +1 +1 +1 +1 +1 0 0 0 0 0 0 0 0 0 0 0 -1 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1) -50 (8) (11) (16) (29) (50) (50) (50) (50) (50) (50) -100 (8) (11) (16) (29) (84) (100) (100) (100) (100) (100) -160 (8) (11) (16) (29) (84) (141) (160) (160) (160) (160) -200 (8) (11) (16) (29) (84) (141) (200) (200) (200) (200) -215 (8) (11) (16) (29) (84) (141) (215) (215) (215) (215) -240 (8) (11) (16) (29) (84) (141) (235) (240) (240) (240) (A) (B) (C) (D) (E) (F) (G) (H) = (E) - (G) (I) CONTINUED FROM ABOVE TARGETED SHIFTS (BPS)¶ MODELED MARKET VALUE MBS PORTFOLIO MODELED MARKET VALUE HEDGE INSTRUMENT MODELED MARKET VALUE COMBINED PORTFOLIO MODELED INCREMENTAL MV CHANGE IN PORTFOLIO DV01 IMPLIED MV** DV01 IMPLIED INCREMENTAL CHANGE IN MV GAIN/LOSS RELATED TO CONVEXITY LOSSES RELATED TO CONVEXITY +260 3,126.8 101.4 3,228.2 (28.6) 3,242.9 (35.1) 6.5 -- +235 3,165.0 91.8 3,256.8 (11.8) 3,278.1 (14.1) 2.3 -- +225 3,180.6 88.0 3,268.6 (23.4) 3,292.1 (35.1) 11.7 -- +200 3,219.5 72.5 3,292.0 (20.6) 3,327.3 (21.1) 0.5 -- +185 3,249.9 62.6 3,312.6 (50.5) 3,348.4 (49.2) (1.4) (1.4) +150 3,318.7 44.4 3,363.1 (74.6) 3,397.6 (70.3) (4.3) (4.3) +100 3,412.8 24.9 3,437.7 (93.3) 3,467.8 (70.3) (23.0) (23.0) +50 3,516.6 14.5 3,531.0

(84.7) 3,538.1 (70.3) (14.4) (14.4) +1 3,607.0 7.4 3,614.4 (1.3) 3,607.0 (1.4) 0 3,608.4 7.3 3,615.7 3,608.4 -1 3,609.8 7.2 3,617.0 1.3 3,609.8 1.4 -50 3,709.8 3.0 3,712.9 97.2 3,678.1 69.7 27.4 -- -100 3,753.4 1.0 3,754.4 41.6 3,745.1 66.9 (25.4) (25.4) -160 3,757.6 0.2 3,757.7 3.3 3,817.0 72.0 (68.6) (68.6) -200 3,745.7 0.0 3,745.8 (12.0) 3,859.1 42.1 (54.0) (54.0) -215 3,745.0 0.0 3,745.0 (0.7) 3,874.9 15.8 (16.5) (16.5) -240 3,743.7 0.0 3,743.7 (1.4) 3,899.6 24.7 (26.1) (26.1) *Partial DV01s for asset portfolio only. ¶Targeted parallel shift across term structure. §Actual shift applied across term structure when determining modeled and implied MV. **(f) = Current MV of MBS portfolio - sum product of applied shifts and partial DV01s. Table 5 Capital Charges For Partial Incremental Rate Shift AAA AA A BBB Max Upward rate shifts (bps)* +260 +235 +225 +185 Sum of losses in Up scenarios¶ (43) (43) (43) (43) Max Downward rate shifts (bps)* -240 -215 -200 -160 Sum of losses in Down scenarios§ (191) (165) (148) (94) Capital charge ($) 191 165 148 94 Capital charge (%) 5.27 4.55 4.10 2.60 *These applied shifts are for demonstrative purposes only. Actual shifts will be published by Standard & Poor's annually.¶Sum of losses from +50 bps to maximum upward shift. §Sum of losses from -50 bps to maximum downward shift. Chart 2 35. The example above shows an application of our convexity model to a simple portfolio where, based on the level of rates and the shape of the yield curve, the company is not able to apply our stressed parallel shifts across the entire yield curve when determining the incremental change in the value of the portfolio. In the example, the yields corresponding to the 60-month term and before are smaller than our largest targeted downward shifts. Therefore, our full targeted shifts cannot be applied at all points along the term structure. (In practice, it is possible that we will be able to apply the full shift relating to some of our targeted confidence levels but not others.) Our partial shift methodology uses the same calculations as described in the earlier example, except only partial shifts will be used in some cases when determining the MV of the combined portfolio. In addition, the DV01 implied MV is calculated differently. 36. In the partial shift method, for each risk point (the point along the curve at which exposure is measured), the downward scenario shifts are determined by taking the smaller of our targeted shift and the U.S. treasury yield at each point. This limits the downward shifts to the corresponding U.S. treasury yield. For example, at the three-month risk point, because the yield is 0.11%, the maximum applied shift is 11 bps as opposed to the 240 bps at the 'AAA' level. 37. In this example, the modeled MVs for the combined portfolio that appear in Column (d) are based on the applied series of nonparallel interest rate shifts that appear to the left of Column (b). For example, the modeled MV of the portfolio corresponding to the negative 160 bp scenario is actually based on shifts of negative 8, negative 11, negative 16, negative 29, negative 84, negative 141, negative 160, negative 160, negative 160, and negative 160 bps for the one-, three-, six-, 12-, 24-, 36-, 60-, 84-, 120-, and 360-month risk points, respectively. We would then subtract the consecutive values in Column (d) to determine the modeled incremental changes in the MV of the combined portfolio, which is shown in Column (e). 38. The DV01 implied MVs shown in Column (f) corresponding to each targeted shift scenario are then determined by taking the difference between (1) the current MV of the portfolio and (2) the sum of the products of the actual applied shifts at each term and the partial DV01s at each risk point. This provides the implied MV based on the actual maximum shift that can be applied. This provides a proxy for the expected portfolio MV in the absence of convexity. The consecutive values in Column (f) are subtracted to determine the DV01 implied incremental changes in MV, shown in Column (g). 