Article Title: ARCHIVE | Criteria | Insurance | Specialty: Guide To Rating Insurance-Linked Mortality Catastrophe Bonds Data: (EDITOR'S NOTE: —This article is no longer current. It has been superseded by "Methodology And Assumptions For Insurance-Linked Securitizations," published Nov. 19, 2018.) 1. Mortality catastrophe bonds (MCBs) are a relatively new tool to enable insurers to transfer extreme mortality risk to the capital markets. Under the transactions, investors purchase notes with principal and interest payments that are exposed to the risk of adverse mortality experience of a portfolio of lives. Insurers issue MCB to protect themselves from extreme mortality risk, generally pandemic risk, but the transactions also protect issuers, to an extent, from terrorism events and significant adverse changes in mortality trends. 2. This article describes the structure of typical deals, the modeling of the mortality risk, and the methodology Standard & Poor's Ratings Services applies to rate these transactions. Life Insurance And Mortality Risk 3. Mortality risk--the risk that an insured will die sooner than statistically expected--is typically borne by insurers. The insurance or reinsurance company will therefore sustain a loss if mortality increases to a higher rate than expected, causing the company to pay out a specified death benefit amount (or to pay out earlier than expected for whole-of-life contracts), without receiving premium payments for as long as it expected when it calculated the insurance premium. 4. If the increase in mortality is due to an epidemic or another mass mortality event (such as a natural catastrophe or a terrorist attack) then the resultant deaths could generate sizeable financial losses for insurance companies, and could even threaten regulatory solvency. Insurers are directing more resources to mortality risk because of recent significant mortality events, the heightened industry discussions on pandemic risk, and increased regulatory focus on extreme events. 5. Insurers' options for managing mortality risk have historically focused on imperfect hedging within insurance portfolios (through the issuance of annuities) or on purchasing reinsurance from a third party. Counterparty credit risk could reduce the effectiveness of the reinsurance option, however, particularly as extreme mortality events could affect reinsurers and insurers simultaneously). Both options are also affected by the effectiveness of the hedge and the availability and price of reinsurance. 6. Insurers developed MCBs to address some of these concerns. They allow insurers with large mortality exposure to transfer the risk of higher-than-expected mortality experience on part of the insured portfolio to the capital market. Investors holding the notes can achieve some diversification in their investment portfolio (due to the low correlation of mortality with traditional financial investments) and purchase relatively high-yielding bonds. Structural Overview 7. A special-purpose exempted vehicle (SPV) is established with shares issued typically held in a trust for charitable purposes. The SPV enters into a counterparty contract with the insurance company to provide the company with protection against specified extreme mortality experience. The SPV issues MCBs to investors and holds the funds raised in a collateral trust, invested in permitted investments to cover obligations arising out of the counterparty contract. 8. Normally, the issuing insurance company also pays the SPV's upfront and ongoing expenses, either through additional floating payments from the counterparty or through a separate reimbursement agreement. 9. Depending on the structure of a transaction, the MCB can contain different classes of notes with varying levels of mortality risk. The issuer can then obtain more comprehensive risk coverage and investors can purchase notes of varying risks and return. Each tranche of the MCB issuance contains the same pool of lives (identical geographical, age, and sex distribution) but the tranches contain varying amounts of mortality risk and so expose principal to varying risk of loss at different rates of mortality. Mechanics of the MCB 10. Issuers also specify the depth of the mortality coverage in each tranche, that is, the difference between the attachment points and exhaustion points (the point at which all the principal would be paid to the insurer under the counterparty contract). 11. Under the counterparty contract, the SPV must pay the insurance company if a certain attachment point (or trigger level) has been reached. The attachment point is determined through the use of a deal-specific mortality index, weighted by country, age, and gender. The issuing insurer specifies the index, which, for parametric deals, is usually constructed to minimize basis risk by attempting to replicate the underlying insured portfolio. Significant basis risk remains, however, as it is highly unlikely that the mortality of an insured pool of lives will be closely replicated by the experience of a population. In addition, the composition of the index is fixed at the outset of the transaction, but the mix of the insured lives at the issuer will change over the risk period. 12. The mortality index has to increase above an attachment point, in reference to a specified measurement period, for the notes to be written down. In

