Article Title: Criteria | Insurance | General: A New Level Of Enterprise Risk Management Analysis: Methodology For Assessing Insurers' Economic Capital Models Data: (EDITOR'S NOTE: —On Sept. 23, 2021, we republished this criteria article to make nonmaterial changes. See the "Revisions And Updates" section for details.) 1. These criteria address S&P; Global Ratings' approach for assessing the "credibility" of an insurer's economic capital model (ECM). 2. Our criteria describe those parts of an insurer's ECM we typically analyze. The criteria are structured around two sets of modules. The first set of modules analyzes modeling considerations, such as the approaches an insurer uses to model total targeted resources, to value liabilities and assets, to model potential exposures to indirect risks such as pension fund risk, and to model the effect of management decisions, diversification, and capital fungibility. The second set of modules analyzes the insurer's modeling of exposure to "distinct" financial and nonfinancial risk groups, like market risk, credit risk, operational risk, and insurance risk (see chart 3 below). We cover the second set of modules in the appendixes of this article. 3. Within each of the risks, we have articulated the criteria around five categories that we review: methodology, data quality, assumptions and parameterization, process and execution, and testing and validation. We assign a score of "basic," "good" or "superior" to an insurer's approach for each category. The appendixes provide the criteria we use, under each of the five categories, to assess an insurer's modeling framework and, where appropriate, provide examples of how we evaluate insurers' approaches. We recognize that not all of these processes exist for every risk, that companies may not use all of the analytic tools mentioned for specific risks, or that they may use tools not mentioned. As such, our final scores for each module reflect our view of the insurer's best practices, using the principles our criteria detail, at each point in time for each risk; the principles the insurer uses to develop its model and assumptions, and how the insurer validates that the selected approach reflects their risks. 4. S&P; Global Ratings' overall assessment for an insurer's ECM combines the scores of the risk modules according to the relative importance of each risk to the insurer's overall risk profile. 5. The results of our ECM reviews feed into our assessment of an insurer's capital and earnings, risk exposure, and governance, within our framework for rating insurers. SCOPE OF THE CRITERIA 6. The criteria apply to all the life and health insurers, property and casualty (P/C) insurers (frequently called non-life insurers), and reinsurers that S&P; Global Ratings rates. The extent of our ECM review depends on the existence of an ECM within each insurer. Our review is also based on the complexity of the ECM and related processes, the extent and availability of documentation supporting the ECM, and the insurer's use of the ECM. CRITERIA SUMMARY 7. This criteria article is related to "Principles Of Credit Ratings," published Feb. 16, 2011. 8. S&P; Global Ratings believes that an insurer's ECM is an integral component of an insurer's enterprise risk management (ERM) program. We analyze insurers' ECMs to further our understanding of their ERM capabilities and capital needs. We note that our ECM review supplements and does not replace the use of our risk-based capital model. 9. S&P; Global Ratings uses the term "economic capital" to mean the financial resources (in addition to the assets supporting reserves and liabilities) required to support an insurer's financial obligations over a stated horizon at a stated confidence level. An ECM is a tool that models the insurer's risks and helps estimate its economic capital based on clearly articulated principles of economic quantification. 10. For insurers exhibiting complex risks and who have credible ECMs and a demonstrated ERM culture, we believe ECM reviews could yield information useful for our analysis. 11. Chart 1, below, outlines the extent of the ECM reviews. Although our ECM criteria apply to all rated life and health insurers, P/C insurers, and reinsurers, we will only undertake ECM reviews for those insurers that have an ECM, that use it in decision making, and that provide sufficient information. 12. ECM reviews provide additional information regarding how management quantifies the risks and interdependencies inherent in an insurer's risk profile, resulting in a more developed picture of its capital needs. We also believe that an ECM review achieves more in this regard than what could be obtained by using a risk-based capital (RBC) model alone (an RBC model is a static formulaic tool wherein factors are multiplied by risk drivers to derive a capital figure). Our ECM review might also highlight differences between an insurer's ECM and an RBC model. 13. The ECM review feeds into the assessment of capital and earnings, which is only one of the major factors we analyze in determining our credit rating on an insurer (see chart 2). Chart 2 14. If an ECM review reveals risk management issues, or we believe the insurer's ECM does not adequately quantify its risks, we may change our assessment of relevant key rating

factors. In some cases, this could affect our insurer financial strength and counterparty credit ratings, depending on our opinion of the severity of the matters identified and their relative importance. 15. S&P; Global Ratings reviews the insurer's capital adequacy by assessing the output of both S&P; Global Ratings' capital model and the insurer's own model. Our capital adequacy analysis involves a grading of the credibility of the ECM through the application of a confidence factor termed the "M-factor". We use the M-factor to indicate our confidence in the results of an insurer's ECM compared with the results of our RBC model (as defined by our criteria "Refined Methodology And Assumptions For Analyzing Insurer Capital Adequacy Using The Risk-Based Insurance Capital Model," published June 7, 2010). We derive the M-factor from our analysis of the insurer's ECM. We use the outcome of our RBC analysis, along with our evaluation of the insurer's ECM process, to form a view of the insurer's capital adequacy when combined with other quantitative and qualitative metrics. Therefore, the ECM review could result in an upward or downward revision in our assessment of capital adequacy, which would in turn feed into our assessment of capital and earnings. 16. The ECM review also provides insight into a company's risk management culture. We view it as positive for the assessment of risk management culture when an insurer can demonstrate that it has identified and modeled all of its major risk exposures, including the correlation of these risk exposures. Also, the insurer's construction of the ECM and the use of its results will indicate how well senior management understands the company's own risk profile and how much it supports the ERM framework. At the same time, the manner in which management uses the results of its ECM will help us better understand the insurer's approach to risk-return optimization and evaluating and prioritizing strategic options. 17. Although the completion of an ECM review may contribute to our assessment of an insurer's capital adequacy, the review will not prompt us to increase the importance we give to capital adequacy analysis within our assessment of capital and earnings or to increase the importance of capital and earnings when determining an insurer credit rating. 18. An ECM review may reveal additional information regarding management's attitude toward the insurer's risk profile, especially the degree and type of risk that management is willing to retain. This additional information feeds into our assessments of the insurer's governance. 19. In determining an insurer's capital adequacy, S&P; Global Ratings typically compares its RBC-based capital adequacy analysis to its evaluation of the insurer's own capital adequacy, produced by its ECM. Regardless of how an insurer constructs its ECM, we look for results that suggest a level of financial security consistent with the parameterization of our RBC model (such as the time horizon and confidence level) or that provide analysis that enables us to measure the results against principles consistent with our model. 20. We compare the "total targeted resources" (TTR) results from the insurer's ECM to the TTR results from our RBC model. 21. S&P; Global Ratings defines TTR as being the minimum resources sufficient to cover an insurer's specified current and future liabilities, considering future premiums and deposits, over a specified timeframe, according to a specified risk measure and at a specified confidence level. 22. In order to be able to compare the results of our RBC model and insurers' ECMs, we expect insurers to estimate their economic capital at a confidence level consistent with the appropriate capital adequacy level according to our RBC model. We expect insurers to be able to justify the confidence levels used in their own models. To facilitate any comparison, as noted above, we might request that an insurer present its results broadly on a basis consistent with that of the S&P; Global Ratings capital model (see "Refined Methodology And Assumptions For Analyzing Insurer Capital Adequacy Using The Risk-Based Insurance Capital Model," published June 7, 2010). 23. Issues of comparability may arise in relation to the risk measure an insurer chooses to define economic capital. We would expect the insurer to be able to provide economic capital figures based on a value-at-risk (VaR) measure, in order to facilitate comparability with our RBC model, which is VaR-based. 24. This paragraph has been deleted. 25. This paragraph has been deleted. METHODOLOGY 26. S&P; Global Ratings first identifies insurers that do not, in its opinion, have fully-developed ECMs, as well as those insurers who have not developed a robust ERM framework either because of model deficiencies or because of management's lack of commitment to integrating ECM results into its decision-making processes. We assign these insurers an "M-factor" equal to zero and, accordingly, give no credibility to the insurer's ECM. 27. This paragraph has been deleted. 28. We only consider an insurer's ECM to be credible if the insurer has risk identification, measurement, and control processes that we believe are adaptable to changing market conditions. We also expect such

insurers' ECM estimates to be integrated with their financial management processes when such insurers assess their risk levels, determine their risk appetites, and plan their capital positions. 29. We typically consider the ECM to be credible only if the insurer is applying the ECM results, together with other measures, as the basis of its major decisions (referred to as "embedding" or the "use test" in a regulatory context). We expect to see documentary evidence confirming use of ECM results, in conjunction with stated risk tolerance levels, strategic asset allocation, pricing, underwriting capacity, reinsurance buying, product design, and performance measurement. While the specific model an insurer uses for its ECM may or may not be appropriate, in our view, for each of these risk applications, we expect an insurer to demonstrate how it integrates ECM results into these activities. 30. Once we assess that the insurer is applying the ECM results in its decision making (as evidenced by a history of successful execution), we evaluate documentary evidence both as to how the ERM program operates to develop reliable estimates of the insurer's risks, and how the ERM represents the insurer's enterprise-wide risks. We describe this documentation in the appendixes of this article. 31. Our main focus in our review is to assess whether an insurer's approach to measuring its capital requirements appropriately reflects, in our opinion, its risk profile at a given target confidence level. Our methodology takes into account the possible considerable differences between the design of our capital model and an insurer's internal capital model. 32. Under our RBC model, we estimate an insurer's TTR, typically using a total balance sheet approach. In that process, we attribute our adjustments to the insurer's total adjusted capital (TAC) figure back to the insurer's balance sheet as adjustments to either assets or liabilities. In so doing, we create a pro forma "S&P; Global Ratings balance sheet" that is consistent with the workings of our RBC model. 33. When we estimate the TTR for an insurer's ECM, we use information that the insurer provides, with any necessary adjustments to ensure consistency with our RBC balance sheet. This process aims to make models determined with different asset and liability valuation definitions more comparable. We then adjust the level of TTR and, ultimately, the level of capital our RBC model indicates, based on the results of the insurer's ECM model, using our credibility measure, the M-factor. The M-factor we attribute to the insurer's ECM reflects our view of the adequacy of the insurer's internal model to credibly reflect their risk profile and capital needs. We constrain the effect of the M-factor in our capital adequacy analysis by limiting the decrease or increase of target capital, so that the change in targeted capital, as calculated under our RBC model for a given confidence level, does not exceed one rating category. 34. Table 1 provides an example of how we apply the M-factor to the TTR, when an insurer's ECM indicates TTR lower than that resulting from our RBC model. Table 2 shows an example of our application of the M-factor when an insurer's ECM indicates TTR higher than that resulting from our RBC model. 35. (The amounts in the tables below are indicative and in currency units appropriate for an insurer.) Table 1 Application Of The M-Factor When An Insurer Calculates Lower TTR Than Standard & Poor's RATING LEVEL (US$) 'AA' 'A' Standard & Poor's target capital* 100 90 Standard & Poor's TTR* 900 890 Insurer's TTR¶ (based on its ECM) 700 APPLICATION OF 10% M-FACTOR AS PER ECM REVIEW POST M-factor TTR [($700*10%) + ($900*90%)] = $880 880 Post M-factor target capital§ 80 Reduction in target capital§ 20 Maximum allowed increase in target capital§ (equivalent to one rating category) 10 Post review target capital§ 90 Post review TTR§ 890 *Based on Standard & Poor's risk-based capital model. ¶Based on the insurer's economic capital model (ECM). §Standard & Poor's calculations. TTR--Total target resources. Source: Standard & Poor's. Table 2 Application Of The M-Factor When An Insurer Calculates Higher TTR Than Standard & Poor's RATING LEVEL (US$) 'AAA' 'AA' Standard & Poor's target capital* 120 100 Standard & Poor's TTR* 920 900 Insurer's TTR¶ (based on its ECM) 1,100 APPLICATION OF 10% M-FACTOR APPLICATION AS PER ECM REVIEW POST M-factor TTR [($1,100*10%) + ($900*90%)] = $920 920 Post M-factor target capital§ 120 Increase in target capital§ 20 Maximum allowed increase in target capital§ (equivalent to one rating category) 20 Post review target capital§ 120 Post review TTR§ 920 *Based on Standard & Poor's risk-based capital model. ¶Based on the insurer's economic capital model (ECM). §Standard & Poor's calculations. TTR--Total target resources. Source: Standard & Poor's. 36. We deduct from or credit to an insurer's risk based capital requirement the decrease or increase in TTR indicated above, as determined by our RBC model. The adjusted TTR takes into account the limitation mentioned above, that is, the reduction or increase in target capital, as calculated under our RBC model for a given confidence level, which should not exceed one rating category of