39. As in the earlier example, the DV01 implied incremental changes are subtracted from the modeled incremental changes in MV to determine the gains or losses relating to convexity, Column (h). Finally, the losses relating to gamma are summed separately in the up and down scenarios, and the absolute value of the largest directional aggregate loss becomes the convexity charge corresponding to each ratings category. The charges commensurate with each ratings category are determined by the corresponding maximum shift applied. In this example, the convexity charges are $191, $165, $148, and $94 (in thousands) for the 'AAA', 'AA', 'A', and 'BBB' categories, respectively. Appendix B: Convexity Factors 40. These factors are used when a company-specific model is not available, and these are from our capital model criteria (see "Refined Methodology And Assumptions For Analyzing Insurer Capital Adequacy Using The Risk-Based Insurance Capital Model," June 7, 2010). Table 4 Capital Adequacy Factors: Convexity Risk (%) AAA AA A BBB Mortgage-backed securities 8.10 7.20 6.60 5.00 Callable corporate bonds 3.30 2.90 2.60 2.00 Home equity ABS 3.30 2.90 2.60 2.00 All other ABS 1.60 1.40 1.30 1.00 Appendix C: Glossary Convexity 41.

Convexity generally refers to the measurement of the nonlinear relationship between MVs of fixed-income assets and changes in yield (interest rates), but the concept can also be applied to liabilities and hedges. In general, option-free bonds exhibit positive convexity, which means for a given absolute movement in rates, the price change is greater when rates decline than when rates rise. This mathematical-based property, which relates to the exponential nature of the discount function, is beneficial in consideration of fixed-income assets and certain interest rate derivatives but is detrimental when considering insurance company liabilities and certain derivatives. Because the beneficial impact of mathematical convexity relating to the assets is roughly canceled out by the detrimental impact of the liabilities as rates change, given a typical life insurance company's balance sheet, we do not include it in our evaluation of convexity. For example, if an insurance company wrote a guaranteed investment contract (GIC) and used the proceeds to finance an option-free bond, for a given decline in rates, the value of the asset will increase more than it would decline for the same absolute shifts as rates rise. However, the value of the GIC would also increase by more when rates decline than when rates rise, which is detrimental. Considering the two together, the impact of convexity would be roughly neutral. 42. Instead, our analysis of capital adequacy is focused on determining the risk relating to fixed-income securities that contain embedded options the insurance company is "short" (i.e., the company does not control), including callable bonds, home equity ABS, and RMBS. In the case of these instruments, the change in the MV that would be implied by their price sensitivity to small rate movements could be greater than the actual change given larger downward rate movements, and the implied absolute change could be smaller than the actual change given an upward rate movement. In other words, the embedded options can cause the MVs to move adversely when rates move in either directions, relative to option-free assets. This detrimental relative price change is what we are measuring and capturing in our convexity test. More specifically, our goal is to capture the change in value specifically related to the potential adverse changes in principal cash flows (e.g., relating to prepayments, extensions, calls etc.) isolated from the impact of MV changes solely relating to movements in interest rates. 43. As a simplified example, if the MV of a portfolio changes by $1 if rates move by 1 bp, in the absence of convexity, the portfolio value would be expected to increase by $200 if rates declined by 200 bps. If instead, the modeled value of the portfolio changes (increases) by only $175 given the applied rate shift, the difference between the expected change and the modeled change, or $25, can be viewed as a result of negative convexity. This measured difference provides the basis for our capital charges relating to convexity risk. Parallel DV01 44. The parallel shift DV01 provides us with the sensitivity of the portfolio to small changes in interest rates isolated from the impact of potential changes in cash flows as rates change. Therefore, the smaller the shift used to determine this value, the more accurate our measurement of convexity will be. 45. The parallel shift DV01 may be based on the average of shifts as large as 25 bps that have been converted to a DV01 by adding the absolute values of the changes in MV for both directions, dividing by the total shift magnitude in both directions. For example, if the value of a portfolio declines by $11,500 if rates are shifted upward by 25 bps and increases by $10,000 if rates are shifted down 25 bps, the average DV01 for a parallel shift would be $430 or ($11,500 + $10,000)/50. Applying shifts larger than 25 bps could begin to introduce a significant element of convexity and will decrease the accuracy of our measurement. Along these same lines, a parallel shift DV01 based on effective or option-adjusted duration would not be acceptable for our test. Appendix D: Additional Analytical Considerations Hedge instruments 46. In our analysis, we will not give a company credit in situations where the basis on the hedge instrument does not correctly match up with that of the embedded option in the asset they are attempting to hedge. Therefore, we may exclude all or a portion of the credit for hedge gains in our model. 