LES CAHIERS

Louis Bachelier

MODELLING OPTIONS FOR MORE EFFECTIVE RISK MANAGEMENT

WITH

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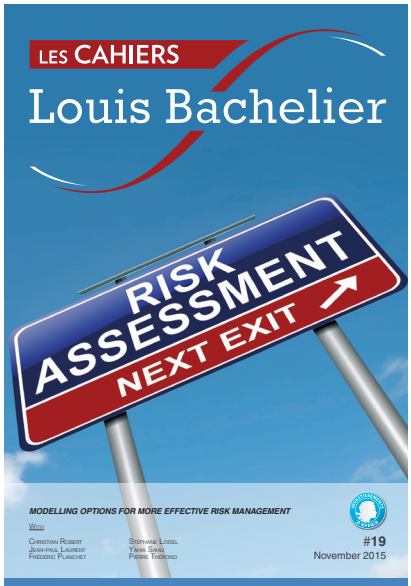

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EDITO

The “Management of Insurance Modelling” Chair of Excellence was created in September 2010 and has since contributed to research at the highest international level in the field of insurance and risk management.

Jean-Paul Laurent

Frédéric Planchet

Christian Robert

The initial project was based on the understanding that the Solvency 2 reform would induce profound changes in insurance companies in terms of modelling. It rested on the idea that decisions pertaining to financial management, investment, reinsurance and pricing would increasingly rely on the use of sophisticated and interdependent quantitative models, as also would provisioning and profit distribution policies, for internal or external growth options, and risk management.

The initial multidisciplinary project, involving researchers from different backgrounds (economists, actuaries, statisticians and financial experts) has recently been renewed for a five-year period, under the heading *Data Analytics and Models for Insurance*. The project also brings in researchers specializing in data-mining

As well as the Chair’s original areas of research, it will focus on data analytics and governance for value creation in insurance companies. The Chair will also work on the interaction between forecasting models and simulation. The aim of this research is to establish links between the collection of new data on policyholders, the modelling of their behaviour, and taking this behaviour into account in forecasting models.

This current issue of Cahiers provides an opportunity to present a summary of the ideas developed during the Chair’s first five years and to illustrate their diversity.

We hope you will enjoy it!

Jean-Paul Laurent, Frédéric Planchet and Christian Robert

PARTNAIRS

Can ambiguity affect risk reduction?

People's ambiguity aversion is rarely considered in risk assessment methods. Yet it has implications for the processes of decision-making. Christian Robert and his co-author show how misunderstanding of risk can harm prevention policies.

Key points

- The models used in risk measurement consider that the distribution of these risks is known. But in reality, economic agents have only partial knowledge.
- Uncertainty related to underlying risks can change agents' behaviour and decision-making. An ambiguity-averse individual will make less effort to reduce risk.
- Prevention policy will be all the more effective if decision-makers are well informed about the nature of risk.

Based on the paper Distortion risk measures, ambiguity aversion and optimal effort by Christian Robert and Pierre Thérond, and on an interview with Christian Robert.

Being ware to the presence of a danger is not enough; one still needs to know what the danger actually is. Risk management involves two ideas: the probability of the risk occurring and the extent of knowledge about the characteristics of the risk. Traditionally, the models used in the assessment and measurement of risk consider that information is perfect and that the distribution of risk is known by economic agents. Within the framework the standard Solvency 2 formula, for example, the regulator sets parameters for defining the distribution of risk. But how are these parameters chosen? Do the recommended risk measures guarantee the safety of those insured? It is unlikely that the standard parameters turn out to be suited to the specificities of different companies, yet these parameters were probably chosen by taking into account the imprecise knowledge of each insurer's risks.

The assumption of perfect knowledge of risk is in fact not realistic. Economic agents do not possess all the information available. To what extent does this imperfect knowledge impact risk measurement and agents' decision-making? May agents' choices be altered as a result?

Understanding the decision process

In their work, Christian Robert and Pierre Thérond endeavour to make connections between uncertainty about the nature of the risk, risk aversion, and ambiguity aversion. They start from the assumption that the decision-maker does not know one [any?] of the distribution of risk parameters.

Given the imperfect knowledge of risk, an ambiguity-averse agent will make less effort to reduce it

As a first step, the authors try to better understand the decision-making process in the ideal context of perfect knowledge of the distribution of risks. They compare the choice of two agents, given that the second is more risk averse than the first. Will these agents make the same choices?