capital adequacy (see "Refined Methodology And Assumptions For Analyzing Insurer Capital Adequacy Using The Risk-Based Insurance Capital Model," published June 7, 2010). 37. We derive the M-factor by combining our assessments of all of the insurer's relevant risk modules. Our assessment of each module's materiality and its contribution to the overall rating is guided by the estimated risk capital assigned to each risk based on the insurer's ECM or our RBC model. However, certain factors in any ECM review could prompt us to form similar conclusions about an insurer's ECM regardless of other facts and circumstances. For example: If the insurer has not conducted material validation analysis on the ECM's output, we would likely attach no credibility to such output, meaning that the M-factor would be zero. If the insurer assumes a diversification benefit, and we believe the process and assumptions cannot be adequately supported, we would likely attach no credibility to the ECM's output, meaning that the M-factor would be zero. If the insurer models less than 75% of its business, as measured by an appropriate metric or metrics, the M-factor we assign typically would be zero. If material, unexplained inconsistencies exist between actual and projected results, the M-factor typically would be zero. 38. This paragraph has been deleted. 39. We then combine the scores for the individual components of the review, attributing relative weights to each one. Where we assess the majority of scores as "basic" (see paragraphs 55-65), we use the weights derived from our RBC model. In other cases, we derive the weights from an insurer's ECM. We note that in cases where we assign scores of "basic" for the most important modules, the M-factor would likely be zero. 40. As noted earlier, we limit the effect of the M-factor by restricting the decrease or increase of target capital, such that the change in target capital, as calculated under our RBC model for a given confidence level, would not exceed one rating category. 41. For insurers with ECMs that we do not consider to be credible, we set the M-factor at zero. In other words, we only rely on the results that our own RBC model produces as part of our analysis of the insurer's capital adequacy. 42. This paragraph has been deleted. 43. For purposes of the ECM review, S&P; Global Ratings analyzes the extent of risks covered in an insurer's internal model, the rationale for the modeling methodologies used in the model, and robustness of the calibration and execution of the model. Our analysis covers the principles governing how insurers deal with risks in their ECMs, the quality of data, the appropriateness of ECM assumptions, and how the insurer produces and integrates results into the overall ERM process. We primarily consider whether an insurer can demonstrate that it has identified and reasonably modeled all of its major risk exposures, including the correlation of these risk exposures. We also evaluate how an insurer incorporates its ECM results into its risk-management and decision-making policies. For example, we analyze whether an insurer reduces its exposure to a particular risk if the ECM indicates that the exposure exceeds stipulated risk limits. Calibration With S&P; Global Ratings' RBC Model 44. To determine the ECM assessment, S&P; Global Ratings uses the results from the insurer's TTR, as calculated consistently with the insurer's ECM, along with the TTR derived from S&P; Global Ratings' own RBC model. The calculation is subject to our limit of the decrease or increase in TTR to within one rating category of the target capital under our RBC model. TTR calibration considerations 45. The following elements contribute to our view of the TTR: 46. Credit rating and confidence levels.S&P; Global Ratings believes that an insurer's confidence level should be consistent with its modeling assumptions, such as the default probability assumptions the insurer assigns to its own counterparties and obligors for assessing credit risk. Although S&P; Global Ratings does not ascribe a specific "default probability" to each rating category (because default rates for all rating categories rise and fall over time), it recognizes the need to correlate confidence levels with rating categories. 47. Time or "at-risk" horizon. We base our RBC model on a one-year stress period applied to capital. We acknowledge that some firms produce multiyear models; however, we will expect results consistent with the time horizon that our RBC model uses. 48. Risk measure, such as value-at-risk. We evaluate TTR calculations based on the VaR metric. Criteria Framework For The ECM Review 49. We have structured our criteria framework around two sets of modules. As previously mentioned, our ECM review places more weight on those modules that are most relevant, in our view, to an insurer's risk profile. We have designed the first set of modules to analyze risks that an insurer does not model explicitly as exposures to distinct risk groups, but that it applies as "modeling considerations." These include: Modeling of TTR; Techniques adopted for valuation and stress simulation of liabilities and assets, including specific tools such as replicating portfolios; Significant sources of risk that may also be based on underlying risk groups, such as pension fund risk that has

exposure to both market and longevity risk; and Considerations such as modeling the impact of management actions, diversification, and capital fungibility. 50. We have designed the second set of modules to analyze the modeling of exposures to distinct financial and nonfinancial risk groups, such as market risk, credit risk, insurance risk, and operational risk (see chart 3). We describe these modules more fully in the appendixes of this article. 51. When assessing an insurer's risk modeling, we not only focus on the level of sophistication in the modeling of risks but, more importantly, we review the insurer's justification of why and how effectively the chosen approach reflects the characteristics of the insurer's risk profiles. Also, our assessment places considerable emphasis on the calibration and execution of the risk models. 52. Within each module, we have articulated the criteria around five categories: methodology, data quality, assumptions and parameterization, process and execution, and testing and validation. We cover the categories of results and governance, separately, as they apply to the overall model rather than to each specific module. Guiding principles and criteria applied across all modules 53. This section describes how we analyze an insurer's individual risks. In general, we analyze each risk with respect to the five categories mentioned above and assign a score of "basic," "good," or "superior." We then combine the scores to arrive at the M-factor, or our view of the credibility of the insurer's ECM, as described in paragraphs 26-41. 54. We expect insurers to demonstrate certain characteristics within each of our score categories (see table 3). 55. Methodology. The "methodology" category focuses on how an insurer identifies and quantifies its risk exposures and whether it incorporates material considerations in its ECM. We analyze the approaches the insurer uses to model its risks as well as other considerations for the ECM. We analyze the insurer's definition of "economic capital" to form an opinion about the adjustments necessary to correlate the ECM with our RBC model. Subjects for analysis include the insurer's rationale for the approach (for instance, scenario-based, static-factor, or stochastic) the ECM uses to capture specific risks, how the approach in our view achieves a fair representation of those risks, how the approach compares with industry standards, and how the approach fits with the modeling of other risks to fairly capture the insurer's overall risk exposure. 56. While we view a stochastic modeling approach as having some advantages over a strictly deterministic approach, we do not believe that a stochastic analysis, in and of itself, necessarily provides a superior framework for analyzing risk and establishing a view of capital. Similarly, merely because a projection has stochastic characteristics, it is not, in our view, "superior" to a deterministic approach. In our opinion, a stochastic projection can provide an unrealistically favorable or unfavorable result depending on, among other things, the number of scenarios generated and the constraints built into the scenario generator. As a result, we score an approach solely dependent on either deterministic or stochastic scenarios as basic, and less favorably than one relying on the combination of the two. 57. Data quality. The "data quality" category addresses both the quality of the data an insurer uses for asset and liability valuation--exposure or position data--as well as the historical risk data used to derive the ECM's assumptions and parameters. 58. We consider the nature of the data used to support assumptions and whether the ECM assumptions take into account stress scenarios based on data derived from one or more unusual circumstances or occurrences falling outside of the normal historical experience. Those insurers that in our opinion have "good" or "superior" approaches to this category generally use data that include periods of high stress for the risks being modeled. For example, to stress test the ECM's market and credit risk parameters, insurers often employ data collected during the 1987 and 1929 crashes. Data collected for 2008 will, in our view, likely become an additional benchmark against which to test credit models. Some examples of nonfinancial stress scenarios are the mortality and morbidity rates observed during the influenza pandemic of 1918-1919 and P/C catastrophe events such as the earthquakes in New Madrid in 1813 and Tokyo in 1923 and the Great New England Hurricane in 1938. 59. Assumptions and parameterization.The "assumptions and parameterization" category addresses the process and governance framework that insurers use to determine the ECM's assumptions and parameters, such as the selection of distributions that best fit the relevant risk variables, and that of assessing and capturing possible tail dependencies among risk drivers. Insurers considered in our view to have "good" or "superior" approaches to this category will have analyzed differences in assumption interdependencies (for instance between stressed scenarios and more benign scenarios) and not, in our opinion, misestimated the degree of correlation between assumptions in varying scenarios. In addition, because of the inevitable uncertainty in estimating

assumptions and parameters, we consider that "good" or "superior" approaches assess the effect of alternative assumptions and parameters through sensitivity analyses. S&P; Global Ratings evaluates the degree of conservatism embedded in insurers' assumptions. 60. Process and execution. The "process and execution" category addresses how an insurer integrates into its ECM inputs from data warehouses, risk engines, other model results, and reporting and analysis tools. An insurer we consider to have a "basic" approach to this category may, for example, manually input data from various sources into its ECM, a "good" approach when it implements clear procedures and methods to gather, clean, and feed data into the ECM, and a "superior" approach when it has a well-maintained data repository requiring limited intervention to populate its ECM. 61. Testing and validation. The "testing and validation" category addresses the quality of an insurer's approach to testing and validating all aspects of its ECM, including the insurer's methodologies, interpretation of data and ECM outputs into its ERM program. Because of the inevitable uncertainty of estimating parameters and assumptions, we consider this category as one of the most important aspects of capital modeling. In general, we expect that, where possible, insurers test parameters, assumptions, and dependency structures while validating methodology through stress and scenario testing at the appropriate confidence levels. Our scores for this category generally depend on the clarity and extent of the insurer's documentation and its testing and validation practices. 62. In S&P; Global Ratings' view, validation should approach an ECM's outputs both from a static and dynamic basis. Static validation compares the modeled results from the insurer's ECM with actual totals from various accounting sources. Dynamic validation compares historical actual cash flows and cash flows from the base assumption set of the insurer's ECM. In addition, dynamic validation compares differences in the projected base scenario cash flows with those of other scenarios (including periods of assumed high stress) to verify that the ECM is doing what it is supposed to do. 63. Further, we typically consider whether insurers monitor ECM outputs over time to understand trends of capital needs predicted for at least the past three years. We also consider whether insurers perform attribution analysis to track variance between modeled risk and actual behavior by risk component in an effort to comprehend and explain the differences. 64. Governance.S&P; Global Ratings does not address the "governance" category at the individual risk module level but as part of the insurer's overall ECM analysis. In this category we analyze the governance structure of the ECM model. In our view, a good modeling governance framework should be characterized by a dedicated modeling team that draws from the insurer's entire resources, both geographically and across functions. Team members should have appropriate training and experience. Initial methodologies, parameterization, assumptions, and subsequent revisions should be fully documented and approved by appropriately designated personnel. Any third-party data and models should undergo assessment procedures in the same manner as internally collected data and internally built models. We review the projection platform's documentation, particularly if the platform is "home-grown" or "off-the-shelf" with open code that facilitates other user-defined functions. As part of our analysis, we ask the insurer to provide documentary evidence of the methodology, assumptions, and mathematical and empirical basis of the ECM, and to explain and address the ECM's limitations. We also analyze user guides and procedure manuals. We review whether individuals responsible for the ECM's are trained in the design and function of the ECM and how compliance with operating procedures is documented. We expect an insurer to demonstrate what we view as consistency of assumptions across business units and well-developed governance of all risk areas to obtain a "good" or "superior" score in this category. 65. Results.S&P; Global Ratings does not address the "results" category at the individual risk module level but as part of the insurer's overall ECM analysis. In this category, we consider the quality of the ECM's results and the reporting tools used. We analyze documentation for the ECM's projection platforms. A score of "good" or "superior" in this category should, in our view, reflect reconciliation of material differences between actual historical results and those produced by the ECM (as described in testing and validation above). We analyze the processes and corporate culture in place to form an opinion of whether the insurer, in its ERM program, adopts the ECM's results as part of its decision-making process. ECM review module criteria A. Modeling by risk group and type 66. This stage of the ECM review evaluates the economic capital modeling of the distinct financial and nonfinancial risk groups (see chart 3 above). Our criteria to evaluate the main risk types are listed below (see the Appendixes on modeling for further details): Market risk; Credit risk;

Insurance risk, which comprises the following risks: Mortality, longevity, morbidity, lapse, expense, underwriting, reserving, and catastrophe; and Operational risk. 67. The appendixes provide the criteria under each of the five categories that S&P; Global Ratings uses to assess an insurer's modeling framework and, in some cases, provide examples of how we assess insurers' approaches. The overriding focus that guides S&P; Global Ratings' judgment in its reviews is how the chosen model reflects the insurer's risk profiles and the calibration and the execution of the risk models. B. Other modeling considerations 68. Determining total target resources.As previously noted, we define TTR as the minimum resources sufficient to cover an insurer's specified future contractual liabilities, considering future premiums and deposits, according to a specified measure of risk and at a specified confidence level. S&P; Global Ratings recognizes that the models an insurer uses to estimate TTR and define its components vary according to the approach it adopts. 69. From a modeling perspective, we have observed that insurers estimate TTR components using stochastic modeling, stress and scenario testing, or a combination of both. In addition, we note that in some cases insurers may find it unavoidable to use different techniques to determine TTR components for different business units. We also note that some insurers use different models to value different components of the TTR calculation. In these instances, S&P; Global Ratings analyzes the insurer's processes to calculate and aggregate these risks. 70. For some insurers, new business expected to be written represents a considerable portion of their risk exposure. S&P; Global Ratings' RBC model allows for one year of new business for P/C insurers and no new business for life insurers. When the amount of new business deviates from this principle, we review how management justifies its allowance of new business in the ECM, and how material this deviation is. 71. S&P; Global Ratings interprets "market consistent" as meaning an insurer values its assets and liabilities on a market consistent basis. Under this definition, we interpret the "market consistent value of liabilities" as meaning the present value of expected cash flows needed to fulfill all the insurer's obligations in the ordinary course of business, based on a discount rate assumption that does not capitalize interest arbitrage. These cash flows generally include a margin for risk and uncertainty (reflecting the cost of risk) under market consistent economic assumptions. 72. Although there are a variety of approaches to estimating the TTR, there are certain standards specific to different methodologies. For example, S&P; Global Ratings expects companies using the one-year mark-to-market approach to value liabilities on a market consistent basis and, for those companies using a run-off approach, to ensure solvency at each year end. 73. The TTR model framework.S&P; Global Ratings analyzes the extent to which an insurer's ECM captures the risks to which the insurer is exposed based on its products, financial assets, and risk mitigation techniques. 74. In S&P; Global Ratings' view, an ECM should be at least as robust and comprehensive as the models an insurer uses for statutory valuation and reporting. It should also capture all lines of the insurer's business and reflect all of its product features. The ECM results should be based on similar standards to the reserving and accounting applications of the models the insurer is expected to maintain for regulatory purposes and should capture all business lines and embedded product features. We anticipate the insurer's ECM would be consistent with its other models (reserving, catastrophe, pricing, and embedded value, among others), unless there are well-documented reasons for differences to exist. 75. We also analyze how the ECM measures and captures the range of the insurer's risks, taking into account the complexity of its product features. While an accurate measurement of risks relating to the most complex product types will likely depend on a model built on a platform that applies a variety of stochastic techniques and distributions, in our opinion other risks may be accurately measured using less sophisticated techniques. 76. Quite often, insurers use different platforms or methods for different types of risks. Models based on several platforms typically require manual intervention and spreadsheet manipulation and thus introduce operational risks. We analyze an insurer's processes to take a view on how such risks are minimized. 77. S&P; Global Ratings believes that if an insurer appropriately considers the discretionary management actions in the ECM, calculated capital needs may provide a better reflection of its risk profile. We analyze whether or not the company has appropriately modeled such actions that it has the intent and ability to implement. S&P; Global Ratings discusses its methodology for assessing the treatment of management actions in models in paragraphs 99-100. 78. The ECM's ability to consider different risks on an interrelated basis across business lines is necessary if it is to accurately reflect the insurer's risk profile. For example, to model adequately complex reinsurance and risk

