QUANTITATIVE STRATEGIES IN OPERATIONAL RISK MANAGEMENT

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ABSTRACT

World-known companies have often been hit by huge losses resulting from the operational risk management misconceptions. As a result, significant rise of interest in this, so far marginalized, risk aspect has appeared.
The quantitative estimation and measurement of this kind of risk proved necessary with the implementation of new operational risk management strategies in companies and financial institutions
Because of the operational risk characteristics as well as of the insufficient historical data regarding the losses of the organization, the process of the quantitative estimation of operational risk level is a complicated one.
The additional motivation for use of the quantitative methods of operational risk estimation are the international banking supervision institutions' recommendations, requesting banks to use quantitative methods in operational risk management.
This article comprises the review of most important quantitative methods of operational risk estimation and measurement.

WORDS

Strategies in operational risk management, operational risk, quantitative methods of the operational risk estimation, Operational Value at Risk, Basel Committee on Banking Supervision Basel Committee on Banking Supervision

1. INTRODUCTION

Each company in the market is exposed to various kinds of risk. Starting from the market risk, through crediting risk to the variety of risks falling under operational risk category. So far management of this kind of risk has been considered and obvious, common-sense kind of thing, an issue important, but not of the utmost importance. The multi-million losses that companies suffered from as the result of misconceptions in operational risk management have finally changed that situation in recent years.
It is worth stressing, that there is no single, unified definition of operational risk.
It refers to risks coming from the level of knowledge and responsibility represented by managers, the documentation quality and consistence, from transparency and practical results of operational procedures, from frauds, legal regulations and many other factors. Basel Committee on Banking Supervision defines operational risk as any kind of risk that is not directly relevant to the market fluctuations or solvency of partners or customers. The Group of Thirty Global Derivatives Study Group Report defines operational risk in a similar way "*operational risk is a risk of losses resulting from faulty systems, insufficient control, human errors or wrong management*".[1]
Looking closer at the above definitions we can see that they refer to all common risk areas, including cases of frauds (which can be referred to as the inadequate systems and insufficient control), risk from regulations (faulty systems and management), and also other kinds of risk, from the directly harming natural disasters to the administrative misconceptions, resulting from the inadequate qualifications of personnel.
For this article purpose I have defined the operational risk in the broad view, comprising various aspects - from the possibility of losses coming from employee's crime to the insufficient return rate on capital caused by withdrawing from some investments at the wrong time. This definition sees the sources of risk in the institution itself, and its ability or the lack of, to react to various, continuously arising outside and inside threats. The multi-aspect nature of operational risk causes the complexity of its modelling. The purpose of this article is to provide businessmen with an effective tool for efficient operational risk management in their companies.

2. CLASSIFICATION OF QUANTITATIVE METHODS OF OPERATIONAL RISK ESTIMATION

[1] R. Kendall Zarządzanie ryzykiem dla menadżerów Liber 2000.

Because of the complexity of operational risk and huge losses resulting from the wrong operational risk management the meaning of estimation and measuring of this kind of risk is growing. As the operational risk issues are still rather new in the risk management science area, so far they are dominated by qualitative measurement methods. The qualitative measurement methods are based upon assessment of the exposition to risk done by experts estimating various threat parameters.
These comprise descriptive methods, heuristic techniques or risk mapping techniques.
However, as economic reality proves, these methods are not sufficient tool of operational risk modelling. Qualitative measurement methods may only be used to complete the results of quantitative risk measurement methods.
The quantitative methods are the ones that enable the risk level estimation using processed numerical data. In case of exposition to operational risk measuring, the numerical data will comprise the information on real results of past losses and the potential results and losses caused by events that can be foreseen.
The quantitative methods used in operational risk management fall into 3 categories:

- Risk measurement methods recommended by Basel Committee

1. basic indicator method,
2. standardized method,
3. advanced measurement method

- Statistical methods

1. methods based upon the Value at Risk index,
2. Monte Carlo methods,
3. comparative methods using emergency scenario methodology and stress testing,
4. methods based upon the Extreme Values Theory
5. methods enabling the modelling of operational risk using Beyes Nets

