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Catastrophe Reinsurance and Bonds: Valuation and Optimum Mix

Carolyn Chang[1], Jack S.K. Chang[2], Min-The Yu[3]

[1] California State University, Fullerton, USA
[2] California State University, Los Angeles, USA; jskchangg@gmail.com
[3] National Chiao Tung University, Taiwan

Cat bonds are issued by a SPV (Special Purpose Vehicle), set up and sponsored by a (re)insurer, as a "pure play", i.e. the SPV is not an affiliate of the sponsor, but rather an independent reinsurance company whose sole purpose is to issue Cat bonds so as to provide the sponsor reinsurance protection against its traditional reinsurance obligations. The purpose of this research is to study how the supply and buy sides of Cat bonds can optimally mix them with their traditional reinsurance counterparts to arrive at an optimum external risk capital structure.

Cat bonds are designed with alternative triggers and event structures that do not necessarily synchronize with the sponsor's actual losses. Potential insurance payments by the SPV to the sponsor are pre-funded by the proceeds of the bond issue that are invested in a collateral account for a fixed return. Investors receive periodic interest payments reset to LIBOR plus a fixed spread as "premium". To immunize the interest rate exposure, the SPV typically enters into a TRS (total Return Swap) arrangement with a counter-party to exchange the fixed-return from the collateral account for floating payments of LIBOR minus a "spread" to match the payment schedule to the investor. Any shortfall, i.e. the premium plus the spread, are captured by the reinsurance payment made to the SPV by the sponsor.

In actual practice, Cat bonds and traditional reinsurance exhibit differential characteristics in their risk and transaction structures in additional to their differences in accounting, disclosure, regulatory and rating agency treatments. Traditional reinsurance can be customized to cover virtually any peril(s), region(s), or exposure(s). Cat bonds, being traded in capital markets, however generally lack the flexibility in defining specific risk coverage and terms, as they must be homogeneously termed to be investor-friendly, i.e. for easy analysis by investors in capital markets in relation to their own portfolios in modeling, documentations, etc., and thus are generally harder for underwriters to place. Traditional reinsurance has a one-year policy term, but Cat bonds are typically multi-year contracts with both advantages and disadvantages. The former being that they allow purchasers to lock in a single annualized premium for several years, which facilitates the insurer's insurance and risk management budgeting activities, and helps protect the insurer from the risk of hardening reinsurance markets. On the other hand, if reinsurance markets soften, insurers that have lock in multi-year coverage will be unable to realize cost savings. Some view the annual renewal process as costly and time-consuming and thus a drawback of reinsurance, yet reinsurance is a relationship-based business, and the renewal process itself is an important part of the information gathering process between

insurers, reinsurers, and their brokers. Over time, reinsurers can learn the risk appetite and exposure file of their repeated customers, better enabling them to anticipate the needs of their clients. Cat bonds, by contrast, are one-off trades in capital markets in which the sponsor and the investors do not necessarily have any on-going commercial relationship. The Cat bond sponsor thus gets no benefits from long-term repeat-business relationships with investors. In addition, securitization can be very costly and time consuming, e.g. the need to obtain rating for bond issues, the solicitation of counsel on legal, accounting, and regulatory matters, and the time spent on back office supports in risk modeling, documentation, disclosure, etc. Reinsurance however requires significantly less in all of the foregoing, and the brokerage and arrangement fees on reinsurance due to annual renewal are often no greater than the fees involved in a complex Cat bond structure. Finally, there are also differences in credit risk. For well-capitalized and highly-rated Cat reinsurers, insurers' exposure over credit risk is often minimal, but in a typical Cat bond structure, the counter-party of the TRS can be default-risky. The Cat bond issued by Willow Re and sponsored by All State is such an example, which went into default in February 2009 for not being able to fully meet its interest obligations when its TRS counterparty Leman defaulted. This counterparty risk is one major reason why the Cat bond market dried up during the sub-prime crisis.

Given the forgoing, we propose to adopt Merton's (1974, 1977) structural approach to model the balance sheet of the reinsurer with further incorporation of the dynamics of the fundamental variables to first value the contracts and then demonstrate how to optimally combine them in a way to achieve optimality in the (re)insurer's external risk capital structure. We first consider the supply side of the market consisting of those providers of catastrophe protection, e.g., reinsurers, and then the demand side, e.g. insurers. The Merton approach has the advantage of allowing us to link the valuation of financial claims to firm's assets and capital structure, and so as to endogenize default. Specifically, our structural model builds upon Cummins (1988), Duan, Moreau, and Sealey (1995), Duan and Yu (2005), and Lee and Yu (2007), to properly allow for the asset, liability, interest rates, and Cat loss dynamics.

We first consider, as the base case, a reinsurer who sells Cat event-linked XOL reinsurance policies in the (re)insurance market and in the same time sponsors and sets up a SPV to issue tailor-made Cat bonds in varying size, tenor, trigger, and event structure in capital markets as a "pure play". The reinsurer buys reinsurance policies with specific terms, e.g. a binary play, from the SPV to reshape its external risk capital structure and to extend its underwriting capacity. In other words, the reinsurer has a short position of traditional reinsurance as a call option spread with varying strike prices and a long position in a binary reinsurance as a binary call option in its external risk capital structure. Optimization in the option mix will be achieved at the point where the marginal benefit of additional Cat bond issuance in enhancing reinsurance premium and capacity is exactly offset by the marginal cost of the additional Cat bond issuance (see Chang, Chang and Lim (JRI, 2013) for a discussion on optimum hedge using a Cat product). We will then extend the analysis to include varying Cat bond structures as well as to the buy-side case of an insurer who purchases traditional reinsurance from reinsurers and in the same time sponsor a SPV to issue Cat bonds to minimize its cost of hedging.