transfer arrangements, the ECM may need to consider a wide range of business lines, as well as the credit risk associated with such arrangements. Similarly, tax calculations may be quite complex and may require detailed considerations across a number of business lines. S&P; Global Ratings analyzes how the ECM captures the interrelationships of these risks. 79. We believe modeling dependencies between different risks and allowing for fungibility of capital are necessary for the insurer's overall capital calculation, given the potentially large impact of these dependencies on an insurer's capital needs. Modeling these dependencies can be challenging. We discuss our analysis of how they are captured by the ECM in paragraphs 101-112. 80. When analyzing a TTR model framework, we generally score an insurer's approach as: "Basic" when the valuation process includes all the insurer's material business lines and liability features, policy data reflect material policy parameters and risk factors (though high level data grouping may be used), and liabilities are established through valuation methods that reflect the insurer's best estimate assumptions, and incorporate considerations related to risk transfer and appropriate tax liabilities treatments. We would also expect that the insurer estimates economic capital based on the estimated increase of the value of liabilities under extreme scenarios calculated by stressing main assumptions with stresses being set at approximately the target confidence level and that it captures dependencies between different risks either through a correlation matrix (variance-covariance technique) or by using scenarios where correlated risks (in particular those with nonlinear dependencies) are stressed together. "Good" when the insurer applies a stochastic process to determine TTR. S&P; Global Ratings also believes that dependencies between different risks should either be built into the ECM or calculated based on a correlation matrix, with correlations adjusted to capture the change in correlation that might exist in tail risks. When approximations are used, for example when the insurer uses replicating portfolios, S&P; Global Ratings seeks evidence of back-testing and expects insurers to demonstrate their attempts to minimize model risk. "Superior" when, in addition to the above, the ECM is integrated and used to project "best-estimate" liabilities and capital needs, and the ECM is based on the assumed probability distribution of all risks. We also expect the ECM to be fully integrated between assets and liabilities, granular enough to capture the significant risks that the insurer faces, and take into account key sources of volatility. The model may allow for the stochastic nature of all material risk drivers, model expected management actions, and incorporate the insurer's risk transfer programs. The insurer is also able to demonstrate minimal model risk with emphasis on whether participating business benefits are calculated consistently with the generated economic scenario. 81. When looking at the process and execution category, we generally score an insurer's approach as: "Basic" when it employs extensive manual intervention that may create model or operational risks, or when its governance process is, in our view, inadequate or non-existent. "Good" when it uses limited simplification and data grouping for material lines of business and a contained number of platforms for valuation of all lines, the insurer's manual intervention is limited, it values its material product lines using simplifications and thoroughly tests approximate methods, such as replicating portfolios (when used); and we consider the governance process to be adequate. "Superior" when the ECM models all the insurer's lines, the insurer's manual intervention is minimal, and the governance process includes checking the ECM, changing the ECM where necessary, and reviewing the means by which new assumptions are signed off. While S&P; Global Ratings believes that reducing the level of manual intervention is valuable, it looks unfavorably on an absolute "black box" approach where the model is inflexible and difficult to review and validate. 82. We generally score an insurer's testing and validation as: "Basic" when it employs only high level reconciliation to statutory and accounting valuations and high level analysis of change. "Good" when it performs a detailed reconciliation to statutory and accounting valuation and employs detailed analysis of change. "Superior" when it employs especially extensive reconciliation and analysis of change (for example, for each risk and product line). We also regard as "superior" a process in which cash flows can be validated to output used for a different projection function. 83. Valuation of assets.An important consideration in our analysis of a capital model is the process an insurer uses to value assets. We review how the company values both financial and nonfinancial assets (for example, reinsurance recoverables) and determines an initial starting balance sheet and, depending on the selected methodology, future balance sheets under stressed conditions. 84. a. Methodology.We generally score an insurer's asset valuation approach as: "Basic" for insurers that initially value assets based on book value or on some other

accounting based valuation process, although we would expect the insurer to be able to reconcile these values with market values. In these cases, asset valuations after movements in relevant risk drivers or at some future time would likely be based on approximations and would not necessarily be market consistent. "Good" for insurers that initially value assets or hedge instruments that have a "deep and liquid market" using market values obtained from an appropriate source, such as a market maker or provider of market information (Bloomberg, for instance). For fixed-income instruments or "plain vanilla" hedge instruments, insurers may derive values using an appropriate fixed-income analytic system and market implied spreads. We also analyze whether the insurer has considered all embedded options (for example, call options), with the understanding that certain valuations of complex assets and hedge instruments can be carried out using an approximate "closed form" solution. For us to view an insurer's asset valuation as "good" our analysis would likely reveal that the insurer values all its assets (including derivatives)consistently with the scenarios generated in the market risk and credit risk models, though it may use some approximations, and that it projects the values of nonfinancial assets using a simplified approach. "Superior" for insurers that use minimal approximations to value complex assets or hedging instruments, in addition to the valuation methods described in the "good" approach above. 85. b. Data quality.We generally view approaches to data quality as: "Basic" for insurers that use only internal data to value assets, such as book values or cash flow analysis, that rely on a significant grouping of data (all corporate bonds rated 'AA', for instance), and that may not consider nonfinancial assets in the ECM. "Good" for insurers that apply data in the "mark-to-market" or "mark-to-model" valuations, taken from a market maker or provider of market information. However, in these cases, we believe that asset data are more reliable when based on asset groupings using average characteristics (such as those for fixed-income assets, the sector, the ratings on the securities, and their duration) rather than on the actual individual securities. When overall data quality is "good", our analysis affords certain leeway to insurers using justifiable assumptions to complete holes in data due to the absence of market observations (for instance, when observable long-term interest rates or spreads are unavailable). "Superior" for insurers that take asset data used in their "mark-to-market" or "mark-to-model" valuations from recognized market data sources appropriate for the assets held. In addition, we analyze whether the insurer uses observable data to construct the term structure of applicable interest rates and whether the insurer scrutinizes and "cleans" the volatility surface (for example, observed market rates on over-the-counter interest rate swaps) to minimize the effect of erroneous data. We also analyze whether missing data points are completed through appropriate interpolation and/or extrapolation techniques (for example, splines), and whether the ECM encompasses all the insurer's assets, including nonfinancial assets. 86. c. Assumptions and parameterization.We generally score an insurer's approaches to the ECM's assumptions and parameterization as: "Basic" when it applies key determinants of asset values, such as spreads and applied volatilities to broad groupings of assets based on specified characteristics, such as sector or rating. We have observed that in a "basic" approach to assumptions, the ECM's modelers often assume that the values of fixed-income assets are modeled to change in a linear fashion and, therefore, would not fully reflect the embedded options (for example, in the case of residential mortgage-backed securities, changes in prepayments would not be reflected). In some cases, the insurer's analysis assumes that valued assets follow an assumed profile, such as the insurer's strategic asset allocation target, rather than that of the actual assets held. In addition, due to the grouping of data or lack of data detail, insurers with "basic" approaches may make assumptions relating to future returns on or characteristics of assets, for instance, based on market value sensitivity. "Good" when the insurer's "mark-to model" approach used for fixed-income assets assumes the nonlinearity of assets exhibiting such features. In such cases, however, assumptions might be not be detailed and may not be fully calibrated to the market. For equity holdings, insurers with a "good" approach likely assume that individual securities would behave like an index to allow simplification of modeling by grouping. A typical assumption, for instance, would be that all U.K. equities behave like the FTSE 350 index. We analyze whether the insurer justifies and supports its assumptions by testing. "Superior" for insurers that model individual asset values assuming the actual characteristics of each individual asset. Insurers with a "superior" approach to their assumptions likely derive these assumptions from data taken from sound sources, while giving detailed consideration to the data used, including aspects such as frequency, reliability, stability, and capturing of extremes.

Insurers with a "superior" approach likely base their financial assumptions made during the initial valuation used to calibrate distributions for projections (volatility of returns, for example) on observable data analyzed over a suitable period of time to provide sufficient market volatility and a credible data set or stressed scenarios where they believe credible data do not exist. In these cases, initial financial assumptions, such as the term structure of interest rates, are likely to be used consistently through the model. Financial assumptions used for future valuations are likely to be consistent with the scenarios generated by market risk and credit risk models, if applicable. 87. d. Process and execution.In our view, an approach to process and execution is generally: "Basic" for insurers that manually input summary data relating to asset characteristics, or if such data are produced on many systems or spread sheets and requires significant manipulation before being fed into the ECM. "Good" when the insurer provides audited and grouped information on asset characteristics from separate systems. We analyze, however, whether standard workflow procedures existing alongside agreed upon best practices are used to manipulate and feed the data into the models used to determine economic capital. For instance, in these cases, insurers would store Committee on Uniform Security Identification Procedures (CUSIP) numbers on fixed-income securities and download and retrieve relevant characteristics and pricing data from a reliable pricing service or information provider. "Superior" for insurers that take individual asset holding information from asset valuation systems integrated into the ECM, thus requiring limited intervention or manipulation. 88. e. Testing and validation.We generally regard approaches to testing and validation as: "Basic" for insurers that provide only a high-level reconciliation between asset values used by their ECMs and other published information. "Good" for insurers whose major business units and assets are reconciled to statutory valuations with appropriate review and revaluation of prices of mark-to-model assets. "Superior" for insurers that reconcile asset values used by their ECMs to statutory valuations, including the identification of any applied spread margins in determining discounts or premiums to the asset value, such as unrealized gains. In addition, in a "superior" approach, we anticipate that the insurer regularly values the prices of mark-to-model securities using appropriate external sources, such as bid side indications from dealers, and that current observable market prices will be validated using the model and current assumptions to ensure that projected market values are reasonable. 89. TTR calculation techniques. The components of the TTR are commonly calculated using either stochastic modeling or stress scenario testing. It may be necessary from a theoretical standpoint to use nested stochastic calculations. The use of nested stochastic calculations is highly complex, particularly for large insurance groups operating with many subsidiaries across multiple countries. For this reason we anticipate that approximate techniques may be used instead. We analyze the approach taken and consider its effectiveness as an element of our review. 90. Standard and Poor's criteria for assessing replicating portfolios.We have observed that some insurers, especially in Europe, are using replicating portfolios for the valuation of assets and liabilities needed for the calculation of economic capital for financial risks. A replicating portfolio is a pool of a relatively small group of asset types, which is used to reproduce the behavior of a portfolio of either or both of assets and liabilities. The driving force behind the use of replicating portfolios is increased efficiency rather than increased accuracy, since after all, they are models of models. Because the complexity of such an approach is directly related to an insurer's risk profile, we will examine the fit of the results with the results of the underlying model(s). 91. S&P; Global Ratings analyzes whether, in its opinion, the replicating portfolios provide a good fit across the tenor of the assets and liabilities over a range of economic scenarios. In particular, we analyze whether insurers using replicating portfolios frequently review them, as well as the scenarios used for the optimization process. We analyze the variety of extreme scenarios and "normal" scenarios employed in the ECM. We consider whether insurers test the "goodness of fit" of replicating portfolios based on a range of tools including "R2" (value of "r" squared; the explained sum of squares), sensitivities to key parameters, and scatter plotting. In particular, we analyze the "goodness of fit" in extreme scenarios. 92. a. Methodology.When an insurer uses replicating portfolios, we generally score its approach as: "Basic" when we consider that the insurer is creating its replicating portfolios for heterogeneous asset or liability portfolios, or if there are no suitable financial instruments available to represent some critical features of asset and liability portfolios, such as long-term options and guarantees in emerging markets. The market value of the replicated portfolio should be as close as possible to that of the

replicating portfolio at time zero. We analyze whether an insurer is able to fit the replicating portfolio to its real portfolio by using a cash flow matching technique, although approaches that seek to match some of the "Greeks" (representations of sensitivities of derivatives to parametric changes affecting the value of a particular instrument or financial portfolio) are also possible. Additionally, elements of what we regard as a "basic" approach likely include a limited range of optimization scenarios, optimization criteria that, compared with the standards of the industry, are not strict, and allow exceptions to the optimization rules. In a "basic" approach, we might also expect to find that the insurer has no well-established procedure to check replicating portfolios of complex assets and liabilities or to determine whether the portfolio is over-optimized. Under the "basic" approach, we also expect that replicating portfolios are infrequently reviewed (usually only annually) for appropriateness. "Good" when the insurer employs a wider range of financial instruments that captures the main features of its replicating portfolios and when the valuation approach for such financial instruments is scored at least "good" (as defined in the criteria for valuation of assets above). The insurer likely features replication scenarios based on a range of market-consistent and real world projections, as well as extreme scenarios. Insurers likely use a range of optimization metrics and allow only minimal exceptions to optimization criteria. Optimization is likely to be based on a number of "duration buckets," rather than across the whole duration of the portfolios. Insurers likely perform detailed analysis on difficult-to-replicate portfolios under various scenarios. We also anticipate that to receive a "good" score, an insurer would likely review portfolios for continued appropriateness in line with the calculations of economic capital. "Superior" when an insurer employs an even wider range of financial instruments capturing the main features of its replicating portfolios than those described in the "good" approach above and when we score the valuation approach for such financial instruments as "superior." The insurer likely features a larger number of replication scenarios based on a range of market-consistent and real world projections, as well as more extreme scenarios than for a "good" score. Insurers likely apply optimization over a large number of relevant duration buckets and use several optimization metrics to determine the match of the replicated portfolio (which may include the "R2" value, average error, and maximum error data) to its real portfolio. A "superior" approach typically involves performing sensitivity analyses of the real portfolios and the replicated portfolios over a range of market swings. Insurers scored "superior" typically have optimization criteria that would allow few, if any, exceptions. We expect that in addition to using optimization techniques, insurers compare replicating models against the ECM under various scenarios (including stress scenarios). Under a "superior" approach, the insurer examines the quality of replicating portfolios of complex assets and liabilities portfolios (including complex and long-term options and guarantees) over extreme scenarios. The insurer also frequently reviews its replicating portfolios. 93. b. Process and execution.We generally score an insurer's approach to process and execution as: "Basic" when it uses a considerable degree of manual intervention for entering asset and liability portfolios into the replicating portfolio optimization engine or for entering replicating portfolios into the ECM. "Good" when it uses minimal manual intervention for entering asset and liability portfolios into the replicating portfolio optimization engine and for entering replicating portfolios into the ECM. "Superior" when it automatically feeds its asset and liability portfolios into the replicating portfolio optimization engine and into the ECM. We also expect that the insurer performs reviews of results for reasonableness. 94. Postretirement benefit plans.Many insurers have their own internal postretirement benefit plans. Depending on a given plan's design, the insurer could be exposed to significant market, longevity, mortality and morbidity risks. 95. The targeted capital for such a plan should, in our view, reflect the estimated funding cost to the insurer under an extreme scenario, considering any assets already allocated in support of the plan, and be consistent with the target confidence level. Furthermore, the possibility that payment of some benefits may be at an insurer's discretion (as is the case in the U.S. for some postretirement life and medical benefits) should, in our opinion, also be taken into account. We consider the approach the insurer takes to reflect such plans in the course of our ECM review. 96. a. Methodology.We generally evaluate the main risks of an insurer's postretirement benefit plans using the same benchmarks we apply to evaluate the insurer's marketed insurance business (see paragraphs 139-196). We generally score an insurer's approach to modeling postretirement benefit plans as: "Basic" when the insurer bases its modeling on a range of scenarios stressing the main risks--market trends, longevity, salary inflation--in line with our

