

**Dr. Michel DACOROGNA**  
**Group Deputy CRO**  
**SCOR**

## **Adding Time Diversification to Risk Diversification, the Case for Equalization reserves for Natural Catastrophes**

*The business of insurance is based on a simple concept of spreading the risks endured by an individual amongst as large a group of persons as possible. As long as he can evaluate the expected loss with a reasonable accuracy, the insurer is able to ask for a price that will cover this loss, plus a premium to pay the capital he needs to set aside. This capital is provided to ensure the payment of loss up to a certain probability. Over the years the insurance business has prospered, and has become a central actor in the economies of developed countries. In the early thirties, mathematicians such as Kolmogorov or Fisher were able to explain successful mechanics of the insurance industry through the law of large numbers. In the last thirty years practitioners and mathematicians have come to recognize that certain risks do not follow the law of large numbers. Natural catastrophes are on such risk category. By nature, such events are of low frequency but high severity. In practice this means that most underwriting years will end up with few losses. However if a natural catastrophe does occur, the loss will probably be much higher than the expected value. In such cases the mathematical functions of expectation and variance do not always converge. The addition of one extra event will increase the value of both functions, even if their estimation was based on many years of previous event occurrence. Catastrophe risk is a difficult issue for insurers. The insurer wants to benefit from the high return this business can generate but does not want to pay the price of its very high volatility. The solution to this problem is to invest in a program that includes a certain form of savings during the years where the losses are benign. This allows the insurer to face the obligations when a big loss occurs, mitigating the high volatility catastrophe insurance, or even the need to raise new capital. This savings program is called "time diversification or equalization reserves" to differentiate it from existing capital. The difference between equalization reserves and capital is twofold: there will be no return on this money above the risk free rate; and no new business will be written against it. Equalization reserves have been banned by the new accounting rules and regulations on the basis that if no loss incurs during the contract period the money belongs to the shareholder who originally put his capital at risk for this transaction. This argument is perfectly valid if it is possible to reasonably estimate loss and average claims over a given period, i.e. for loss distributions showing low volatility. With high severity, low frequency losses, we have already seen that this is not the case. Those insurers who did not experience a major claim in such a line have simply been lucky. Effectively the investor is playing roulette. At some point he risks losing his capital to pay back a large claim, as the premium the insurer will get during that particular year will certainly not cover it. Moreover, he would have no chance of recouping some of his losses because the company would become insolvent once it has lost its capital, and would not be able to write any new business. Using a model of the balance sheets of two firms submitted to the same risks<sup>1</sup>, one that is allowed to keep equalization reserves and one that pays all the extra gains as dividends, we analyze the value of both firms from the point of view of the shareholders. Both companies start with the same capital. We submit both companies to the same losses over a period of thirty years and analyze the cash flows resulting from their business in terms of the Sharpe Ratio and the Merton model that would give the value of the call option on the assets of the company. We explore two different distributions lognormal and Fréchet with various tails, but all with the same Value-at-Risk at 99%. First, we see that, within certain rules, it is possible to build up equalization reserves. Second, in all the cases, we show that the company that holds equalization reserves has a higher value for the investor. We present and discuss details of the model and the results.*

*<sup>1</sup> Work done in collaboration with H.J. Albrecher (EPFL), M. Moller (SCOR) and S. Sahiti (EPFL & SCOR).*

**ESSEC**  
BUSINESS SCHOOL

**YOU HAVE THE ANSWER**

*For any information, please contact  
Patricia Fernandez (01 34 43 32 45 and  
fernandez@essec.fr)*