Statistical Models for Operational Risk

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INTRODUCTION

A statistical model is a possible representation (not necessarily complex) of a situation of the real world. Models are useful to give a good knowledge of the principal elements of the examined situation and so to make previsions or to control such a situation.

In the banking sector, models, techniques and regulations have been developed for evaluating Market and Credit risks, for linking together risks, capital and profit opportunity. The regulations and vigilance standards on the capital have been developed from the Basel Committee founded at the end of 1974 by the G10.

The standards for the capital's measurement system were defined in 1988 with the "Capital Accord" (BIS, 1988); nowadays, it is supported from over 150 countries around the world. In January 2001 the Basel Committee published the document "The New Basel Capital Accord" (BIS, 2001), which is a consultative document to define the new regulation for the bank capital requirement. Such a document has been revisited many times (see BIS, 2005).

With the new accord there is the necessity of appraising and managing, beyond the financial risks, also the category of the operational risks (OR) already responsible of losses and bankruptcies (Cruz (Ed.), 2004; Alexander (Ed.), 2003; Cruz, 2002).

BACKGROUND

The operational risk (OR), according to the new Basel accord, is due to detrimental events caused by the inadequacy or the failure of internal processes and systems, human errors and external events, for instance natural calamity (BIS, 2005).

The evaluation of a suitable risk profile is important, because banks with the same levels of market and credit risk can have a different OR profile. The operational risk, in fact, is an intrinsic characteristic of the bank, of the performed activities and of the place in which the institution is located (Cruz (Ed.), 2004).

Due to the peculiarity of OR, the difficulties that are peculiar to its modelling are the following:

1. The OR set is heterogeneous and strongly dependent of the context where it is valued.
2. Some events, which are referable to the OR, produce damages that are hardly evaluable.
3. Some OR events are very rare. Probably the single bank has never faced such events, and in this case the institution needs also external data.
4. For some events the past history is not a good indication of the future.
5. Lack of reliable historical data.
6. Associated problems with events' estimate that have high frequency and low impact (HFLI) and vice versa with low frequency and high impact (LFHI).

Besides, the greatest problems arise from the organization of the database (DB) for the construction and validation of the models, (Cruz (Ed.), 2004; Alexander (Ed.), 2003).

The Basel Committee with the new accord recommends the use of three methods for the valuation of the *value at risk* (VaR) characterized by increasing complexity: base (*BIA*), standard (*STA*) and advanced (AMA), (BIS, 2005; Cornalba & Giudici 2004).

Such approaches are subjected to criticisms due to the difficulties to evaluate operational risk and for the way in which they influence the capital (necessary to cover OR) in function of the institution amplitude (Cruz (Ed.), 2004; Alexander (Ed.), 2003).

MAIN FOCUS

The AMA approach is more complex, but it makes the calculation of the *value at risk* (VaR) more sensitive to the risk profile and generally smaller than the approach calculated with *BIA* and *STA*. Every bank can use its advanced internal model if it satisfies the qualitative

and quantitative standards defined by the new accord (BIS, 2005; BIS, 2003).

The AMA methods are bottom-up type and this because the VaR calculation is achieved considering the losses obtained by dividing the bank's activities in eight business lines (BL) and seven event types (ET or risk category). In this manner there will be at least 56 different kind of losses, one for each intersection BL/ET.

The models for the AMA approaches are divided in two principal classes, quantitative and qualitative models. The actuarial and analytical models represent the former; the latter are constituted by Scorecard Approach (SA). Bayesian methods are placed between the two categories, (Fanoni, Giudici & Muratori, 2005; Giudici & Bilotta, 2004; Cornalba & Giudici, 2004; Cruz (Ed.), 2004; Alexander (Ed.), 2003; Cruz, 2002).

To quantify the risk is necessary to know the statistical distribution of the number of risky events (frequency) and the statistical distribution of theirs consequences (severity or impact).

All the models have to be validated with *scenario analysis* and *backtesting*. (BIS, 2005; Fanoni, Giudici & Muratori, 2005; Cruz (Ed.), 2004; Alexander (Ed.), 2003).

Scorecard Approach

The scorecard approach models are based on the expert opinions collected using questionnaires (scorecard). By scorecard, the frequency, the severity and the quality of the controls are appraised and so the effectiveness of the system of risk management is already integrated in the model (Alexander (Ed.), 2003).

Inside the questionnaires the frequency and the severity are (generally) classified in five levels (high, high/middle, middle, middle/low and low) and similarly the quality of the controls with (excellent, good, fair, weak and poor). The questionnaire is periodically compiled (every six months, every year, etc…) and, usually, the expert himself is the one who fill it (self-assessment), (Fanoni, Giudici & Muratori 2005; Alexander (Ed.), 2003; Cruz, 2002).

The Basel Committee requires that the estimates are validated on a quantitative base using internal and external historical data related to the OR losses. The difference between this approach and the qualitative method is that the risk profile can change in function of the results that periodically emerge from the compila-

tion of the scorecards. In such way, the method follows the "trend" recognized by the experts (forward-looking characteristic) and so it has a prevision action, (Cruz (Ed.), 2004; Alexander (Ed.), 2003).

The procedure of assessment is obtained after having mapped the activities of the bank and the possible risks according to the standards defined by Basel.

The assessment operation depends on factors as, for instance, (see Alexander (Ed.), 2003):

- The nature of the analyzed activities.
- The geographical location.
- The greatness and complexity of the main activities and of the necessary operations to perform them.

Besides, the choice of the indicators and the appropriate metrics to define the risk profile (as the *Key Risk Driver*) and to monitor and control the harmful events (as the *Key Risk Indicator*) will depend on the previous phase.

The results obtained are visualized on a graph (risk map) where on axles we report for each risk the frequency and the severity. Therefore the graph shows how the various harmful events are distributed and emphasizes possible LFHI or HFLI situations, (Alexander (Ed.), 2003). Afterwards, the graph can be divided in action zones to define the activities to be implemented to face such risks, as, for instance, to accept, to share, to avoid or to transfer them, etc.

Once defined the risk frequencies and severities, some *scenario analyses* are performed to underline the risks, the control systems and the losses associated at the sceneries (see Alexander (Ed.), 2003).

Actuarial and Analytical Models

In these models we use the database of the historical data to estimate either the loss distribution via simulation or the necessary parameters to calculate the VaR, the expected and unexpected losses. The only use of historical data makes these models backward-looking and, therefore, not very flexible for forecasts.

Actuarial Model

The actuarial model calculates the VaR through a percentile of the annual loss distribution (Loss Distribution Approach).

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