benchmark criteria for each of these risks. "Good," when, in addition to the "basic" characteristics immediately above, the insurer's risk modeling is consistent with its modeling approaches for equivalent risks in its business. For example, we would likely assign a "good" methodology score if the insurer uses the same underlying model for the equity exposure for both its insurance business and its postretirement benefit plan. "Superior" when the insurer adopts a stochastic model incorporating multiple risks and the insurer's modeling is consistent with its approach to similar insurance risks. 97. b. Data quality, assumptions and parameterization, and testing and validation.When analyzing postretirement plans, S&P; Global Ratings typically employs the same benchmarks for assessing data quality, assumptions and parameterization, and testing and validation as it uses to analyze similar insurance risks. In particular, we analyze whether an insurer validates its valuations of postretirement benefit plans against other valuations, such as accounting and ongoing funding. However, we also believe that some aspects of the ECM used for postretirement benefits may differ from the ECM used for the insurance business. For example, the subject populations are almost entirely different and therefore have different characteristics. In our view, an important assumption is the circumstances under which benefits would not be paid, in cases where payment of benefits is discretionary. 98. c. Process and execution.In our view, the modeling of postretirement benefits is generally separate from that of the insurance business. Model populations are different, the benefits are likely different as well, and benefits may or may not be funded, among other factors. Lastly, we consider that economic scenarios should be consistent when insurers add the results of this model to those for other areas of risk capital. 99. Management actions.An insurer's management may take action to mitigate risks and thereby reduce the insurer's capital needs. Such actions include but are not limited to changes in nonguaranteed elements like cost of insurance charges, credited interest rates or dividends, modifying non-guaranteed agent compensation structures, and cutting staff, among others. In this section, we consider the modeling of such actions in response to the economic environment, anticipated product profitability, or a deviation in the capital position from the level that management targets. A key consideration is whether we believe management has the willingness, ability, and resources to implement modeled actions on a timely basis, as demonstrated by prior actual actions, existence of well-documented plans, and our discussions with key personnel. 100. We analyze how an insurer models the medium- and long-term impact of management actions and reflects them in its capital position. Implementing management actions may also bear material extra costs. We analyze how insurers include these when modeling their capital needs. 101. Diversification and capital fungibility.Each insurer diversifies risk differently. S&P; Global Ratings has classified insurers' risk diversification into several levels (see table 4). Table 4 Classification Of Insurers' Risk Diversification LEVEL 1 WITHIN RISK TYPES. RISKS ARE STANDALONE WITHIN A SINGLE RISK CLASS IN AN INDIVIDUAL PRODUCT OR BUSINESS LINE. EXAMPLES: ASSET CREDIT INTERDEPENDENCIES; LAPSE RISK WITHIN UNIVERSAL LIFE PRODUCTS WITH DIFFERENT FUNDING LEVELS. Level 2A ACROSS RISK TYPES. Risks are within the same risk class but may run across various business lines. Example: underwriting risks in the motor, fire, and personal property businesses of a property/casualty insurer. Level 2B ACROSS RISK TYPES. Risks span different risk classes within the same business entity. Examples: market risk, credit risk, and underwriting risks for any insurer; mortality and longevity risks for a life insurer. Level 3 ACROSS ENTITIES AND REGIONS. Risks run across different legal entities or business units in multiple regions and are subject to fungibility considerations. Source: Standard & Poor's. 102. This section focuses on level 2A and 2B diversification across risk types and on level 3 diversification across entities, where we also address capital fungibility issues. 103. Diversification within risk types is either implicitly captured through the assumed distribution of individual risks or explicitly captured if included in the same dynamic model. As such, level 1 diversification is captured in individual risk benchmarks. Consequently, we do not discuss level 1 extensively in this section. 104. S&P; Global Ratings analyzes the approach that an insurer applies to model interdependencies, and, perhaps more importantly, the insurer's ability to articulate the rationale behind the approach. 105. Given what we view to be a significant uncertainty in model and parameter selection, we generally consider the insurer's testing and validation processes as an important aspect in diversification modeling. We analyze how an insurer tests for interdependencies, recognizing that in some cases, observed data tend to be scarce, limiting the credibility of such tests and validation. We

analyze how risk parameters are modeled as random variables or how parameters may be selected to overstate rather than understate risk interdependencies. 106. We view capital fungibility as an important constraint when insurers quantify diversification. We examine whether the insurer has appropriately considered regulatory or other constraints limiting the fungibility of capital across legal entities. 107. a. Methodology.S&P; Global Ratings generally scores a diversification modeling approach as: "Basic" when an insurer considers interdependence partially or generically through a high level correlation matrix, with little or no empirical justification. "Good" when an insurer applies empirically derived dependency assumptions to determine interdependence among major risk drivers, for example by using Gaussian copulas or a correlation matrix. These are calibrated to tail correlations using stress scenarios, with such scenarios capturing all the most significant dependencies and fungibility of capital between the insurer's relevant businesses or investment entities. "Superior" when an insurer estimates economic capital using a set of fully-integrated stochastic models with joint distributions to integrate exposures or a copula approach (for example, the "T"-copula approach) that adequately captures tail dependencies. In addition, insurers we score as having a "superior" approach perform extensive scenario testing (including stress scenarios) to capture complex dependencies--such as dynamic policyholder behavior--and fungibility of capital between the insurer's relevant business or investment entities. 108. We generally score approaches to capital fungibility to be: "Basic" if an insurer adopts a "one-balance-sheet approach," implying that when one part of the insurer's business is stressed, capital from another unit could be used to support the stressed business, without justification or support. "Good" if an insurer applies conservative or otherwise appropriate fungibility restrictions. For instance, an insurer could require that each of its separate entities meet its own regulatory minimum solvency level. "Superior" if an insurer's ECM includes the requirement that (i) each of its regulated entities meets its minimum stand-alone capital adequacy on a regulatory basis, after considering an appropriate level of regulatory intervention (as a result, it is likely the modeled target capital will exceed the absolute regulatory minimum) or any pre-agreed reputation limit on capital adequacy to carry on normal business; (ii) liquidity restrictions appropriately reflect the type and quality of the insurer's assets in which capital is invested and are a gauge of their relative liquidity and marketability following stress (e.g. the transfer may require the sale of assets or the release of margins; the proceeds might not be available immediately); (iii) in cases where excess capital is necessary to be moved from one entity to support another, the insurer provides an analysis of the plan for its transfer, an accompanying analysis of the "costs" of transfer (including tax and other frictional costs), and an analysis of the source and anticipated timing of liquidity; and (iv) in cases where an entity is assumed to be sold, the insurer provides an evaluation of the timing and cost of the sale, consistent with the stress scenario in which the sale occurs. 109. b. Data quality.We generally score approaches to data quality as: "Basic" when an insurer uses limited data that do not represent adequately tail dependencies. "Good" when an insurer uses external and internal data from a range of sources to capture dependencies at a variety of confidence levels, including tail dependencies. We analyze the insurer's procedures for the cleaning and interpolation or extrapolation of data. "Superior" when an insurer uses particularly extensive internal and external data and includes credible statistics on the interdependencies being modeled. 110. c. Assumptions and parameterization.We generally score approaches to assumptions and parameterization as: "Basic" when an insurer bases key assumptions on normal dependencies and may adjust them at will. "Good" when an insurer's assumptions include tail dependencies implied by data, assuming appropriate data are available. In some cases, the insurer adjusts for known deficiencies in the data. We analyze the extent to which these assumptions take into account expert opinions and management's view. "Superior" when, in addition to the above, the insurer adjusts data for known deficiencies, such as the different behavior of dependencies in extreme scenarios, compared with scenarios closer to the mean of the distribution. 111. d. Process and execution.We generally score approaches to process and execution as: "Basic" when an insurer applies an assumed correlation matrix when determining capital needs for individual risks (e.g. interest rates), while any fungibility constraints are considered using only high level adjustments outside the individual risk models. "Good" when an insurer models dependencies using a simplified technique that aggregates the results of individual risk models. Under a "good" approach, fungibility constraints applied in the model are detailed but done outside the individual risk models. "Superior" when the insurer simultaneously (during

the main stochastic run) considers dependencies between all major risk drivers with minimal manual intervention. Furthermore, under a "superior" approach, fungibility constraints are supportable and taken into consideration in the ECM. 112. e. Testing and validation. We generally score approaches to testing and validation as: "Basic" when an insurer has not validated its assumptions relating to the fungibility of capital and assumes a single economic balance sheet with no restrictions to capital mobility. A "basic" score also implies that the insurer will not have tested applied dependencies and correlations with techniques such as "goodness-of-fit." "Good" when some validation of fungibility is considered, though unintended consequences may not have been fully explored. "Superior" when the insurer fully validates its assumptions relating to the fungibility of capital and tests dependencies using appropriate statistical techniques. APPENDIXES APPENDIX 1: Modeling Market Risk 113. One of the ways S&P; Global Ratings uses the term "market risk" is to describe the potential economic losses of insurers deriving from financial market conditions. When evaluating an insurer's ECM, we analyze how the ECM identifies and accounts for the various market risks that might affect the insurer. In particular, we analyze how the ECM treats an insurer's assets, liabilities, and hedge instruments in light of possible market changes. More specifically, we analyze how the ECM models potential portfolio losses caused by systemic macroeconomic factors, market variables, and as a consequence of the insurer's asset and liability portfolio's composition. 114. We also analyze how an ECM's market risk modeling integrates with its modeling of liquidity, credit, and insurance risks. For example, we expect that an ECM's treatment of an annuity contract involves not only its modeling of market risk but also of lapse and mortality risks. We evaluate market risk by analyzing the ease (in terms of timing and volume) with which a hypothetical liquidation of the asset portfolio to pay amounts due under the annuity could be executed under a market scenario. 115. Certain risks, such as credit migration risk (single-name risk) or systemic spread movement are not, as a matter of industry practice, consistently classified as either credit risk or market risk. Under our analysis, an insurer's ECM could treat these risks as a component of either market risk or credit risk, but not both. Methodology 116. We generally score an insurer's approach to market risk as: "Basic" when it models market risk drivers and assesses them stochastically in conjunction with other risk drivers, while applying a generic correlation matrix with non-empirically-derived coefficients. The ECM might not capture all material market risks. For example, higher order measurements of interest rate risk (for instance, vega or gamma) or equity risk might not be captured or would be grouped into broad categories or "buckets." The ECM, for example, would evaluate market risk by aggregating risk attributable to components (for example, interest rates, foreign exchange rates, and equity prices) by applying a simplified approach, such as the variance-covariance technique using a correlation matrix. A "basic" approach also likely assumes an arbitrary distribution to derive applied market movements based on observations over a given period for the actual or proxy market variables applied as risk drivers. The ECM relies more on estimated sensitivities and uses assumptions of linear risk or price movement. Lastly, although the insurer might analyze potential market illiquidity, the ECM's modeling of market risk capital does not integrate liquidity risk. "Good" when it estimates correlation coefficients empirically, models market risk drivers stochastically, and analyzes all major risk drivers. In a "good" methodology, the insurer employs a stochastic process that evaluates risk interdependence while modifying the dependency structure for extreme market scenarios. The insurer may also employ other techniques such as stress testing to determine capital adequacy in extreme scenarios. In addition, under a "good" approach, the risk bucketing is fairly granular and covers all major market drivers. S&P; Global Ratings analyzes whether the insurer evaluates the liquidity of hedge instruments or financial assets and integrates such analysis into its ECM model. "Superior" when it models risk drivers' dependency through a market-derived dependency structure, when it runs a more extensive range of risks and extreme events than under a "good" approach, and when it employs a stochastic process and analyzes the simultaneous movement of market risks. In a "superior" approach, insurers apply techniques, where relevant, using a varying dependency structure involving various market risk drivers allowing for extreme event contagion. In a superior approach, the insurer addresses material correlations among market risks, including sector correlations, which realistically reflect extreme market movements to mitigate possible limitations in assumed distributions. Also, the insurer models nonlinear price movements, if applicable, for its assets, liabilities, and hedging instruments. The model captures material components of market risk drivers

measured at material points along the relevant term. The ECM may also supplement its analysis of market risk by including the consideration for liquidity risk based on an assessment of the time necessary to close or adjust risk under different market conditions according to the insurer's internal risk policies and the size and positions relative to the market size. Lastly, the ECM analyzes market risk in a diversified and undiversified fashion and allows for decomposition by magnitude and source of risk. 117. S&P; Global Ratings analyzes the approach used for the following market risk components: 118. Interest rate risk modeling.We generally score an insurer's approach to interest rate risk modeling as: "Basic" when in modeling the yield curve, the ECM involves modeling interest rate movements at limited points on the yield curve. The primary focus of such modeling would be to capture yield curve "shifts," or measures of the degree to which a curve has moved upward or downward, in parallel, across all maturities. Under a "basic" approach, the ECM analyzes only lower order components of interest rate exposures and does not comprehensively capture basis risk or measure component exposures. "Good" when it uses additional techniques, such as principal component analysis, to identify and calibrate additional yield curve risk factors, such as unparallel yield curve shifts. A "good" approach reflects major component exposures but does not comprehensively model basis risk. "Superior" when it incorporates a full-term structure framework to fully model these relevant yield-curve risk factors across the entire curve. A "superior" approach minimizes model risk, and comprehensively reflects component exposures, as well as spread movements at the most relevant points along yield curves. It also considers the effect of interest rate movements on insurance liabilities. 119. Equity risk modeling. We generally score an insurer's approach to equity risk modeling as: "Basic" when the model does not fully analyze extreme equity movements (for instance, the models assume a distribution for equity returns that does not have fat tails). In addition, these models likely do not attempt to capture basis risk reflecting differences between movements in the actual portfolio and a modeled index, if applicable. Under the "basic" approach, the insurer models miscellaneous equity holdings, including certain minority interests in companies and private equity holdings, by applying charges as percentages of the portfolio value. "Good" when the model generally captures the potential for extreme equity movements and analyzes basis risk, though perhaps not comprehensively. Miscellaneous equity holdings are assessed based on models that use observable proxies. "Superior" when the model is based on more sophisticated techniques to model equity exposure (such as modeling the stochastic volatility of equity returns) than those found in a "basic" or "good" approach. Under the "superior" approach, when modeling miscellaneous equity holdings, an insurer uses proxies but reflects in the model the basis risk between the actual holdings and the proxies used. 120. S&P; Global Ratings generally analyzes the methodologies used to model other market risk drivers, if it deems these risks to be significant in an insurer's ECM. Some examples are foreign exchange rates, commodity contracts, and real estate modeling, among others. When evaluating methodologies for modeling foreign exchange rate (FX) risks, S&P; Global Ratings analyzes the spot and forward FX rates in an insurer's model, with underlying yield curve models based on interest-rate parity assumptions. When evaluating methodologies for modeling commodity risks, S&P; Global Ratings analyzes the approach insurers use to determine commodity prices based on structural macroeconomic models. When evaluating the methodologies for modeling real estate, we analyze the approach to estimate capital for real estate replacement value, with underlying assumptions not only based on historical data, but also through measuring the variability of real estate value risk drivers (such as macroeconomic variables) simultaneously with other financial and nonfinancial risk drivers. Assumptions and parameterization 121. We generally score an insurer's assumptions for market risk as: "Basic" when it assigns static values to risk drivers or generally assumes that such values follow an arbitrary distribution. A "basic" approach is also generally characterized by the insurer grouping its portfolios into generic classes without assessing potential basis risk. "Good" when it empirically estimates risk drivers' parameters, while assuming they will follow generic distributions without back testing. In a "good" approach, insurers group their portfolios into generic classes, with basis risk assessed, and also assess their risk drivers' possible tail dependencies. "Superior" when it assumes that risk drivers follow market derived distributions and it estimates risk drivers empirically using techniques such as maximum likelihood and moment-matching, among others, while also assessing its risk drivers' possible tail dependencies. In a "superior" approach, the insurer also analyzes the amount of data used (including a focus on