the deals Standard & Poor's has seen so far, the increase in the index has been averaged over a measurement period, typically two years, to smooth out any random events. Attachment points on rated transactions have ranged from 106% to 125%. In the first case, mortality increases in excess of 12% are required over the measurement period before principal is written down; in the second case, mortality would have to increase by 50% over the measurement period before principal is written down. 13. If the mortality index during any measurement period is greater than the specified trigger level for the respective class of notes, then the assets held in the respective trust are sold to fund the payment to the insurance company, and the principal amount of the notes is reduced. The principal is linearly reduced according to the level of mortality experience and the depth of the notes (that is, the exhaustion point, less the attachment point). All principal is lost if the rise in mortality is greater than the exhaustion point. Note that any event that causes the mortality index to exceed the trigger level, and principal to be reduced, will cause the rating on the notes to be revised to 'D', Standard & Poor's default rating. 14. Another party involved in the transaction is the calculation agent. This independent third party is usually responsible for performing the initial and ongoing modeling (after new data becomes available) and determining whether the mortality index has exceeded the notes' attachment point. The agent will document this in an event report it will send to the SPV, insurance company, and other relevant parties. 15. In the absence of a trigger or extension event, the SPV repays noteholder principal in its entirety on the scheduled redemption date. If the insurance company has the option to terminate the counterparty contract early, the notes can be redeemed earlier than the scheduled redemption date. 16. The expected time to maturity of the transactions Standard & Poor's has rated so far has been four to five years. The maturity of the notes may be extended, however, following a possible triggering event. This allows the relevant data sources to publish the necessary mortality data and for the calculation agent to perform an index calculation to determine whether a trigger event has occurred. Typically, notes extend in quarter-year intervals up to a maximum period (usually several years) following the scheduled redemption date. Usually, the coupon during the extension period will step down (see Appendix A: Frequently Asked Questions). Modeling 17. Modeling is critical to MCBs. Model risk is significant because of the limited data available for these deals. 18. Several modeling and actuarial companies offer extreme mortality modeling. A typical model comprises several separate components that analyze mortality trends in each country and the probability of occurrence, and potential impact, of a disease or a terrorism incident. The RMS Influenza Pandemic Risk model uses an alternative approach, in which epidemiologic modeling assesses the effect of a pandemic on populations. The RMS model analyses the spread of the disease and includes variables such as vaccination and immunity to model the spread and impact of the disease. As with other forms of insurance-linked securitization (ILS) transaction, Standard & Poor's will continue to examine each deal, and model, on a transaction basis. 19. The models used for these transactions include the following types of factors although the models differ in approach: Baseline mortality: a model that estimates the future trend in mortality by projecting from historic, country-specific mortality data. Data, typically for the last 25 years, is used to parameterize country-specific models that are then used to project mortality over the risk period of the transaction. For most developed nations, the trend in population mortality is for increasing longevity and we usually stress this annual reduction in mortality in rating these transactions. If the annual improvement rate is too high, then the risk of the notes triggering can be understated. Disease mortality: this is the most significant of the three models and is also subject to the greatest modeling risk. The modeling agency constructs a disease model based on the frequency and severity of past epidemics. Projections are made to determine if a disease occurs in a particular year and how significant the disease can be. Data is a significant issue for this model because of the limited number of diseases that have occurred and the lack of sufficiently detailed information (e.g., poor records of the impact of historic diseases). The data issue is further exacerbated because the data quality varies by country. As a result of these data problems, most transactions use U.S. mortality data for the disease model. Terrorism/aggression: this is usually the least significant of the models but, like the disease component, the projections suffer from a lack of historical data. Country-specific models project the number of fatalities from a range of scenarios. 20. A large number of scenarios are run to assess the effect of each factor and the results are combined into a mortality index. For parametric deals, the insurer specifies how the index should be constructed, using population data weighted by the