The answer depends on the distribution of risks. A choice that appears less risky for the first agent will not necessarily be so for the second, even though he is more risk averse. For each individual has his own perception of risk. In their decision criteria, two people do not attach the same weight to the same parts of the dis-

Christian Robert

Christian Robert is professor of Statistics and Actuarial Science at ISFA, the internal school of the University Claude Bernard Lyon 1. He is also director of Actuarial Science and Finance Laboratory and co-holder of the BNP Paribas Cardif "Management of Insurance Modelling" Chair. His areas of research and expertise include the theory and statistics of extreme values, actuarial theory and its applications, and statistical finance.

Methodology

Christian Robert and Pierre Thérond consider the class of distortion risk measures, as proposed in Yaari's (1987) Dual Theory, and insist further that these measures be consistent. They present theorems in comparative statics, then examine the willingness to pay to reduce risk. In a second stage they investigate the context of imprecision of information coupled with ambiguity aversion, as well as the willingness to pay to reduce inaccuracy of information. Finally, they examine a model of effort to reduce risk.

tribution of a risk. Someone who is averse to extremes, for example, will pay greater attention to distribution tails.

In addition, the risk averse agent is not necessarily willing to pay more than his counterpart to reduce his risk. This again depends on the distribution of risks.

Less knowledge…

Decision-making methods are different in a context of imperfect knowledge. When the agent has only partial knowledge of the distribution, he increases the measurement of risk by a premium for ambiguity. The measurement is therefore higher, not because of a greater risk, but because of the decision-maker's aversion to ambiguity.

Reducing ambiguity in fact entails an additional cost. It is a matter of defining how much the agent is willing to pay for information enabling him to reduce this uncertainty. A more ambiguity-averse agent will always display a greater willingness to pay, whatever the underlying risk.

Furthermore, the authors assess the financial effort that a decision-maker is willing to make to exchange a high risk for a low risk. It becomes a question of the trade-off between cost and risk reduction. Consequently a more risk-averse agent will always make more effort. However, in a context of imperfect knowledge of the distribution of risk, a more ambiguity-averse agent will consent to less effort.

…goes hand in hand with less effort

The work underscores the need to take into account the extent of decision-makers' knowledge. For the degree of risk aversion is not the only factor to influence decision-making. The limitation of knowledge also affects behaviour.

These findings can help define prevention policies, the role of which should be both to reduce risks and to provide information pertaining to them. Poor appreciation of risk limits the efforts that agents are willing to make, especially when they are ambiguity averse.

This anxiety with regard to uncertainty should also be taken into account in the relations maintained with the regulator. If insurers want to discuss the parameters set out in Solvency 2, for example, in it is their interest to reduce the level of uncertainty of the regulator, who is inherently averse to both risk and ambiguity.

Find the Christian Robert's interview on www.louisbachelier.org

Does Basel III succeed in harmonizing the measurement of credit risk?

Faced with discrepancies in credit risk measures, the regulator has imposed certain modelling constraints. Are these new rules effective? Are they able to reduce the dispersion of results? The answer is equivocal.

Key points

- For the same portfolio of assets, credit risk measurements vary fourfold, depending on the bank.
- This dispersion results is due in part to the confidence level imposed by the regulator. A 99% confidence level over a one-year time horizon (instead of the 99.9% level currently applied) would harmonize the results.
- The diversity of data used in making the calculations also reinforces the measurement of discrepancies.

Based on the paper "Trading book and credit risk: how fundamental is the Basel review?" by Jean-Paul Laurent, Michael Sestier and Stéphane Thomas, and on an interview with Jean-Paul Laurent.

In line with more prudent and safer management, supervision of credit risk in market activities has been strengthened in recent years. Banks must now include this risk in the trading book (in which assets held for short-term trading are recorded), and provide the associated hedging strategy. But the models used to calculate capital provisions vary from one bank to another. Hence for the same risk exposure, results between institutions differ.

Marked disparity of results

The regulator noted the size of these differences following the dispatch of a set of test portfolios to major companies (Basel Committee and European Banking Authority documents, on the variability of risk-weighted assets). It was found that the capital requirements arising from credit risk measures could vary by a factor of four for the same portfolio of assets.