frequency, reliability, stability, and capturing of extremes). A key difference between "superior" and "good" assumptions, in our view, is the robustness of procedures used to derive the assumptions for variables for which available market data are somewhat limited. 122. Regardless of scoring, S&P; Global Ratings typically analyzes an insurer's modeling assumptions to determine the extent to which they reflect the insurer's concentration limits, stop-loss limits, limits on position types. One characteristic of a "basic" score could be that the model assumes that price or market value movements behave in a linear manner, while approaches we score as "good" or "superior" assume that the price movements of many financial instruments are nonlinear. Characteristics of a "basic" approach could involve the model assuming that covariance remains stable as markets move, while under a "superior" or "good" approach, the model might capture the expected movement. In a "superior" approach to liquidity issues, the model might make assumptions on the timing of asset sales as well as taking into account the size of positions relative to the size of the market. Data quality 123. We generally score an insurer's data quality as: "Basic" when the insurer relies on asset data generically grouped into buckets based on similar characteristics (for example, corporate bonds rated 'AA'), or proxy data (meaning index data used to represent mutual fund exposure), which may not have been vetted or adjusted, as appropriate. "Good" in cases where the insurer has applied what we view as reasonable assumptions to adjust for missing data due to a lack of market observations (for example, an absence of long-term interest rates). In situations where full or partial data on specific market risks are not available, we may also review techniques used to create proxy data. In scoring an insurer's approach to data quality as "good," we evaluate the processes it uses to validate market data, the methods it employs to construct the term structure of interest rates and relevant volatility surfaces, the techniques it uses to evaluate and cleanse data to minimize the impact of erroneous data, and the methodologies it employs to address missing data points (including the use of robust interpolation or extrapolation techniques). Historical data span time horizons supported by testing and justified effectively by management, and include specific scenario data relevant for stress testing for the most significant risks. "Superior" when we observe all the features of a "good" approach, described immediately above, and in addition it incorporates, in our view, systematic data quality control processes and appropriately executed internal reviews. It also includes specific scenario data relevant for a broad range of stress testing. Process and execution 124. We generally score an insurer's approach to process and execution as: "Basic" when it models market risk as a stand-alone risk, calculating capital for individual market risk drivers. "Good" when it models market risk together with other financial risks and then aggregates them with nonfinancial risks. "Superior" when it models market risk events with other risks during the main stochastic run, based on a market-implied dependency structure. Testing and validation 125. We generally score an insurer's approach to testing and validation as: "Basic" when it back-tests parameters but does not stress test portfolio losses. "Good" when it back-tests risk drivers (but not correlation structure or parameters) and portfolio losses against stressed scenarios. "Superior" when it back-tests risk drivers with historical data of, in our view, appropriate lengths, back-tests risk correlation structures and parameters with historical data, and stress tests extreme predicted portfolio losses at high confidence levels. APPENDIX 2: Modeling Credit Risk 126. In our evaluation of an ECM's approach to credit risk, we analyze the extent to which credit risk controls and mitigation techniques such as absolute and relative concentration limits, underwriting standards, guarantees and credit derivatives may, in our opinion, affect the risk profile of an insurer. 127. We also recognize that certain types of credit exposure and the related loss severity may change based on movements in the financial or insurance risks that underlie such contracts. In our opinion, the magnitude or degree to which certain credit risk mitigation strategies offset modeled exposures may be directly linked to movements in underlying market variables. Accordingly, we analyze the credit risk portions of ECMs not only in the context of the methodology insurers use for simulating or applying the frequency and timing of defaults, but also in the context of how ECMs capture loss severity, given default. Along the same lines, we evaluate the methodology used to scale credit quality and the techniques used to link this methodology with the frequency of default. In addition, we analyze methodologies for evaluating the interrelationship between default frequencies for various exposure types. Methodology 128. Our scoring is based on our opinion of the methodologies used in the following components, if applicable. 129. Inclusivity.We generally score an insurer's approach as: "Basic" when it only captures default risk and loss given default (LGD). "Good" when it also largely

captures the risks relating to credit quality migration. "Superior" when it fully captures the risks relating to credit defaults and credit quality migration. 130. Default risk. We generally score an insurer's approach as: "Basic" when it measures default risk by applying the frequencies and timings of defaults to obligors, counterparties, and other credit exposures based on multidimensional factors (for instance, tenor and credit rating). "Good" when it assigns default probabilities to obligors and counterparties based on cohort assumptions, such as internal or external credit ratings, which the insurer would adjust based on the obligor's risk characteristics and market conditions individually, among others, with appropriate risk differentiation. "Superior" when the insurer supplements the estimates of default probabilities with additional market information (for instance, equity value volatility, bond option-adjusted-spreads, and credit default swap spreads). 131. Default correlations.We would likely score an insurer's approach as: "Basic" when it applies fixed, average, or identical and unstressed or simulated probability of default to all exposure types without analyzing correlations and factors such as seniority, initial credit quality, or sector and risk mitigation. "Good" when it uses stressed or average probability of default based on historical data, including analysis of correlations with other credit risk drivers under highly stressed scenarios. "Superior" when the probability of default is modeled simultaneously with other credit risk drivers, including correlation structures capturing tail dependencies, and taking into account the effects of such factors as seniority, initial credit quality, or sector and risk mitigation. 132. Recovery risk and LGD. We generally score an insurer's approach as: "Basic" when it applies fixed, average, or identical LGDs for all asset classes and debt seniorities without stressing or simulating changes to them. "Good" when it uses stressed or average LGDs based on historical data, including analysis of correlations with other credit risk drivers under very stressful scenarios. "Superior" when it applies LGDs modeled simultaneously with other credit risk drivers and with correlation structures capturing tail dependencies. Under a "superior" approach, the insurer might also analyze the effects of risk mitigation (for instance, collateral values captured dynamically to address asset price volatility, and correlations with exposures, either through exposures at default {EAD} or LGD) and debt seniority. 133. Credit exposures and EAD.We generally score an insurer's approach as: "Basic" when it measures credit risk using exposures or EAD assumed to be a function of balance sheet carrying values or notional values. "Good" when it applies EAD based on historical data together with a process that identifies risk exposures, particularly under stressful scenarios. "Superior" when it applies simulated or stressed EAD modeled simultaneously with other credit risk drivers, while applying correlations that capture tail dependencies. A "superior" approach might also capture the impact of risk mitigation techniques (e.g., collateral provisions) dynamically. 134. Credit quality migration risk.We generally score an insurer's approach as: "Basic" when it assesses credit quality migration risk as a fixed percentage of capital or EAD, or does not assess this risk at all. Under a "basic" approach, an insurer might assume credit risk drivers with static values and assume such drivers follow an arbitrary distribution without back-testing. In addition, an insurer might assume that credit exposures are infinitely granular and perfectly diversified without analyzing concentration risk. "Good" when it assesses credit quality migration risk using short-term market movements (as part of a VaR model based on normal or empirical distribution assumptions). Under a "good" approach, an insurer may also empirically estimate credit risk drivers but under the assumption they follow generic distributions without back-testing, with only partial analyses of risk concentrations. We would expect it to consider any changes in the interrelationships of the drivers under stressful scenarios. "Superior" when it empirically captures the likelihood and severity of downgrade risk based on historical transition probability matrices and spread data, among others, with appropriate correlations. In addition, the insurer's model would assume that risk drivers follow distributions calibrated to historical observations and implied statistics, and it empirically estimates those using appropriate statistical techniques, in addition to capturing risk concentrations, including single-name, geographic, industry segment, and asset class exposures, correlations, and tail dependencies. Assumptions and parameterization 135. We generally score an insurer's approach as: "Basic" when credit risk drivers have static values or if the insurer assumes these drivers follow an arbitrary distribution without back-testing. Under a "basic" approach, the insurer might assume that its credit portfolios are infinitely granular and perfectly diversified. "Good" when it estimates credit risk drivers empirically, while assuming they follow generic distributions without back-testing. Under a "good" approach, risk concentrations are only partially

captured. We would expect it to consider any changes in the interrelationships of the drivers under stressed scenarios. "Superior" when it assumes that risk drivers follow distributions calibrated to historical observations and implied statistics, and it estimates these drivers empirically using appropriate statistical techniques, in addition to capturing risk concentrations, correlations, and tail dependencies. Data quality 136. We generally score an insurer's approach to data quality as: "Basic" when it "buckets" applied data or uses proxy data without quality control, or it collects historical data used to generate key risk driver data without characteristic information. "Good" when its data are portfolio-specific with associated characteristic information appropriately classified. Under a "good" approach, the insurer's risk rating system may also differentiate credit exposures by default risk and loss severity. In addition, the time period to which the data pertain may include at least one severe economic or credit downturn. "Superior" if the approach has all the features of a "good" approach, as outlined immediately above. In addition, under a "superior" approach, the insurer may implement systematic data quality control and review processes. The time period to which the data pertain should include several severe economic or credit downturns. Furthermore, the insurer's system of ranking credit quality may differentiate "credits" by their potential for default and their loss severity and the insurer may integrate material external data sources into its overall data system. Process and execution 137. We generally score an insurer's approach to process and execution as: "Basic" when it models credit risk as a stand-alone risk without a stochastic generation process and it adds measured capital to the aggregate capital charge. "Good" when it models credit risk together with simulated movements in financial market risks and then aggregates the results with nonfinancial risks. "Superior" when it models credit risk events (e.g., defaults and migrations) with other risks during the main stochastic run, if applicable, based on a market-consistent correlation structure. Testing and validation 138. We generally score an insurer's approach to testing and validation as: "Basic" when it back-tests certain but not necessarily all parameters and back tests historically observed losses in stressed environments. "Good" when it back-tests the risk drivers and also considers the correlation structure or parameters, or both of these, while testing portfolio losses against significantly stressed scenarios. "Superior" when it back-tests risk drivers with historical data of appropriate lengths and coverage while also back-testing risk correlation structures and parameters with historical data and stress-tests extreme predicted portfolio losses at high confidence levels. APPENDIX 3: Modeling Insurance Risk Mortality risk 139. Mortality risk arises from the deviation between actual mortality rates and those expected in pricing and reserving. The importance of mortality risk to insurers depends on their product offerings and benefit structures. Most permanent and term life insurance products contain material mortality risk as do many health insurance products and annuities in payment. In our view, saving or unit-linked policies with no death guarantees could also be affected by second-order mortality risk effects such as future profit losses. Finally, the impact of a huge mortality deviation--such as from a pandemic--could go beyond life insurance, due to the possible interactions it may have with market, lapse, and operational risks. 140. In assessing mortality risk modeling, S&P; Global Ratings analyzes an insurer's modeling sophistication, data credibility, and the exposure granularity of the mortality module itself, its integration within the insurer's overall ECM framework, and the identification of the interactions it may have with the other modules. 141. Methodology.We generally score an insurer's approach to modeling mortality risk as: "Basic" when, in our view, such modeling captures this risk adequately. However, we assume an insurer bases its modeling on assumptions of aggregate or high-level-granularity rates of mortality applied to total exposure-at-risk or volume exposures (specifically loss ratios on premiums or capital charges on reserves), including an allowance for extreme events through an additional mortality charge. Under such an approach, reinsurance may be captured through a justifiable reduction of claims. "Good" when, in our view, it includes a more refined approach to capturing the range of possible cash flow outcomes arising from mortality risk and, where appropriate, capturing the possibility of extreme events, for example, pandemic, terrorism and natural catastrophes. Under a "good" approach, the insurer may employ stochastic valuations, particularly to value the most severe mortality causes, using simulation techniques to allow for full distribution of the risk. In addition, the insurer may value reinsurance or other risk mitigation techniques consistently with the modeling of gross exposures, including, among others, appropriate allowances for incidence rates, severities, and deductibles (health insurance), varying retention limits, reinstatement costs, and