territory, age, and gender distribution. 21. Projections of mortality are rolled forward over the duration of the risk period and then divided into measurement periods (typically two years). A measurement period of several years means that the mortality events over the period must be greater, if the notes are not to lose principal, than if a single year's mortality was measured. Using a longer measurement period reduces the risk to investors by reducing the effect on the notes of small-scale events or a significant single event. 22. The modeling agency then determines the probability of attachment of the notes (the probability that the notes will be written down) over the lifetime of the transaction and then converts it into an annual probability of attachment. This attachment point may also be communicated as a minimum number of additional deaths over expected deaths in the measurement period. Significant Events 23. The published population data already takes into account the effect of historically significant events, so additional modeling for past events is not required for the baseline mortality. For example, the national statistics already include the impact of diseases (e.g., the 1918-1920 outbreak of "Spanish" influenza), wars, natural catastrophe events (such as the 2003 Asian tsunami), and terrorism (e.g., the events of Sept. 11, 2001). The modeling of future diseases is, however, separately analyzed under the disease section of the model. 24. Chart 2 shows mortality rates in the U.S. from influenza and pneumonia from 1900 to 1939 for four age bands. The chart illustrates both the severity of the 1918-1920 Spanish flu and the particular age bands most affected by the disease. Chart 2 25. Due to the extreme levels of mortality coverage under typical MCB, the notes would often not be triggered, even if a significant past event were to be repeated. For example, while events such as 20th century wars and the 1918 influenza epidemic caused large-scale fatalities, they would not usually trigger the higher tranches of notes, illustrating the remote levels of protection sometimes offered by these transactions. 26. Chart 3 illustrates the mortality for five ages, in England and Wales, from 1841 to 2005. The overall mortality trend is a decline that is particularly pronounced from the early 20th century onwards. The chart highlights the spike in mortality for the younger ages caused by the two World Wars. Despite these significant increases in mortality rates for the younger ages, MCB would not typically trigger for events such as these due to the spread of ages, and sexes, in the portfolios that insurers specify. Chart 3 Data 27. The mortality data is provided by official government agencies, government actuaries, or other recognized bodies. Transactions typically contain provisions that can be exercised if data is not produced by the required agencies to a certain standard within a specified time. The alternatives may include using draft data, switching to alternate data sources, or even winding up the transaction through an early redemption event. Standard & Poor's Rating Criteria 28. Due to the complex and changing nature of MCBs and the inherent risks they bring, Standard & Poor's uses a mixture of qualitative and quantitative techniques in estimating the mortality risk factor for these transactions. It is imperative that Standard & Poor's gains a thorough understanding of the risk modeling. 29. We can improve our understanding of the risks involved by stress testing single or multiple factors and by separately modeling components (such as the disease curve). 30. Standard & Poor's insurance analysts review the insurance component of the transaction, while structured finance analysts review all other aspects of the transaction. Standard & Poor's Stress Testing 31. Due to the differing features of each transaction, it is not possible to apply a standardized set of stress tests for all MCBs. However, Standard & Poor's stress tests in rated deals have included the following parameters: The incidence of diseases; The severity of diseases; The shape of the disease curve (that is, the relationship between the incidence of a disease and the resulting increase in mortality); The incidence of terrorism events; The severity of terrorism events; and The level of future mortality improvements 32. We apply stress tests to each class of notes to be issued. Depending on the risk characteristics, different stress tests may be required for each tranche. Stresses can be run as single or multiple scenarios (so several types of stresses from the above list may be run simultaneously). 33. In Standard & Poor's experience, the most significant risk for MCBs, and the greatest source of modeling risk, generally lies with disease risk and disease modeling. Terrorism has, so far, been the least significant factor for rated MCBs. Other risk factors taken into consideration by Standard & Poor's 34. Due in part to the significant model risk inherent in these transactions, Standard & Poor's also considers other risk features of the structure in rating these deals. These qualitative factors include: The number and geographic diversity of countries included: generally speaking, the more countries included in the index, the more diverse is the mortality risk, because of the reduced risk from a single event (such as