- other quantitative methods

1. comparative analysis methods,
2. methods of operational studies
3. six sigma methods

Methods recommended by Basel Committee from the New Capital Agreement refer to the ways of calculating the regulation capital for operational risk. The Agreement comprises three basic methods:

- Basic Indicator Approach- BIA
- Standardised Approach- STA
- Advanced Measurement Approach- AMA

As well as the Alternative Standardized Approach
The BIA and the STA with the Alternative STA represent the „top down" concept – when the capital is set on the level of the whole financial institution and then, using a system of simple keys it is accredited to particular business lines. In those methods the gross financial outcome is the measure reflecting the exposition to operational risk.
Whereas Advanced Measurement method AMA is a „bottom up" methodology example, where the risk is analyzed on each process level and the results are then aggregated for particular business lines and the whole organization. In this method the regulation capital calculation is the result of using inner operational risk measurement models based upon qualitative and quantitative criteria.
The key aspect of this method is constructing a database collecting the information about operational losses of the institution. Moreover, if the loss breakdown achieved this way is not sufficient for credible calculations, it can be completed by outside data and the scenario analysis method. The scenario analysis method consists of setting several potential scenarios and – for each of them – calculating operational risk level using quantitative methods. The final, credible collection of losses becomes the base for creating a model, allowing to determine the capital required to cover the operational risk with a certain confidence level.
Basel Committee recommendations based upon the operational capital indices are the additional factor intensifying the works on effective operational risk quantitative measurement methods.

Methods based upon the statistical models are a much larger group of operational risk estimation methods. This group consists of the following methods:

- Value at Risk index-based methods – in case of operational risk it is the Operational VaR
- simulation Monte Carlo methods
- comparative methods using emergency scenario analysis methodology and stress testing
- methods based upon Extreme Value Theory
- methods enabling the modelling of operational risk using Beyes Nets

Methods VaR

Value at Risk based methodology enables to estimate the level of risk using statistical and simulation models for assets fluctuations and allows to measure the largest expected loss that the company can suffer from in given time and confidence level and in regular market conditions.

The concept of operational risk management based upon the standard VaR methods is called Operational Value at Risk (OpVaR) methodology. The base for operational risk modelling in OpVar technique is creating its own operational database by the organization (incl. all the events that influence the system efficiency and accessibility, and bringing potential losses). This database, using statistical methods modified for the purpose of estimating the exposition to operational risk allows to estimate the highest potential loss providing conditions as per standard VaR – described above. However, because of the complex operational risk nature, and also because of the conditions set in VaR methodology, operational risk modelling using this method may not be precise enough.

Monte Carlo methods

Simulation Monte Carlo methods (MC) are methods based upon mathematical problem solving through random generation of numbers. Operational risk modelling using the MC techniques has four stages. Firstly, data on the frequency of single losses depending on event type and corresponding with business lines (typical for the financial institution) has to be collected. Eg. frequency of losses resulting from system failure in business line „retail banking". The second stage considers defining risk factors as random variables using the empirical data collected in the first stage. In the same stage their mutual relations and probability distribution has to be defined. For each combination of event type and business line we set the frequency distribution of this event happening and its influence on the size of losses. Then, using the set distributions we do the simulation of the number of events in a given amount of time. Afterwards, n-times we sample from the distribution function of the influence of the given event on the amount of losses and we sum up the resulting financial flows. We repeat that simulation till we reach the expected accuracy. The number of necessary simulation varies from a few hundreds to over ten thousands. The same actions have to be taken with regard to each event and business line combination. This way we receive the aggregated losses distribution from which we can estimate standard deviation referring to expected, unexpected and catastrophic losses. The most important issue in operational risk modelling process with the MC method is defining the distributions correctly describing frequency of events and their influence on the loss size. This problem is called model risk[2]. This risk consists of two basic parts. First of them is finding the right density function, and the second is the correct estimation of the parameters of this function. Additional problem that appears here is the choice between modelling the frequency of events causing operational losses and modelling the time between those events. Using the frequency is reasonable when the events take place rather often (eg. a few times a week) and when this frequency is rather stable in the longer period of time. When the events take place rather seldom (eg. a few times a year) and they cause huge losses the quantity of empirical data is insufficient. Therefore it becomes impossible to determine the frequency of events precisely as it changes with time. In such cases thus it is better to concentrate on modelling the time between the events. Having determined the distribution of the frequency of events or the time between them, the last stage is the simulation of the influence of the event on the loss size.