Such variability prompted the authorities to act, by supervising credit risk measurement models and making the results of banks managing similar portfolios comparable. Basel III thus makes a number of recommendations regarding modelling choices, in order to variously calculate collection rates in the event of default, the level of dependence between default events (correlation level) and the probability of default.

"The models are hypersensitive to extreme situations"

Are these constraints suggested by the regulator effective? Do they provide a more consistent measure of risk between banks? The authors of the paper set out to assess the impact of these recommendations, particularly those relating to the calculation of the level of dependence.

A too high level of confidence?

The rules for calculating the level of dependence address several points. First, Basel III requires the use of a two-factor correlation model – a constraint

Jean-Paul Laurent

Jean-Paul Laurent is a professor at the university Paris 1 Panthéon-Sorbonne, where he heads the finance section of the Management Sciences Laboratory. He is also a member of the Financial Regulation Labex. His research focuses on the modelling of financial risks and prudential regulation.

Methodology

The empirical study aims to compare the risks of representative credit portfolios in accordance with different (i) data sources (CDS spreads, equity, etc.), (ii) methods for estimating the default dependence structure, and (iii) factor model specifications by varying the number of factors. These comparisons are carried out at several confidence levels of risk measurement over a one-year time horizon, including the confidence level set at 99.9%.

that in the view of the researchers is not very effective. "The fact of using two factors or more to calculate the correlation makes little difference to the results in terms of risk," Jean-Paul Laurent notes.

The text also sets the confidence level of measurement. Credit risk is thus to be assessed with a 99.9% confidence level over a one-year time horizon. This particularly high level means that the risk of an event occurring is once a millennium. "At such a level, the results of risk calculation vary widely from model to model," Jean-Paul Laurent warns. "The models are in fact hypersensitive to extreme situations. We found differences in the results varying by a factor of three."

A 99% confidence level, over a one-year time horizon, would still be high, since it would include the probability of hundred-year events, but it would have the advantage of greatly reducing the dispersion between the different models. Furthermore, it would be possible to compensate for the lowering of the confidence level by increasing the capital reserve: for the same level of risk the provisions would, for example, change from 100 to 150. The level of protection would then be similar, but the risk measurements made by the banks would be more comparable.

Data harmonization

The final regulatory point concerns the type of data used to determine correlations. The Basel Committee allows two categories of data: the profitability level of assets and changes in spreads of Credit Default Swaps (CDS – a form of credit derivative). However, for the same scenario, the results vary markedly, depending on whether an institution uses the profitability of assets or CDS spreads. If the regulator wants to improve the comparability of results, it would be necessary to harmonize the data used.

The effectiveness of regulation on the measurement of credit risk is therefore mixed. While the constraints on the correlation factors are of little consequence, the level of confidence threshold imposed and the data authorized largely account for the dispersion of results. A slightly lower confidence level and the same type of data would enhance the comparability of measurements.

The authors are continuing their work on assessing the impact of default probabilities and recovery rates. Their research thus aims to determine the effect of each factor on the dispersion of the measurement of credit risk, enabling them to better characterize the quality of the models used by banks.

Find the Jean-Paul Laurent's interview on www.louisbachelier.org

Valuation of life insurance: how is volatility to be measured?

Economic valuation practices draw heavily on the logic of financial markets, thereby generating extremely fluctuating results. Such modelling choices complicate insurers' decision-making processes. How should a short-term approach be adapted to long-term management?

Key points

- Economic valuation methods are based on the financial logic of markets. Their results are thus very volatile.
- This type of modelling is not suited to the activities of life insurers, which manage portfolios over the long term.
- It is therefore necessary to adapt it by distinguishing own portfolio volatility from volatility generated by market fluctuations.

Argument based on the papers cited below.

Financial markets have acquired considerable importance in the world economy. The economist François Morin has shown, for example, on the basis of the 2002 accounts of the Bank for International Settlements (BIS) that the total amount of annual exchanges needed for the real economy (trade of goods and services, commercial exchanges) was 40.3 trillion dollars, whereas total transactions between banks amounted to 1,150 trillion dollars.

This financialization necessarily has repercussions upon ways of valuing economic activities: whereas an asset was originally valued on the basis of its acquisition cost, it is now valued according to the potential selling price set by the markets at time t. Such valuation logics, conceived initially in order to calculate the price of derivatives, are now found in all financial and prudential reference systems, in particular in the Solvency 2 directive. But while these modelling choices are legitimate for exchange activities, they are less suited to life insurance, the management of which extends over several decades.