accumulation covers. "Superior" when it includes highly granular modeling of material risk drivers, taking into account trend risk, the possible change in volatility compared to historical levels, and, where appropriate, the possibility of extreme events, for example, pandemics, terrorism, and natural catastrophes. Under a "superior" approach, the insurer may use stochastic mortality projections for all material risk drivers; it may employ Monte Carlo simulation models that allow for path dependency when a multi-year approach is used. Also, the insurer may employ an underlying distribution function that appropriately reflects tail mortality risks with its approach complemented with scenario-based simulations backed by an appropriate scenario identification process and comparison with the extreme outcomes from Monte Carlo simulations. Under a "superior" approach, the insurer's projections may integrate industry- and entity- specific features, such as events in areas of risk concentrations, and the effectiveness of risk management initiatives designed to mitigate such concentrations. In addition, the insurer's modeling process may integrate the effect of all forms of reinsurance and other risk mitigation techniques along with changes in underwriting standards. 142. Assumptions and parameterization.We generally score an insurer's approach to developing mortality assumptions as: "Basic" when its models analyze rationales for underlying assumptions, such as underlying probability distribution. Under a "basic" approach, the insurer's model may not explicitly identify the different layers of mortality rates (for instance, it may not split extreme mortality assumptions between general deviation and deviation stemming from pandemics or other causes). Furthermore, the insurer's assumptions may not include the underlying portfolio's experience; rather, the assumptions could be based mostly on industry mortality tables. In the case of multiyear models, under a "basic" approach, the insurer may use a path-dependent model for future simulations of mortality rates. "Good" when the insurer includes an allowance for its own experience in setting risk assumptions as supported by a sufficiently detailed past claims database. "Superior" when it employs a model fed by highly granular assumptions that extensively rely on the insurer's own experience, while appropriate and documented industry assumptions are applied to new products or generations of products lacking past experience. Under a "superior" approach, the insurer's assumptions may rely on historical data adjusted for known information and allowing for future possible changes (e.g., population mortality improvement or changes in underwriting procedures) mainly if the insurer uses a multiyear approach. 143. Data quality.We generally score an insurer's approach to data quality as: "Basic" when it "buckets" exposure data (for example product, exposure levels, age, and sex). Under a "basic" approach, the portion of business not modeled may remain limited; the insurer may document any possible effects and scale up results based on volumes. Under a "basic" approach, data may capture nuances of the insurer's claims history. "Good" when it takes a more granular approach to data grouping. Under a "good" approach, the insurer may have multiple grouping criteria going beyond those we score "basic," avoiding data grouping or simplifications that could result in unsupported risk offsets. Under a "good" approach, data may reflect the full exposure, leaving business not modeled at a nonmaterial level and scaling up the results appropriately. Under a "good" approach, the granularity of data used to derive the assumptions may be suitably detailed with statistics on cause of death, geography, and population type. In addition, the insurer's data may reflect the insurer's current exposure. "Superior" if in our view it encompasses data grouping of high but credible granularity, reflects material risk drivers, and avoids artificial diversification and risk offsets that a less granular grouping may imply. 144. Process and execution.We generally score an insurer's approach to process and execution as: "Basic" if its mortality model is an integral part of the ECM. Under a "basic" approach, an insurer bearing minimal mortality risk relative to its counterparts may run the mortality module separately from the whole capital model, and aggregate back the results while ensuring adequate coverage of material dependencies. Under a "basic" approach, the insurer's model may allow for the effect of mortality risk on future cash flows (that is, the possible cross subsidies between risks), though with a simplified approach. "Good" if its mortality model is integrated into the ECM and captures material direct dependencies (for instance, morbidity risks in group contracts) and material indirect dependencies (for example, the effect of mortality deviation on longevity assumptions). "Superior" if its mortality model is integrated into the ECM, and if its execution processes are in our view better documented with fewer manual operations than seen in a "good" or "basic" approach. Under a "superior" approach, the insurer models all dependencies. Compared with approaches we score as "good," a "superior" approach may provide for the addition and documentation

of material impacts on financial or operational risks. 145. Testing and validation.We generally score an insurer's approach to validation and testing as: "Basic" when it conducts minimum testing and validation for its mortality model, including back testing against actual claim counts and amounts or "as-if" testing with past extreme events or high mortality losses. "Good" when it conducts a reasonable range of testing on the results of the model, including back testing, scenario testing (for instance, "past events" testing, real-world scenario identification, and testing against the model's worst outcome), and potential changes in reinsurance costs and mortality bonds as appropriate. Under a "good" approach, the insurer may provide some form of reconciliation with existing extreme mortality bonds. "Superior" when it demonstrates a wide range of testing and validation. Under a "superior" approach, an insurer may include sensitivities to assumptions, a multiple real-world, scenario-based comparison, back testing, and reconciliation with existing extreme mortality bonds. Longevity risk 146. In S&P; Global Ratings' view, analyzing longevity risk is central to the assessment of insurance products where policy terms specify guaranteed or minimum annuity payments (for instance, immediate annuities, structured settlements, and guaranteed minimum income benefits). Insurers writing these products are, in S&P; Global Ratings' opinion, exposed to the possibility that policyholders may live considerably longer than expected and that ensuing payouts would substantially exceed expected payout amounts. 147. Methodology.We generally score an insurer's approach to longevity risk as: "Basic" when it bases its model on generally available mortality data while using some stress testing. "Good" when it combines relevant industry and insurer-based mortality experience. Under a "good" approach, a model may include considerations based on fitting an appropriate distribution of risk to the insurer's assessment of both best-estimate and extreme longevity. In addition, given the wide range of alternative longevity models, we view as sound practice the analysis of several modeling approaches and appropriate analysis of their impact on results. We consider as "good" the use of stochastic models as they can, in our opinion, better reflect the inherent uncertainties of future longevity. Under a "good" approach, insurers may take into account the latest industry and actuarial approaches, including Lee-Carter, P-Spline, and "cause of death" based models. "Superior" when the model is granular and is based on the stochastic behavior of base mortality and mortality improvements. We note, though, that the relative volatility of longevity experience will be a function of the size of the modeled population. Under a "superior" approach, the model may allow for parameter risk and shock improvements, such as a cure for cancer. Under a "superior" approach, the insurer may factor in most alternative modeling approaches and analyze their impact on results. 148. Assumptions and parameterization.We generally score an insurer's approach to assumption setting as: "Basic" when it uses standard mortality assumptions with only limited tailoring. "Good" when it uses a range of approaches to tailor industry tables to its own experience and specific portfolio characteristics. Under a "good" approach, an insurer may take into account recent academic and actuarial research for setting its mortality improvements. "Superior" when it analyzes its own experience extensively and analyzes the impact of a wide range of alternative approaches, particularly with regard to mortality improvements. 149. Data quality.We generally score an insurer's approach to data quality as: "Basic" when its capital modeling only takes into account the age and sex of policyholders. "Good" when it bases its ECM calculations on policy data that incorporates an extensive range of risk factors, particularly items that capture health and socio-economic characteristics of policyholders, including zip codes of residence and occupation, when available. Under a "good" approach, an insurer may use extensive and relevant past data to derive its assumptions. Under a "good" approach, an insurer may use robust procedures to clean data from "walking dead," (annuitants who have died whose deaths have yet to be reported). "Superior" when the insurer demonstrates how well it captures the health and socio-economic characteristics of its policyholders. 150. Process and execution.We generally score an insurer's approach to process and execution as: "Basic" when it models longevity separately. "Good" when it incorporates longevity risk in its ECM, reflecting dependencies with other risks, particularly mortality. "Superior" when it allows for more complex dependencies (including for instance catastrophe events and financial risks). 151. Testing and validation.We generally score an insurer's approach to testing and validation as: "Basic" when the validation's main focus is the comparison with standard industry assumptions. "Good" when it performs what we consider to be extensive sensitivity and scenario testing on alternative modeling approaches. Under a "good" approach, an insurer may compare its results and underlying assumptions

with those of its peers and with the latest applicable academic and industry research. "Superior" when it performs what in our view is a particularly extensive analysis of results. Morbidity risk 152. Morbidity risk generally arises in insurance products that cover losses stemming from accident, sickness, or disability, including: Disability income (group and individual); Medical care/hospitalization (group and individual); Long-term care and Medicare supplement policies (in the U.S.); and Specialty products, such as cancer or critical illness policies. 153. Coverage generally takes the form of separate policies or riders to other products, such as life insurance. 154. Methodology. The pattern of claim payments for morbidity coverage differs considerably from that of life insurance coverage. Depending on coverage, a single loss can result in payments for months or years, and, in the case of disability, over 30 or more years. We review the methodology an insurer chooses to assess its consistency with the relevant products and whether it accounts, in our view, for the products' key characteristics. 155. Because morbidity-related losses are frequently ongoing in nature and may last many months or years, many insurers frequently analyze loss adjustment expenses (LAEs) along with claim costs. Insurers account for LAEs in their methodology either as part of their expense assumptions or as integrated into their morbidity assumptions. In our review, we will analyze whether LAEs have been appropriately considered, not how they been classified. 156. We generally score an insurer's approach to morbidity risk as: "Basic" when it uses simple loss and expense ratios for all coverage, both group and individual. "Good" when it models individual products using product specific loss and expense ratios, summary data, or industry data. Under a "good" approach, an insurer may consider management discretion with respect to policy rate increases. It considers reinsurance at a summarized level. "Superior" when, in addition to the characteristics mentioned above for a "good" approach, the insurer's products use credible insurer experience and granular claim costs (where appropriate), taking into consideration product characteristics and insurer demographics. Under a "superior" approach, an insurer's health modules in actuarial projection systems may be used, where appropriate, rather than spreadsheets. Under a "superior" approach, an insurer's material reinsurance treaties may be reflected consistently with their terms. 157. Assumptions and parameterization.We generally score an insurer's approach to assumption setting as: "Basic" when its assumptions are product specific but do not analyze all material benefit structures and geographic and demographic differences, including basic claim cost assumptions for individual medical coverage that do not vary by age or geographic region. "Good" when it takes into account what we view as material structural, geographic, payment patterns, and demographic differences. Under a "good" approach, the insurer may base its assumptions on industry data supported by actual insurer data. "Superior" when it considers the material structural, geographic, payment pattern, and demographic differences to account for age, sex, coverage, and duration (where appropriate), as well as inflation for medical care costs. Under a "superior" approach, the insurer may use assumptions based on credible relevant insurer experience. Under a "superior" approach, the insurer may take into consideration interdependencies such as economic trends, claims patterns, and rate increases. 158. Data quality.We generally score an insurer's approach to data quality as: "Basic" when it takes into account source information at only a general level, such as loss ratios for medical products. "Good" as its base data increase in granularity, such as by product structure, age, and duration, and as its own data become more credible, for instance through including more exposure years. "Superior" when the base data are sufficiently granular so as to be analyzed by all risk factors and we consider that there is a credible volume of data. 159. Process and execution.We generally score an insurer's approach to process and execution of the morbidity model as: "Basic" when it runs the morbidity model separately from other parts of the ECM and aggregates the results while ensuring adequate capture of material dependencies. Under the "basic" approach, in some jurisdictions (particularly with respect to group health coverage written in conjunction with mortality risk, meaning group life and health packages), the model may allow for the effect of possible cross subsidies between mortality and health risks on future cash flows. "Good" when the model is integrated into the ECM and captures the most important interdependencies with other risks. "Superior" when the model is integrated into the ECM, captures all material interdependencies, has a fully documented process of execution, and has fewer manual operations than a "good" or "basic" model. 160. Testing and validation.We generally score an insurer's approach to validation and testing as: "Basic" when it conducts minimum testing and validation for its morbidity model, such as back-testing against actual

claim counts and amounts or employing "as-if" testing with past extreme events or high morbidity losses. "Good" when it includes a wider range of testing on its morbidity risk model results, such as back-testing, scenario testing (including extreme scenarios), potential changes in reinsurance costs, and claim completion patterns, as appropriate. "Superior" when it employs a wide range of testing and validation (e.g., sensitivities to assumptions, a multiple real-world scenario-based comparison including extreme scenarios, back-testing, and consistency of sensitivity tests with past experience) to support the appropriateness of its assumptions. Lapse risk 161. In S&P; Global Ratings' opinion, different types of policies are subject to risks of surrender, lapsation, or expiry for different reasons. Furthermore, some products, such as deferred annuities and universal life, allow premium payment patterns that are at the discretion of policy owners. We review the approach the insurer takes to incorporate non-mortality-related policy and premium lapsation. 162. Methodology.We generally score an insurer's approach to its lapse model as: "Basic" when the model shows lapses based on best-estimate assumptions "per product" and "per policy year," while capturing the variability of lapses around best estimates through sensitivity and a limited number of stress scenarios. Under the "basic" approach, insurers may choose stresses so that the worst of higher- or lower-than-expected lapses are tested. "Good" when the insurer models best-estimate lapses with a higher granularity than per product and per policy year–for instance by distribution network--and uses a stochastic model with some extreme scenario analysis to capture the relationship between market conditions and policyholder behavior. "Superior" when the insurer models all sources of variability stochastically, including dependence on market conditions for business lines where there is strong evidence for links between lapse levels and market performance. 163. Data quality.In S&P; Global Ratings' experience, data quality on lapse risk depends on data granularity and the integrity of the systems used to collect them. 164. We generally score an insurer's approach to data quality as: "Basic" when only limited past lapse data with little granularity is available. "Good" when there is more extensive and detailed past lapse data. Under a "good" approach, the insurer may use external and industry-wide data, where such data exist, to support its assumptions. "Superior" when it validates data against records and makes adjustments for events it perceives as nonrecurring. 165. Assumptions and parameterization. We generally score an insurer's approach to assumption setting as: "Basic" when it bases best-estimate lapse assumptions on analyses of lapse experience per product and per policy year and years to maturity or expiry. "Good" when the insurer's assumptions consider additional variables such as distribution channel and funding level (for universal life policies) although extreme lapse levels might be based on a significant level of judgment. Under a "good" approach, the insurer may make adjustments in assumptions to account for known changes in experience due to changes in tax and regulations. When setting assumptions for extreme lapses, the insurer may also take into account industry wide experience, including, for example, lapse experience of distressed insurers. "Superior" when it links lapse assumptions to market performance, while robustly calibrating operational and credit risks. 166. Process and execution.We generally score an insurer's approach to process and execution as: "Basic" when it models lapse risk separately. "Good" when it incorporates lapse risk into the ECM and reflects dependencies with other risks, in particular market, expense, and operational risks. "Superior" when it allows for more complex market dependencies. 167. Testing and validation.We generally score an insurer's approach to validation and testing as: "Basic" when it conducts minimum testing and validation, such as back testing or as-if testing with past extreme events. "Good" when, in addition to the above, it compares assumptions for consistency with the experience of similar existing products and reconciles the results. "Superior" when it includes a range of testing on model results, such as back-testing and scenario testing (including past-events testing and testing against the model's worst outcome). Expense risk 168. S&P; Global Ratings observes that for modeling purposes, insurers classify expenses in broad categories including investment management costs, administration expenses, overhead or costs incurred at holding entities level, acquisition expenses and commissions, and claims handling expenses. 169. Methodology.We generally score an insurer's approach to expense risk modeling as: "Basic" when the insurer analyzes future administrative and management costs with an allowance for unit cost inflation and cost volume increases. Under a "basic" approach, an insurer may allocate overhead or other non-policy related expenses (head-office and holding-level costs) to the different businesses, or otherwise allocate them to the entity that generated them. Under a "basic" approach, the