47. For example, suppose a company is attempting to hedge options embedded in their RMBS securities that are largely affected by movements in 10-year rates, but positions a hedge instrument that has value that is largely driven by movements in two-year rates. If a parallel shift is applied when determining the modeled values, these rates will move in concert, and the value of the "long" and "short" options would appear to offset each other. However, in reality, it is possible that the 10-year rate will move in smaller or larger magnitudes than the two-year rate if the shape of the yield curve changes. Therefore, there could be scenarios where the hedge might not actually provide an offset to the convexity risk. Cases where partial shift methodology is applied 48. If applying our full incremental shift equally across all the relevant points on the term structure would produce negative interest rates, we will apply our partial shift methodology. For example, suppose the yield on the 10-year treasury is 3.70% and the 1-year treasury rate is only 1%. The aggregate incremental downward shifts applied to the one-year rate would be limited to 100 bps. If the ratings commensurate maximum shift is 250 bps, applying this shift equally across the entire yield curve would not be possible. If we apply our full shift approach in this case, in the downward scenario, the change in the modeled MV due to lower interest rates will only reflect the actual shifts applied at each point, which would be different than the shifts used to determine the implied change in MV based on the parallel shift DV01. This could overstate the company's exposure to convexity. (In other words, because the implied linear change in MV we are using to compare to the modeled change in MV is greater than it should be, the assumed negative convexity would be greater.) Revisions And Updates This article was originally published on April 27, 2011. The criteria became effective upon publication. This article supersedes the article titled "Criteria Assumptions: Interest Rate Scenarios Updated For U.S. Insurance Risk-Based Capital Model," published on Jan. 27, 2009. Changes introduced after original publication: Following our periodic review completed on March 3, 2015, we updated the contact information. Following our periodic review completed on March 1, 2016, we updated the contact information, updated criteria references, and deleted paragraphs 9 and 10, which were related to the initial publication of our criteria and no longer relevant. Following our periodic review completed on March 1, 2017, we updated the contact information and the "Related Criteria And Research" section. We republished this article on Dec. 22, 2017, to correct a criteria error relating to our methodology for determining interest rate stress scenarios. The error, which related to a mathematical error in our interest rate model, affected the interest rate stress scenarios published in the related article "2017 Interest Rate Scenarios For The U.S. Insurance Risk-Based Capital Model," published on Jan. 25, 2017, and applied in these criteria. The correction of the error has resulted in a revision of the interest rate model framework used in the application of these criteria (Hull-White, rather than Heath-Jarrow-Morton). As a result, we updated references to the interest rate model in the first sentence of paragraph 6 and revised the last sentence of paragraph 30 to "Our implementation follows the Hull-White model framework" from "Our implementation follows the Heath Jarrow Morton (HJM) framework, whereby the instantaneous forward rate is used as the fundamental quantity to model." The correction of the criteria error, in and of itself, is not expected to have any impact on current credit ratings. Following our periodic review completed on Feb. 15, 2018, we updated paragraph 40 to enhance the transparency of our criteria by specifically noting the related criteria reference. We also updated the "Related Criteria And Research" section. On Feb. 25, 2021, we republished these criteria to make nonmaterial changes. Specifically, we updated the contact information and deleted outdated text in paragraph 2 that spoke to criteria that had been previously superseded and was no longer relevant. On Jan. 30, 2023, we republished this criteria article to make nonmaterial changes to the contacts and the "Related Research" section. Related Criteria And Research Related Criteria Refined Methodology And Assumptions For Analyzing Insurer Capital Adequacy Using The Risk-Based Insurance Capital Model, June 7, 2010 Related Research Guidance: Methodology For Calculating The Convexity Risk In U.S. Insurance Risk-Based Capital Model, March 2, 2018