The technical difficulties raised by the transposition into insurance of the idea of the absence of arbitrage and the replication of flows stemming from it have been clearly identified. Models are being progressively refined to provide results that reflect as accurately as possible the consequences in terms of valuation of the insurer's shares, especially in terms of allocation of profit sharing for savings contracts. It is no longer a matter of discussing the merits of these valuation rules, but of incorporating the results into decision-making processes.

Insurers cannot base their decisions on extremely fluctuating data

Distinguishing intrinsic volatility from parasitic volatility

The high volatility of the various indicators, particularly of economic capital and the coverage ratio of solvency capital[1] required by Solvency 2, constitutes a major problem for insurance company managers. Indeed they cannot base the decision process on highly fluctuating data.

The regulator has partially become aware of this situation, and distinguishes volatility that reflects the risks borne by the insurance from "parasitic" volatility linked to market fluctuations, that will be smoothed out in the medium term.

1. *With regard to this point, the volatility of the solvency capital requirement (SCR) is much lower than that of equity (in a ratio of 1 to 10).*

Fréderic Planchet

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Further information available on: http://www.ressources-actuarielles.net/

In order to mitigate the effects of the latter, two mechanisms have been introduced: correction of volatility (Art. 50 of EU Commission Delegated Regulation 2015/35) and equalizing adjustment (Art. 53 of the same regulation).

Relying on price history

Academic studies also show that calibration choices for generating economic scenarios have a direct and significant impact on the volatility of the valuation. Thus the most common practice is to base the calibration on immediate prizes. It is, however, possible to estimate the parameters on price history (not on the last known price), so as to reduce the volatility of the valuation.

The goal is not to "break the thermometer", but to distinguish the informative component of noise volatility. To make decisions, insurers need to extract relevant information from indicators of economic performance. In other words, they have smooth out the raw value derived from the prescribed calculation.

Note that this situation is specific to economic approaches, which rely on valuation models and not, as in company accounts, on values calculated to draw up the balance sheet.

ORSA (Own Risk and Solvency Assessment) no doubt provides a framework within which to situate the search for what, in the change in net asset value, should be attributed to the result and what concerns fluctuations in value that are not attributable to the result. Indeed, ORSA involves planning the balance sheet under various scenarios and allows, subject to incorporating stochastic modelling of financial risk factors, the measurement of expected ex-ante volatility indicators around a central scenario.

Therefore analysis of the trend and of differences between ex-ante volatility and volatility measured ex-post provides the basic elements for constructing performance measures.

This topic is likely lead to extensive research in the coming years.

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Risk management: defining an area rather than a threshold

Risk measures such as VaR or ruin probability are often based on an extremely binary approach: is the company above or below its solvency threshold? But this logic may be somewhat restrictive. Stéphane Loisel and his co-author propose a new measure based on the average time spent below the solvency threshold.

Key points

- Risk measures such as VaR and ruin probability are often based on a binary and short-termist approach to risk.
- The authors have created a "mean red area" risk indicator to represent the time spent below the solvency threshold.
- The new measure allows the optimal allocation of the initial reserve and of the risk budget to be calculated.
- The authors show that the two approaches are equivalent.

Based on the paper "Properties of a risk measure derived from the expected area in red" by Stéphane Loisel and Julien Trufin, and on an interview with Stéphane Loisel.

Insurance companies are subject to increasingly stringent regulation with regard to their risk management. But do we really know how to define a risky situation? Can risk be reduced to the idea of an uncrossable red line or should this perspective be widened?

Depending on the level of risk taken, insurers are under an obligation to provide a solvency capital requirement (SCR), plus a certain percentage. The aim is to introduce the SCR only in the event of major incident. This initial reserve is calculated using methods from the theory of economic ruin, which is defines as "the occurrence of an adverse scenario, that can make it impossible for the company to meet some of its commitments, with regard to both its policyholders and its shareholders, or even cause it to cease trading due to insolvency." It is then a question of determining the initial reserve so as to control the risk of ruin, i.e. the risk that the amounts set aside in provision are lower than the debts.

Getting away from a binary view of risk

"This approach is based on a very binary view of risk," Stéphane Loisel says. "It is also rather short-termist, as it situated within a one-year time horizon in Solvency II, whereas insurers operate on the basis of long-term management. So in our work we hypothesize that risk is not defined as being below the solvency threshold, but as being below the threshold for too long or being very much below it." Stéphane Loisel and Julien Trufin introduce the concept of "average red area", i.e. the area representing the time spent below the solvency threshold. Being in the red area generates a cost for the insurer, which must therefore plan on a risk budget for the group for the payment of penalties.