Also in this case it is possible to adjust the theoretical probability distributions. A great advantage of the operational risk estimation using the MC method is creating the automatic prognosis of the complete distribution (distribution function of losses and profits) and not just their number as it is with the VaR methodology.[3]

Emergency scenario methods

Comparative methods using the emergency scenario analysis methodology in operational risk estimation are different from the ones described above. The purpose of the scenarios analysis is not estimating the probability of huge operational loss occurrence, but testing the organization in view of its survival and further activities should the losses occur. In the scenario analysis method three kinds of scenarios are analyzed – the optimistic, the probable and the pessimistic kind. Scenario analysis method is particularly useful in case of operational risk on the derivative instruments market. It requires assuming on the frequency of events and the values of losses they would bring and then calculating the losses that would be possible in a given time[4]. The particular usefulness of the scenario analysis method on the derivative instruments market, where we have insufficient historical data regarding the frequency of operational risk occurrence and the losses caused shows through setting the pessimistic scenario defining the maximum level of losses on a given transaction. To sum up, we can

[2] C.L. Marszal Measuring and Managing Operational Risk In Financial Institutions, Wiley&Son 2001

[3] J. Orzeł Ilościowe metody pomiaru ryzyka operacyjnego Bi K VII 2005

[4] T. Mori, J.Hiwatashi,K.Ide Measuring Operational Risk in Japanese Major Banks. Bank of Japan. Financial and Payment System Office, Working Paper Series , July 2000

say that the scenario analysis method is a way to estimation of the scale, the extreme results and irregular events, unfavourable for the organization.

Extreme value based methods

Extreme value is a value that is significantly different from the average. Operational risk estimation with the use of this method bases upon setting the loss distributions caused by the operational risk at the maximum level that may result from the occurrence of given event. The extreme values distributions may be described together as the risk level. The approach based upon the extreme values theory uses the fact that the observations form the end of the distribution may be approximated by generalized Pareto's distributions[5] and Poisson's distributions. These distributions are used for generating loss distributions above the given level of values and operational risk level estimation.

Bayes methods

Methods allowing to model operational risk using the so-called Bayes nets. Bayes net is used for representing, according to probability calculus, relations (of probabilistic nature) between the events. Bayes net represents in a compressed way the joint probability distribution of the parts of the net. This allows to execute any kind of conclusion drawing about their value.

The additional advantage of the nets is the possibility to visualize presented data in a graphic way, comprising the multilateral reactions between the sources of uncertainty. The Bayes net concept is a direct result of conditional probability concept. In the economy, especially in the analysis of the functioning of companies, there are many situations when the occurrence of one event os strictly dependant on a different event. Use of the net allows to avoid the highly complicated calculations. Calculation of one probability a posteriori is linked with earlier calculation of probabilities used. Setting those probabilities enables us the estimation of the risk of a given event occurrence and therefore – in case of this risk exceeding acceptable level – the occurrence may be prevented from.

The graph structure allows to create or to modify the net by an expert easily. Thanks to this fact, his highly specialized knowledge may be used in a simple way. What differentiates the Bayes net method from other analysis methods is the variety of possible conclusion-drawing ways.

Concentrating on the graphical net structure only, we can discover conditional relations of the variables, whereas considering the parametrical models assigned to the knots, we can find the most probable of the available variables' configurations.

The basic concept is like that – the Bayes net, built on empirical data in a compressed way represents the joint distribution of the probability attributes. And the joint distribution is enough to be able to draw any kind of conclusions regarding the probability of attributes.

Thus, a reply to any question may be achieved through setting – with the use of the net – the total probability distribution and using it for adequate calculations. In the Bayes approach, the distribution of the parameters of probability is a way of presenting the subjective knowledge with regard to its possible values.