insurer's expense modeling may be consistent with the model's general framework. In other words, if new business is modeled, it stands to reason that related future acquisition expenses should be considered for inclusion as well. Under a "basic" approach, an insurer's expense levels may be consistent with relevant indicators such as the number of contracts, premiums, and assets under management. Under a "basic" approach, an insurer may estimate expense deviations based on stress scenarios to include the incremental costs incurred in extreme situations. "Good" when the insurer includes more granular modeling of extreme events by identifying the sources of cost increases including those costs not reflected in past data and modeling them through dependencies with the other risks valued in the model. "Superior" when the insurer includes modeling expense types separately so as to capture future expense evolution and deviations, depending on relevant volume indicators. Under a "superior" approach, the insurer may allow for costs not reflected in past data but which the insurer could face in extreme scenarios. 170. Assumptions and parameterization.We generally score an insurer's approach to assumption setting as: "Basic" when its inflation assumptions are consistent with other economic assumptions used in the model. Under a "basic" approach, an insurer's other assumptions are aligned with its strategic planning and stress expense assumptions. Under a "basic" approach, an insurer may also explicitly include expense overruns (expenses not anticipated in pricing) and other nonrecurring costs. "Good" when its inflation assumptions (depending on the nature of its expenses) are more granular and it bases its assumptions on its own experience and cost structure. "Superior" when the insurer analyzes alternative approaches to inflation assumptions and includes other approaches to modeling economies of scale. Under a "superior" approach, a model may include management actions, such as charge increases or cost reduction initiatives. 171. Data quality.The main differentiating factors between different levels of scoring of an insurer's approach to data quality are, in our experience, the level of granularity, the period of time over which historical data have been collected, and the extent to which an insurer achieves consistency across historical data. 172. We generally score an insurer's approach to data quality as: "Basic" when it employs broad accounting categories such as administration, claims handling, investment management, or overheads. "Good" when it models costs based on its nature, for instance modeling IT and wage costs separately. "Superior" when it relies on a historic view of its incurred costs and uses relevant inflation data assumptions according to different expense types. 173. Process and execution.We generally score an insurer's approach to process and execution as: "Basic" when its model analyzes best-estimate cost provisions with limited sensitivity analysis. "Good" when, owing to the dependencies between expenses and other risks, the insurer's model captures material dependencies. "Superior" when its model identifies and models the insurer's full set of dependencies and other relevant risks. 174. Testing and validation.We generally score an insurer's approach to validation and testing as: "Basic" when the insurer's model includes a reconciliation of modeled expenses to financial statements, and documents differences between modeled figures and accounting figures. Under a "basic" approach, an insurer may also test baseline figures against its business plan. "Good" when the insurer's model includes a wider range of stress tests including extreme scenarios, including testing the reasonableness of unit cost increases. "Superior" when the insurer's model includes a reconciliation of extreme cost outcomes with its continuity plan cost budgets. Under a "superior" approach, such testing may also include testing by specific expense type. Underwriting risk 175. Underwriting risk is the risk that the premiums charged for unearned business together with the premium to be charged for prospective business may be insufficient to cover losses experienced and expenses incurred from these exposures. It is particularly relevant for P/C insurers. For life and health insurers and reinsurers, we consider this risk within the contexts of mortality and morbidity. 176. In S&P; Global Ratings' opinion, there are three main sources of uncertainty surrounding underwriting risk: Business to be written, including volume and assumed exposures, composition and mix, premiums generated, and retained versus ceded risks; Future losses and payments, including deviations from expected levels and the timing of future cash flows; and The effectiveness of any risk transfer programs, such as reinsurance. 177. Methodology.We generally score an insurer's approach to modeling underwriting risk as: "Basic" when, in our view, it employs a number of material simplifications and as such may not capture the key risks and uncertainties. For example, an insurer could build the underwriting projections from its historically observed loss ratios instead of capturing the trends in premiums and loss frequencies and severities. Also, it may project the amount

and types of business to be written and the associated premium rates using deterministic assumptions. S&P; Global Ratings expects these assumptions to be consistent with the forecasts in the insurer's business plan. In order to capture the effect of risk mitigation, a "basic" methodology may project losses net of any risk mitigation or apply a simple cession ratio to calculate any recoveries. A "basic" approach may use deterministic payout and loss-development patterns to estimate payments and reserves from the projected losses "Good" when the model captures key underlying risks and associated uncertainties and when methodological simplifications do not, in our view, weaken the model's functionality. While we recognize simplifications may be necessary to overcome data or technical limitations, under a "good" approach, these should not materially affect the overall ECM results or weaken the model's use in decision making. A methodology we score as "good" may project a deterministic central scenario for exposures and associated premiums, as per the "basic" methodology. At the same time, it also evaluates the risks arising from variations to the business plan through sensitivity analysis. These projections may encompass changes to the business mix and attempt to realistically assess future business writings gross and net of reinsurance. A "good" approach may model losses stochastically using separate projections for future attritional and large claims. For expedience, the insurer may model attritional claims using a single distribution for loss ratio or cost per unit of exposure while estimating the large claims using distributions for frequency and severity. However, under this framework we still expect the methodology to retain any dependency between small and large claims. Under a "good" approach, the insurer may integrate known and emerging trends affecting the frequency and severity of losses into the loss trends while exercising prudence in recognizing positive trends. Any one-off events that would materially affect the insurer's profitability, such as changes in legislation, may be incorporated through adjustments to the parameters. S&P; Global Ratings expects a "good" methodology to consider the most significant dependencies, namely those between the various lines of business, and with some macro-economic factors (such as claims inflation, interest rates, and exchange rates). In order to capture the effect of risk mitigation, a "good" methodology may project any future reinsurance programs and reflect the underlying properties of the protections, albeit with some simplifications that do not materially affect the outcome. A "good" approach may attempt to model the effect of the reserving process and use payout and loss development patterns to estimate the payments and reserves from the projected losses. "Superior" when the insurer applies methodologies that are sophisticated enough to reflect the risks inherent in the entity, enable a realistic assessment of their capital needs, and facilitate a wider range of strategic decision making. Under a "superior" approach, such methodologies may include the features of a model we consider "good", while stochastically projecting and retaining the interaction between the business volumes, types of policies to be written, and the premium rates for that business. A "superior" approach models the underlying claims trends stochastically and retains dependence with the claims' trends affecting other lines of business and any macro-economic factors. The exposure, premium, and loss projections may be linked to economic scenario projections and may also be linked to macro-economic effects such as GDP and insurance penetration and may capture the importance of emerging risks. The model considers any factors that may affect the pricing of any risk mitigation and all of its features, such as the variability in coverage for different perils, reinstatement and adjustment premiums, and any indexing of limits. A "superior" approach may attempt to model the effect of the reserving process and use stochastic earnings, payout and loss development patterns to estimate the payments, and reserves from the projected losses. 178. Data quality.We generally score an insurer's approach to data quality as: "Basic" when it collects and maintains historical loss and policy data, including regular loss-valuation updates enabling paid and incurred loss development analyses, encompassing data from the acquired and divested businesses. We expect the insurer to update loss valuations at least quarterly. "Good" when, in addition to the above, it includes alternative development scenarios for large open claims, for instance, minimum expected and maximum ultimate-loss scenarios. The insurer validates and cleans the data used to populate and set parameters for its ECM by checking for reasonableness and reconciling to actuarial studies and financial statements. If an insurer's own data are not sufficient, it could use external data sources to supplement internal data, including external benchmarks or proxies to help compensate for insufficient data. We expect the insurer to extract data used for estimating the relevant assumptions and parameters from data systems

with minimal manual intervention. "Superior" when, in addition to the properties of a "good" approach, the claims and policy database has the functionality to retrieve and reconcile data in different formats, including individual-loss listings, loss counts, and aggregate losses by homogeneous lines of business. We expect database coding to reflect coverage terms, including retentions, cover limits, and currencies. In addition, the insurer's premium-volume and exposure data could be mapped to loss-data groupings. Any data may be supplemented by published expert analyses of insurance market cycles, claim-cost trends, exposure inflation, and other historical patterns, along with emerging trends. 179. Assumptions and parameterization.Insurers derive model parameters from assumption-adjusted loss and exposure data. In our view, there is inherent uncertainty in the selection of these assumptions and parameters. 180. We generally score an insurer's approach to assumptions and parameterization as: "Basic" when it employs certain assumptions and parameters while not taking into account uncertainties regarding their selection. Under a "basic" approach, assumptions may integrate current conditions, views, opinions, and anticipated trends, and be supported by research or expert opinion, and be consistent with assumptions applied elsewhere in the ECM. The model uses assumptions and parameters selected by third parties without internal validation or "ownership" by the insurer. "Good" when it employs a set of assumptions and parameters that it selects so as to not understate the insurer's risk and capital needs. The insurer may apply stress to these assumptions and parameters to capture any material effects on the modeled output from variability around their selection. We expect the insurer to understand the differences and sensitivities in the modeling assumptions and approaches used in any third-party models and assume "ownership" of the controllable assumptions and parameters used in these models. "Superior" when its calibration and population of its underwriting risk model focuses on uncertainties arising from assumption and parameter selection. An insurer could present some assumptions as random variables, if values are highly uncertain and their variance significantly affects model results. Under a "superior" approach, parameters may be based on an estimation method that captures extreme outcomes, while the most critical assumptions and parameters may be supplemented by model runs with alternative parameter sets (see testing and validation below). 181. Process and execution. Paragraph 60 provides an overview of general process and execution principles that we would consider as applicable to modeling of underwriting risks. 182. Testing and validation.We generally score an insurer's approach to testing and validation as: "Basic" when, in our view, it reasonably reconciles model outputs with historical loss experience, underwriting/pricing estimates, and financial/business plans. A "basic" approach may also show consistency between the model outputs and the ultimate liability projections derived from loss-reserve models. "Good" when it includes alternative assumptions and parameters and tests their impact on overall ECM results (for instance, their effects on solvency and profitability indicators). We also expect the insurer to test emerging profit and loss against the output from the model and reconcile it to management's understanding of recent experience. Under a "good" approach, the insurer distributes key output from the model to relevant areas of the business to check the results. For example, the relevant underwriters validate output showing losses at various confidence intervals. Lastly, we expect to observe testing of output from any third-party models to quantify the differences arising from applying various options and assumptions. "Superior" when it uses sensitivity analysis to identify selected methodologies and parameters that could materially affect the outcome of the ECM. In addition, the insurer then attempts to reduce model risk by further refining the model's calibration (by benchmarking against an external data source), building into the model the uncertainty stemming from parameter selection, and presenting "what if" model runs based on alternative sets of assumptions. Under a "superior" approach, the insurer seeks expert (internal or external) opinions to validate the reasonableness of particularly severe underwriting-loss and event-contagion scenarios that models may generate. The insurer analyzes the effect of insufficient or inaccurate data on the model. Reserving risk 183. Loss reserves for many P/C insurers and reinsurers tend to be the largest source of uncertainty in their balance sheets. A loss reserve is an estimate of funds needed to be held in order to meet all claims arising from policies written in the past. The ultimate amount of these future payments is usually unknown and can be highly uncertain. We will review the methodology used, the historical accuracy of estimates, and the manner in which the methodology is built into the modeling processes used. 184. Any liabilities resulting from new business will be recognized on future balance sheets, for example on the balance sheet as of a

year from now. The risks to the future balance sheet from the new business are analyzed in the underwriting risk section of this article. 185. Methodology.A number of methodologies may be used to recreate the period-to-period development of incurred and paid losses in a stochastic manner. Modeling approaches to reserve risk may vary by line of business and often depend on the availability and robustness of data. We review both the methodology and data used for appropriateness in the course of our analysis. 186. We generally score an insurer's reserving-risk methodology as: "Basic," when it extrapolates a probability distribution from a small number of estimates, such as the projected "best estimate" and an adverse-development scenario. With that, we expect these "intuitive" stochastic models to be sufficiently conservative and unlikely to underestimate the worst-case outcomes. All significant lines of business in the insurers' liability profiles are modeled stochastically, with conservative correlation assumptions. "Good," when the insurer bases its methodologies on stochastic modeling of reserves and uses its own loss-development history, split by homogeneous business lines. Under a "good" approach, we expect the extreme outcomes that the selected model generates to be consistent with loss-development scenarios for known large claims. A "good" approach takes into account existing reserving and claims practices and anticipated policy changes. In addition to modeling all significant lines of businesses, "good" approaches may also allow for potential new types of claims and latent claims such as asbestos and environmental (A&E;) exposures. A "good" methodology considers reinsurance recoverables and addresses counterparty risk in these recoverables. "Superior" when the model has all the characteristics specified in the "good" category and is, in our view, sufficiently detailed and sophisticated to assess the insurer's targeted capital, while also enabling other decision-making functionality (for example, evaluating pricing strategies, product, business, and geographic mix, and reinsurance purchases). Under a "superior" approach, an insurer may use external data to obtain a broader view of potential outcomes. The insurer may have considered modeling gross reserves and net reserves to analyze reinsurance strategies, and capital adequacy effects. In addition, a "superior" methodology may reflect observed and emerging regulatory, socio-economic, claim-cost trends, potential under-pricing of future businesses, key interdependencies of reserving risk across main business lines, links with the macroeconomic scenarios generated by the economic scenario generator (ESG), and counterparty (reinsurance) risk, among others. In addition, a "superior" methodology models gross and net losses and explicitly accounts for counterparty risk. 187. Data quality. We generally score an insurer's approach to data quality as: "Basic" when the insurer collects and maintains historical loss and policy data, including data from the acquired and divested businesses, it updates loss valuations at least quarterly. We expect that the insurer checks all data used to populate and parameterize an ECM model for reasonableness and reconciles it to actuarial studies and financial statements. "Good" when, in addition to the above, it includes development scenarios for large losses, for instance, minimum, expected, and maximum ultimate-loss scenarios. The corresponding claim-cost assumptions and underwriting terms are also stored along with claims data for more refined analysis. "Superior" when its claims and policy database captures relevant details, including regular loss-valuation updates, occurring at least quarterly and enabling paid- and incurred-loss development analyses; exposure details, and any changes, such as geography, limits, retentions, and other coverage terms; and assessment of alternative development scenarios (including worst-case scenarios) for the largest open claims. Insurers may also collect relevant external industry data, including external benchmarks or proxies, if available, to help gauge period-to-period loss-development volatility; published expert analyses of claim-cost trends, regulatory changes, and other developments, along with emerging trends. 188. Assumptions and parameterization. We generally score an insurer's assumptions and parameterization as: "Basic" when it employs certain assumptions and parameters while not taking into account any uncertainties regarding their selection. Under a "basic" approach, assumptions may be timely, and may integrate current conditions, views, opinions, and anticipated trends, be supported by research or expert opinion, and be consistent with assumptions applied elsewhere in the ECM. "Good," when in addition to exhibiting the characteristics of a "basic" approach, it employs a reasonably conservative set of assumptions to set parameters for the reserving risk model. We expect the economic parameters to be consistent with the parameters in the ESG. Additionally, the uncertainty in parameter selection may be explicitly recognized by calibrating certain parameters as random variables. Under a "good" approach, the insurer may base parameters