> *Risk consists of being beneath the solvency threshold for a lengthy period or being very much below the threshold*

In this context, the researchers first focussed on the minimum initial reserve that an insurance company should hold so that to its "average red area" risk indicator, specified for a given time horizon, does not exceed the previously

Stéphane Loisel

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Methodology

The authors use and generalize Loisel's (2005) differentiation results. They show that the risk measure considered satisfies similar properties to the notions of consistency of Artzner et al. (1999), after adjustment of the consistency axioms. They use the classical results on stochastic orders and generalize the results of Trufin et al. (2012) and Loisel (2005) to demonstrate these properties and characterize the optimal allocation solution.

established threshold. The properties of this capital requirement as a measure of risk are then investigated, particularly the question of the subadditivity of such a measure.

Optimizing the initial reserve or risk budget

The proposed model thus provides the optimal reserve allocation that minimizes the average red area. It takes into account the issue of the fungibility of capital, namely the ability to quickly move money from one entity to another. Insurance groups are usually made up of different divisions, geographical areas and activities. But if one of them is facing a major claim, it cannot always quickly obtain funds from the other entities.

In the second step, the authors restate the problem in terms of the risk budget. They create a new measure capable of establishing the optimal risk budget allocation. The insurance company thus specifies the total amount of penalties it is prepared to pay. It then determines how to allocate the budget between the various entities, with a view to adhering to the risk limit it has chosen.

This computable measure values distribution tails dynamically, that is to say, it includes the cost associated with a risk as well as its volatility. A highly volatile risk, or a risk whose realization would generate significant financial costs, is therefore heavily penalized. Portfolio size, and hence the level of risk pooling, are also taken into account.

Reconsidering solvency requirements

Finally, the researchers show that both approaches lead to the same result. Sharing out the initial reserve is equivalent to seeking the best allocation of the overall risk budget: it is a matter, in both cases, in the absence of saturation, of equalizing the average time spent below the risk threshold for the different branches.

Although the average red area indicator cannot be used by insurers in continuous time without recourse to proxies, because it involves knowing the economic value of the company in real time, it highlights the shortcomings of the measures used: a highly binary view of risk and an overly short-termist time horizon.

In addition, a simplified version of the mean red area could be envisaged and taken into account in thinking about overall solvency requirements and reserve capital allocation. This would, for example, involve spreading the cost generated by the immobilization of capital. The model can help determine how much each entity in the group should pay on the basis of its contribution to the overall risk.

Find the Stéphane Loisel's interview on www.louisbachelier.org

Insurance: how can sudden changes in the frequency of claims or the intensity of mortality be detected?

Risk pooling, a fundamental principle in insurance, leads insurers to estimate an average risk, with a view to pricing. Estimating the frequency and magnitude of claims is one of the basic tools of insurance. One of the challenges is then to robustly detect moments of "regime change" (also called moments of rupture) in these parameters so as to quickly adjust rates and risk management in response to this change.

Key points

- To configure their products, insurers introduce a hypothesis regarding the intensity of claims. They base this hypothesis on historical data.
- This frequency, however, is liable to change over time. It is then essential for the insurance company to be quickly informed of this change so as to adjust its products and risk management.
- The authors have demonstrated the optimality of the CUSUM method for addressing this problem.

Based on the paper by Nicole El Karoui, Stéphane Loisel and Yahia Salhi "Minimax Optimality in Robust Detection of a Disorder Time in Poisson Rate" and on an interview with Yahia Salhi.

An upsurge in accidents, an increase in the number of natural disasters in a region, or a rapid decline in mortality of policyholders are some of the reasons that lead to higher prices for certain insurance products. An insurance company structures its products according to the estimation of the claims frequency: the more numerous they are, the higher the premium. To calculate this risk of loss, insurance companies use a mathematical process known as the Poisson process. In view of long experience, it is held that claims arise randomly, but with a certain similarity that enables the average frequency (intensity) of claims per time interval to be estimated: for example, given its history, the insurance company may estimate there will be 10 claims a year. Similarly, in the context of life insurance, the company starts, for example, from a "reference" mortality intensity (e.g. TGHF05 tables in France or Meduim Cohort in U.K.) to determine the mortality intensity of the population in its portfolio, the characteristics of which are different from those of the reference population. The insurer then chooses an abatement rate to link the two mortality intensities.