aggression/terrorism or a natural disaster). There is an argument, however, that the disease risk is only slightly reduced by diversification, due to the speed with which a pandemic could develop and spread in today's global market place. The insurer also selects the weighting of countries in the index (to replicate the insured portfolio) and applying higher weightings to countries with smaller populations can concentrate mortality exposure on a particular country's gender or sex mix. We also consider the volatility of the mortality experience. The lives included in the population: Standard & Poor's considers the extent of diversification by age and gender mix of the pools of lives. As the issuers typically aim to replicate insured portfolios, the lives are usually aged between 15 and 74, often with a higher weighting toward male lives. Influenza epidemics often affect the elderly, weak, or young children disproportionately. However, the 1918 H1N1 influenza strain caused an overactive immune system response in young adults, often referred to as a "cytokine storm." This resulted in an unusually high fatality rate in previously healthy young adults. The countries included: do the countries included have high quality healthcare, how prepared are they for pandemics, and do the governments have stockpiles of anti-viral drugs in place? We also consider whether the countries are judged to be at a higher risk from terrorism or natural disasters. The length and inception point of the risk period: Several deals have included a risk period that had already started when the deal was launched. While this makes the notes less risky, because a portion of the risk period has elapsed without a significant mortality event occurring, we attach limited credit to this risk reduction because mortality levels are not known accurately (mortality data generally lags experience by several years). 35. The above list, and stressed results, focus on the mortality risk factors that we consider as part of our analysis. In addition to these factors, the rating will also depend on the structure of the deal and whether any higher rated entities have made any guarantees. 36. The results of the stressed analyses, in combination with the other risk factors considered above, are compared to Standard & Poor's ILS default table (see "Default Table Used To Rate Insurance-Linked Securitizations Updated," published May 8, 2008) to determine the rating on the notes. 37. We review the rating on the notes on an ongoing basis, particularly when mortality data is published. Standard & Poor's capital model credit 38. MCBs issued to date have not received any credit in Standard & Poor's risk-based capital model because of the significant model risk in these transactions; the extreme nature of the risks being covered; the basis risk (for parametric deals); and the relative size of the transactions compared to exposure. 39. However, the issuance of MCB can be viewed positively from an enterprise risk management, liquidity, and financial flexibility perspective. Appendix A: Frequently Asked Questions Does a default event occur if there is an event notice that results in an extension beyond the scheduled maturity data that is combined with a coupon step down? A mortality catastrophe bond defaults when there is an extension due to an event notice beyond the scheduled maturity date when this is combined with a coupon step down. Although the security terms may allow for an event notice to extend the maturity beyond this date, it is a default because there is both an extension of maturity due to the event notice and the coupon is reduced, relative to the "at risk" period of the bond. This is consistent with paragraph 15 of "Rating Natural Peril Catastrophe Bonds: Methodology And Assumptions," published Dec. 18, 2013. Revisions And Updates This article was originally published on Sept. 11, 2008. Changes introduced after original publication: Following our periodic review completed on Jan. 15, 2016, we updated the author contact information, updated criteria references, deleted material that wasn't relevant to these rating criteria, and added an appendix. Following our periodic review completed on Jan. 12, 2017, we updated the author contact information, updated criteria references, deleted commentary, and numbered the paragraphs. Following our periodic review completed on Jan. 10, 2018, we updated the author contact information and criteria references and deleted the phrase "but not included in Chart 1" from paragraph 14. Related Criteria And Research Related Criteria Structured Finance: Asset Isolation And Special-Purpose Entity Methodology, March 29, 2017 Guarantee Criteria, Oct. 21, 2016 Principal Stability Fund Rating Methodology, June 23, 2016 Principles For Rating Debt Issues Based On Imputed Promises, Dec. 19, 2014 Global Framework For Assessing Operational Risk In Structured Finance Transactions, Oct. 9, 2014 Rating Natural Peril Catastrophe Bonds: Methodology And Assumptions, Dec. 18, 2013 Assessing Bank Branch Creditworthiness, Oct. 14, 2013 Methodology Applied To Bank Branch-Supported Transactions, Oct. 14, 2013 Use Of ‘C’ And ‘D’ Issue Credit Ratings For Hybrid Capital And Payment-In-Kind Instruments, Oct. 24, 2013 Counterparty Risk Framework Methodology

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