The Bayes approach solves the problem of the lack of data considering the distribution of losses in the so-called „thick tails". This approach combines the qualitative, quantitative, outside data and Key Risk Indicators. Generalizing, we can say that the use of Bayes nets allows to integrate various information sources and to use them effectively in the operational risk management process.

Other quantitative methods

Other quantitative methods of operational risk measurement are of a lesser meaning in the economy reality than the ones described above, however their role is still too important to omit them here. There are three groups of these methods as follows:

- comparative analysis methods
- operational study methods
- six sigma methods

Comparative analysis methods

Comparative analysis methods are based upon the benchmarking concept in its broad meaning. Benchmarking means comparing processes and practices used in the companies considered best in the given field. The results of such analysis become the basis for improving the business processes. The core issue in benchmarking is discovering the factors that make the process effective and then finding similar possibilities in one's own company. This is a process of learning and adapting the best practices. Typical phases in benchmarking are: choice of the issues to be compared, preparing the analysis plan and the choice of methods for data collection, choosing the companies to compare to, data collection, data comparison, analysis, preparation of recommendations, change implementation planning, change implementation, process repeating after the changes have been implemented.

[5] K.Kuziak Koncepcja wartości zagrożonej VaR StatSoft 2003

Operational studies methods

Operational studies methods are based upon the analysis of targeted actions – operations. These studies are the objective decision assessment with the use of mathematical models. The mathematical models are built with the use of probability theory, game theory and other techniques. This is to enable the determination of risk level and using that information when taking decisions or taking up actions to execute a plan.

The risk modelling with the use of operational studies has four stages as follows:

1. Mathematical model preparation – determine the target of an action, extract the factors determining the possibility to achieve the target and to determine the variability range.
2. Model solving – finding the optimal decision depending on the analytical shape of the created model.
3. Verification of the model and of the solution – analysis of the solution should be done in view of the practicability and stability of the solution.
4. Model implementation

The meaning of this methodology should not be overestimated in the operational risk estimating, however, risk models created with the use of operational studies method my be very efficient in supporting the operational risk management process.

Six sigma methods

Six sigma methods are the techniques aimed at limiting the number of errors and failures changing the organization, in order to make the organization provide the best quality impressions for its customers. The "sigma" symbol means the deviation from the perfect work and each of the indicated sigma levels means smaller number of errors.

Six Sigma enables doing the objective measurements useful in justifying the technology-aimed investments.. It allows to determine the real value of a given technology very precisely and to generate that value more efficiently.

The core part of that methodology is the team choosing process, the determination of the measurements important for the company, choice of the people responsible for given tasks and setting the mechanisms allowing to monitor the results and progress[6]. In the Six Sigma method the problem is evaluated in five stages: define, measure, analyze, improve and control (in short DMAIC) Each of the DMAIC stages has its own tools – histograms, Pareto's graphs, dissolution graphs. Six Sigma not only helps to make the organization more efficient and cost-effective but also helps make the systems do more for the customers of the organization.

3. CONCLUSIONS

Use of the quantitative methodology in estimation of exposition to operational risk in company depends on the assumption of the company having the database regarding the operational losses. However, because of the operational risk characteristics, in reality the empirical data may happen to be insufficient in that area. Therefore it proves necessary to obtain information from the institutions outside the company. Such information, modified in a special way may be very effective in completing the database with the data concerning the probability of certain threats.

Still, the full picture of the operational risk may only be achieved by using the qualitative-quantitative approach where quantitative estimation methods are completed by the qualitative methodology using experts' evaluation, their experience, intuition and knowledge.

Implementation of the modern, integrated systems of measurement and analysis of the operational risk in companies requires increasing – and often still introducing – the systematic approach to data forecasting. Making a consistent system of the qualitative and quantitative methods of operational risk estimation is necessary in order to avoid being off-balance – the domination of the over-all look (eg. through exposing the risk indicators that do not always have the operational value) on one hand – and on the other – looking through the single event perspective which makes introducing system's solutions difficult.

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