Valuation and Modelling Operational Risk: Advanced Measurement Approach

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A significant part of uncertainty in a firm's earnings is related to the way it operates business in terms of operational risk that cannot be explained by market fluctuations. It was only a decade ago, when the more or less common view was that operational risk could be measured using subjective/qualitative approaches only. Since then, quantitative modelling of operational risk has evolved significantly, driven mainly by regulatory requirements. Commonly, risk in financial institutions is divided into credit risk, market risk and other types of risk such as operational risk. The Basel Committee on Banking Supervision in its 1988 Accord (Basel I) recognised that capital charge for credit risk implicitly covered other risks. However, the New Basel Capital Accord (Basel II, effective from January 2007) explicitly defines and treats operational risk. Operational risk is now receiving the same regulatory treatment as imposed on credit and market risks. It is expected that economic capital allocation for operational risk is 15-25% for the major banks.

Operational risk as defined by Basel II is "the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events". Strategic and reputational risks are excluded from this definition while legal risk is usually included. Some of the examples of operational risk event types are: internal fraud, external fraud, business disruption, system failures. Under the Basel II requirements, operational risk can be estimated using three approaches: Basic Indicator Approach, Standardised Approach and Advanced Measurement Approach (AMA). While the first two approaches are mainly to calculate capital charge according to given regulatory factors, the AMA allows banks to quantify capital charge for operational risk using their measurement approaches. It is expected that banks receiving AMA accreditation will benefit by having lower capital requirements for operational risk. The development of AMA is of strong importance for the banks and is the focus of this article. Currently, there is no established measurement methodology for AMA and the Basel II Accord allows an unprecedented amount of flexibility in the approach. The basic elements of AMA are: internal data, external data, scenario analysis, and factors reflecting business environment and internal control systems. Emerging best practices share a common view that AMA based on a Loss Distribution Approach (LDA) is the soundest method.

LDA relies on actuarial techniques based on modelling of frequency and severity of operational risk losses to estimate expected and unexpected losses, see e.g. Klugman Panjer, and Willmot (1998). To illustrate the approach, consider loss events due to one operational risk over one year. Assume that their annual frequency, number of events per year, is well described by the discrete random variable (or counting process) N from

some discrete distribution (so called frequency distribution). This corresponds to some event times $\tau_1 < \tau_2 < ... < \tau_N$. Also, assume that losses at these events $X_1, X_2, ..., X_N$, i.e. severities, are well explained by some continuous distribution (so called severity distribution). Then, the annual loss can be calculated as

$$Z = \sum_{i=1}^{N} X_i$$

It is common to assume that N and $X_i, i = 1,..., N$ are all independent. Typically, the frequency and severity distributions are well described by the Poisson and LogNormal distributions respectively. The total operational risk loss over one year is the sum over annual losses of all risks in the bank. The distribution of annual loss usually cannot be found in closed-form and Monte Carlo simulation is used to estimate unexpected and expected losses objectively. Expected loss is typically defined as the mean of the loss distribution. Unexpected loss is defined as the difference between Value at Risk (VaR) at the 0.999 level (i.e. 0.999 quantile of the loss distribution) and expected loss. The regulatory capital charge is assumed to cover unexpected loss only, while expected loss is assumed to be covered via the internal bank's provisions.

The loss data is primary input for estimation of the frequency and severity distributions. A large enough quantity of the internal loss data would be sufficient for estimation of the distributions using statistical techniques. However, many business areas have insufficient internal data, and thus the external data should be combined with the internal data. Using loss data for risk management purposes has inherent weakness because it is not forward looking and do not capture changes in risk and control environment. This issue can be addressed through scenario analysis and factors reflecting internal and external environments.

There are many important aspects in the quantification of operational risk that require careful consideration. Some of them are:

- Loss data are collected above some reporting threshold level. This should be taken into account when the distributions are estimated using statistical techniques.
- The dependence between risks has significant impact on estimates of the total capital charge. For example, the capital charge due to several independent risks can be significantly less than the capital charge for these risks if they are perfectly dependent, this is so-called diversification. The easiest way to introduce dependence between risks in the model is via dependence between frequencies of the risks. This can be done using, for example, copula methods.
- Scaling of the external loss data to be combined with the internal data and expert opinion for estimation of distribution parameters. One of the possible approaches to resolve this is credibility theory.
- An important part of operational risk is risk management. That is, scenario analysis should be incorporated. This can be achieved by identifying dependence of distribution parameters on certain factors (e.g. revenue of the company, number

of transactions, etc.). Then, the capital charge can be calculated for different scenarios of these factors over the coming year.

- Accurate modelling of the distribution tail is required. Some approaches suggest use of the Extreme Value Theory for tail modelling.

Quantification of operational risk is a relatively new area when compared to quantification and understanding of credit and market risks. Operational risk modelling is a broad field for new research and development. Creation of meaningful quantitative approach to operational risk management is a difficult task with many challenges emerging. Different opinions on measurement techniques and methodologies are hotly debated.

Further reading

Overview of the New Basel Capital Accord: Operational Risk, Basel Committee on Banking Supervision Consultative Document. Bank for International Settlements (http://www.bis.org). July 2003.

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An LDA-based Advanced Measurement Approach for the Measurement of Operational Risk, Ideas, Issues and Emerging practices, Industry Technical Working Group on Operational Risk, working document, 2003.

Cruz, M. G. (2002), *Modeling, Measuring and Hedging Operational Risk*, John Wiley & Sons

King, J.L. (2001), *Operational Risk: Measurement and Modelling*, John Wiley & Sons

Klugman, S.A., H.H. Panjer, and G.E. Willmot (1998), *Loss Models From data to Decisions*, John Wiley & Sons

See also: Simulation approaches for risk management; Simulation techniques for value-at-risk; Operational Risk (overview); Basel Committee On Banking Supervision, capital adequacy directive (1998) [Basel II].