on an estimation method that captures extreme outcomes, and as such focuses on the tails of the distributions. The most critical assumptions and parameters may be supplemented by and compared with alternative parameter sets (see testing and validation below). "Superior," when in addition to displaying the characteristics of a "good" approach, the insurer links the parameters in the reserving model to the outputs of the ESG. More specifically, the parameters for claim-cost inflation may be linked to the ESG-generated inflation, while valuation of the reserves on the projected (future) balance sheet may be performed under the ESG-generated discount rates. Compared with the focus on the tail under the "good" approach, the insurer under a "superior" approach focuses on the entire distribution and considers all possible modeling aspects. 189. Process and execution.Paragraph 60 of this article provides an overview of general process and execution principles that we will apply to the modeling of reserving risk. 190. Testing and validation. We generally score an insurer's approach to testing and validation as: "Basic" when it reconciles model outputs with historical loss experience, underwriting/pricing estimates, and financial/business plans. A "basic" approach may also show consistency between the model outputs and the ultimate liability projections derived from loss reserve models. "Good" when it includes alternative assumptions and parameters, testing their impact on overall ECM results (for instance, their effects on solvency and profitability indicators). Under a "good" approach insurers may seek expert opinions to validate the reasonableness of particularly severe reserving loss and event-contagion scenarios that models may generate. "Superior" when the approach has all the characteristics of a "good" approach and the insurer uses sensitivity analysis to identify selected methodologies and parameters that could materially affect the outcome of the ECM and then attempts to reduce model risk by further refining the model's calibration (for example, by benchmarking against an external data source), and presenting "what if" model runs based on alternative sets of assumptions. Catastrophe risk 191. S&P; Global Ratings defines catastrophe risk as the risk that a single event, or series of events, of major magnitude, usually over a short period, leads to a significant deviation in actual claims from the expected claims. 192. S&P; Global Ratings notes that unless explicitly excluded, catastrophe risks have traditionally been an integral part of the overall underwriting risk of an insurer. Therefore, all criteria previously outlined in the underwriting risk section of this article also apply to the modeling of catastrophe risks. However, we have developed additional expanded criteria for catastrophe risk modeling because of its significance for many insurers and to recognize the material analytical advancements made in this field in recent years. 193. S&P; Global Ratings observes that life and health insurers typically forecast catastrophe losses by analyzing their specific risks. For example, we view catastrophe life insurance losses such as those that might occur as a result of an avian flu epidemic as a sub-risk under mortality risk. Insurers typically handle catastrophe considerations for P/C coverage in a separate analysis. For this reason, we only address P/C catastrophe risk in this section. 194. Methodology.We generally score an insurer's approach to catastrophe risk modeling as: "Basic" when, in our view, it employs a number of simplifications, and as such may not capture the key risks and uncertainties, or the instances where the insurer relies on output taken from a third-party model without any adjustments to allow for the insurer-specific risk profile. When an insurer does not consider the effect on all lines of business that are exposed to catastrophe risk, we would likely score the methodology as "basic." "Good" when catastrophe loss information is generated from an external catastrophe model, where available, with any adjustments when the standard models do not reflect the key risks and uncertainties. The methodology also considers catastrophe risks that vendor models do not cover, such as U.S. non-coastal floods, and those catastrophe claims that do not arise from natural perils, such as the aggregation of casualty claims. The methodology may capture the key features of any risk mitigation in place. "Superior" when the methodology has the characteristics of a "good" methodology, along with more customized adjustments and in-house-developed models. S&P; Global Ratings notes that insurer-specific catastrophe scenarios may not be fully captured by industrial software. Under a "superior" approach, the insurer may confirm differences in the modeling assumptions and approaches from standard third-party models. Under a "superior" approach, these models may analyze and test "rippling effects," such as demand surge, while also taking into account integrated scenarios, such as a catastrophe combined with insolvency of a reinsurer, or the simultaneous occurrence of natural and man-made catastrophes. 195. Data quality.For how S&P; Global Ratings assesses an insurer's approach to data

quality, please refer to the underwriting risk modeling section (paragraphs 174-181). However, we believe that the accuracy and completeness of exposure data is especially important for the modeling of catastrophe risk. In evaluating catastrophe risk, we look to see that projected exposure data are detailed, tested for accuracy, up-to-date, and supplemented by robust assumptions where data are missing. 196. Assumptions and parameterization, testing and validation, and process and execution.We apply the criteria outlined in the underwriting risk modeling section. Due to the dependency on models provided by third parties for the modeling of catastrophe risk, S&P; Global Ratings will pay particular attention to how an insurer validates that the selected models and methodologies best capture the risks and uncertainties of their business. APPENDIX 4: Modeling Operational Risk 197. There is no universally accepted definition for operational risk in the financial services industry. Insurance groups with banking subsidiaries are likely to have adopted most of the Basel II definition of operational risk (see "International Convergence of Capital Measurement and Capital Standards – A Revised Framework, Basel Committee on Banking Supervision," June 2006). It includes the risk of loss resulting from inadequate or failed internal processes, people, and systems, or from external events, while including legal risk but excluding strategic risks. In our opinion, a robust enterprise-wide ECM would need to cover all material risks. When an insurer's definition of operational risk excludes material risks such as reputation risks, we seek to ascertain whether the insurer models and assesses these risks as a risk type other than operational. However, we apply our operational risk model criteria when assessing these risks. 198. In addition, we note that because of the nature of operational risk and the various practices that insurers commonly implement, we take into account in our analysis our view of an insurer's assumptions, granularity, and the validation process, when evaluating whether we would qualify a given methodology as "basic," "good" or "superior." Methodology 199. We generally score an insurer's approach to operational risk modeling as: "Basic" when it adopts a "factor-based" approach. Such insurers would thus assess their capital as a percentage of a relevant risk indicator, such as total capital or premiums written. "Good" when it models operational risk loss frequency and loss severity or operational risk yearly losses using a stochastic framework, while considering loss mitigants (for example, through insurance written by an unrelated insurer). "Superior" when it stochastically models loss frequency, loss severity, and effectiveness of controls, analyzes appropriate loss mitigants, and allows for model or basis risk to account for possible inaccuracies of the modeling approach for major risks. Under a "superior" approach, the insurer may analyze not only the direct financial impacts that may arise when an operational risk materializes, but also the reputation and strategic impacts and consequently any additional resulting costs that may be incurred. Insurers could address these various impacts through analysis that fully maps causes to effects so as to capture all potential interactions. Assumptions and parameterization 200. We generally score an insurer's approach to assumption setting as: "Basic" when it demonstrates the calibration of operational loss severity data fitted to a log-normal distribution, with little if any challenge to such assumptions. In addition, insurers may use loss frequency data to estimate probability of single events. The results could then be used to calibrate a factor-based approach where applicable. "Good" it calibrates severity to a fat-tailed distribution, while calibrating frequency to a distribution that allows multiple events. "Superior" when it assesses the quality of its internal controls for each major loss event, in addition to the calibration described above under a "good" approach. Data quality 201. We generally score an insurer's approach to data quality as: "Basic" when it uses only industry data. "Good" when it conducts internal workshops to identify operational risk loss frequency and severity, and maintains an internal database of loss history. "Superior" when it collects historic internal loss data and "sense checks" them through internal experts, while taking its loss data from a number of cross-referenced sources to ensure consistency. These sources may include external loss databases containing industry losses, as well as internally collected losses, information regarding internal assessment of quality and effectiveness of internal controls, and evidence of internal workshops identifying the impact and likelihood of events. Process and execution 202. We generally score an insurer's approach to process and execution as: "Basic" when it models operational risk as a stand-alone risk, represented by a percentage of other risk capital. "Good" when it meets the standards for a "basic" score, while encompassing testing of scenarios including operational risk events. "Superior" when it models operational risk events with other risks during the main stochastic run, addressing scenarios including the testing of operational risk

events. Testing and validation 203. We generally score an insurer's approach to testing and validation as: "Basic" when it does not validate its results. "Good" when it compares its operational risk capital with industry losses and standards (for instance percentage of premiums). "Superior" when it compares its operational risk capital with industry losses, in turn compared with senior management's assessment of risks, and when it uses these comparisons to assess operational risk capital against scenarios of possible events. APPENDIX 5: Examples Of Model Documentation And Materials 204. At the start of our ECM review, we provide a Request for Information (RFI) form to companies. The RFI requests samples of the detailed financial, actuarial, and systems documentation that support an insurer's ongoing maintenance and quality control of its ECM. In general, much of the information we request should be available from an insurer's existing model documentation materials. Although most of the RFI will be common to all reviews we conduct on the insurers we rate, we generally will also address specific items that reflect an individual insurer's situation. 205. In addition, the RFI asks for any financial materials pertaining to an insurer's capital model that have been presented for regulatory review. For example, in the U.K., where the Prudential Regulation Authority (PRA) has been reviewing internal capital models, we ask to review any materials submitted to, and responses from, the PRA (subject to any confidentiality restrictions). 206. We will likely refine the items in our RFI over time, as we complete reviews of insurers. 207. The key information we request in our RFI covers an insurer's: ECM set-up; ECM validation and control processes; Asset valuation; Liability valuation; Risk modeling; Diversification and aggregation; Risk mitigation activities; Scenario testing; and ECM results. 208. To assess an insurer's ECM set up, we request: The description of modeling tools it uses to develop its ECM, which should, in our view, include external as well as internally developed tools. The approach, the key decision-makers involved, and the decision-making process for setting assumptions, model parameters, and for approving methodology changes. The description of key risk measures produced by the model, why they are appropriate to the business, and how they are calibrated (where appropriate). To evaluate an insurer's ECM validation and control processes, we request: The description of processes it uses to recommend, assess, and implement changes in the ECM when it updates methodologies, data, assumptions, and parameters. The provision of a full reconciliation to previous results when assumptions or approaches have changed, which should, in our view, detail the impact of each change. Results of any reconciliation to other externally reported information (for example, accounting information). Data reconciliation to data used for accounting purposes. The description of checks made to ensure the accuracy of the grouping process, when the insurer groups individual contract data for modeling processes. Other validation processes. 209. To assess an insurer's approach to asset valuation, we request: Comprehensive descriptions of the framing assumptions, data, methodologies, and accounting paradigms it uses to value all assets. Reconciliation to existing accounting or regulatory valuation for asset values (meaning a comparison of the economic view of the value of assets and the accounting or regulatory view of the value of assets). 210. To evaluate an insurer's approach to liability valuation, we request: A detailed description of the assumptions, data, and methodologies it uses to value all liabilities. Reconciliation to existing accounting or statutory valuation, or both where applicable, for liabilities. 211. To analyze an insurer's risk modeling, we request: A detailed description of the approach it uses to estimate liability risks in its model, namely methodologies used, assumptions set, and data required. A detailed description of its approach to estimate asset risk in its model, namely methodologies used, assumptions set, and data required. Detailed descriptions of its approach to estimate all other risks allowed for in its model (for instance, operational risk), namely methodologies used, assumptions set, and data required. A comprehensive description of any management or policyholder actions assumed within the model. 212. To assess an insurer's diversification and aggregation, we request: A detailed description of the interactions of risk drivers that could have a substantial impact on the model, including information on the methodologies, assumptions, and data used. A breakdown of the impact of the various levels of diversification, for instance between risk types and between operations (life assurance and nonlife assurance), and on geographic locations. A description of the methods it uses to assess its ability to move excess capital from one entity or country to another in a time of stress (capital fungibility). 213. To review an insurer's risk-mitigation activities, we request: A description of how reinsurance structures are allowed for within the model (including the impact of delays in payment or disputes). Details on any

other risk-mitigation activities allowed for within the model (for instance, hedging strategies or the use of insurance-linked securities). 214. To analyze an insurer's stress and scenario testing, we request: A detailed description, including results for any additional stress and scenario tests not covered above. We request information on the purpose of these tests and how the insurer arrived at and agreed on parameters for the tests. 215. To analyze an insurer's model results, we request: Detailed reports that the insurer uses to validate its model's results. Copies of any final reports and presentations of results, as submitted to the insurer's risk committee and to its board of directors. 216. This paragraph has been deleted. REVISIONS AND UPDATES This article was originally published on Jan. 24, 2011. Changes introduced after original publication: Following our periodic review completed on Aug. 20, 2015, we updated the contact information. We also updated the descriptors of the key rating factors and related subfactors and replaced references to archived criteria to align with the current applicable related criteria. We deleted the last two sentences of paragraph 43 because they were superseded by the article titled "Enterprise Risk Management," published on May 7, 2013. We updated chart 2 because it was superseded by the chart depicting the insurance ratings framework in the article titled "Insurers: Rating Methodology," published on May 7, 2013. Following our periodic review completed on Aug. 19, 2016, we updated the contact information, updated criteria references, and deleted outdated sections in paragraphs 7, 24, and 25, which were related to the initial publication of our criteria and no longer relevant. We also deleted the list of "Related Research" articles that appeared at the end of this article, given that these articles were published in 2006 and 2007. Following our periodic review completed on Aug. 11, 2017, we updated the contact information. Following our periodic review completed on Aug. 3, 2018, we deleted Appendix 6 ("Responses to Standard & Poor's Request for Comment and Main Changes to Proposed Criteria") because it pertained to the initial publication of our criteria and was no longer relevant. On July 1, 2019, we republished this criteria article to make nonmaterial changes in connection with the publication of "Insurers Rating Methodology" (IRM). Specifically, we deleted outdated text and noncriteria text from paragraphs 10, 12, 27, 28, 29, 30, 33, 38, 40, and 42, and we made minor changes and clarifications to the text, including updates to charts 1 and 2, in order to align these criteria with the IRM and aid transparency. We also updated the relevant criteria references. On Sept. 21, 2020, we republished this criteria article to make nonmaterial changes to update the contact information. On Sept. 23, 2021, we republished this criteria article to make nonmaterial changes to update the contact information. RELATED CRITERIA AND RESEARCH Related Criteria Insurers Rating Methodology, July 1, 2019 Principles Of Credit Ratings, Feb. 16, 2011 Refined Methodology And Assumptions For Analyzing Insurer Capital Adequacy Using The Risk-Based Insurance Capital Model, June 7, 2010 These criteria represent the specific application of fundamental principles that define credit risk and ratings opinions. Their use is determined by issuer- or issue-specific attributes as well as S&P; Global Ratings' assessment of the credit and, if applicable, structural risks for a given issuer or issue rating. Methodology and assumptions may change from time to time as a result of market and economic conditions, issuer- or issue-specific factors, or new empirical evidence that would affect our credit judgment.