It is important to detect a rupture as quickly as possible while having a fixed average time up to false alarms

Signalling a change rapidly…

This hypothesis about the frequency of claims plays a key role in insurance, both in product pricing and the management of the underlying risks. It is therefore important to be able to properly estimate this frequency and especially to update it whenever the data flow indicates it is appropriate.

The research by Yahia Salhi and his co-authors sets out to address these issues. Specifically, the aim is to establish a surveillance procedure able to raise an alarm as soon as the intensity changes. This involves detecting an upsurge in claims, for example a

Yahia Salhi

Yahia Salhi has a PhD in applied mathematics from the University of Lyon, an MSc in actuarial science and finance, and an engineering diploma from the Ecole des Mines. He is now assistant Professor at ISFA, University of Lyon 1, and associate researcher at the BNP Paribas Assurance "Management of Insurance Modelling" Chair. Yahia's main research interests include detection of abrupt changes, longevity and mortality modelling, pricing and management as well as surrender risk modelling and mathematical aspects of impairment of financial assets under IFRS regulations.

Methodology

In the Poisson case, the authors solved the robust quickest detection problem by means of the cumulative sums (CUSUM) of the log-likelihood ratio. The basic idea of using this type of process was introduced by Page (1954), with the aid of sequential hypotheses testing. The author in fact draws a parallel with the statistical test based on the likelihood ratio. By considering two hypotheses – H0 "no change" and H1 "change" – a test of the likelihood ratio between the two hypotheses is implemented. To take into account the arrival of observations, the likelihood ratio is updated at each new observation. Then, to decide between the hypotheses H0 and H1, one considers the time(s) where the statistics of this test exceed a certain threshold set in advance. To show the optimality of such a procedure, the authors use martingales and local martingales related to the number of jumps up to the next time the CUSUM process goes above a barrier. The key to the demonstration is to solve the problem raised by the discontinuity (at the barrier) of the function, which links to a starting level the average number of jumps until it is above the barrier.

shift from an average of 10 claims a year to an average of 12 claims a year, or conversely a decrease in deaths corresponding to growing improvements in longevity.

…while limiting false alarms

To this end, the authors introduce the formalism of fast and robust detection. "Detection of ruptures in dynamic models has generated growing interest, including statistical monitoring, signal detection and control of industrial processes," Yahia Salhi says. "It meets a need on the part of risk managers to better control changes in their risk. The main objective is to diagnose problems that may arise throughout the evolution of the system." We are talking about the system as a whole. Monitoring involves detecting any abnormalities in a sequential manner.

Early detection answers to a two-fold issue: sounding the alarm as soon as possible to enable the supervisor to make appropriate decisions without delay, and at the same time limiting false alarms, namely the triggering of an alarm when no change has occurred. This issue is addressed through the minimax formulation, which combines the ideas of average time up until the false alarm and detection delay. The quality of a detection procedure is then assessed on its capacity to detect a rupture as quickly as possible, while having a fixed average time up to the false alarm. Taking these two measures into account, the minimax approach is formulated as an optimal stopping problem.

Financial and industrial applications

In their work, the authors show the optimality of the so-called CUSUM method for detecting a change in the intensity of a Poisson process. Though the method has been previously used, its optimality has not been proven until now.

This rapid detection method has numerous applications, especially in the insurance industry. For both life and general insurance, it signals a rupture in claims intensity within the portfolio. Insurance companies are thus able to better manage their risks, by adjusting their prices and quickly updating their working hypotheses, without over-reacting to a false alarm.

Outside the financial sector, the CUSUM method also has industrial applications, for example detecting a disturbance in a network or an intrusion into aviation air space.

Find the
Yahia Salhi's interview
on www.louisbachelier.org

IFRS: How are the optimal impairment parameters to be defined?

The rules for registration of securities impairments are open to various interpretations. In particular, practices differ widely from one insurance group to another. How do these choices affect the company's results? How are the most appropriate options for its strategy to be determined?

Key points

- IFRS provide companies with significant flexibility regarding the rules for recording unrealized losses.
- Each company itself defines what is a "significant" decline and a "prolonged" decline. The level of the parameters chosen directly impacts the amounts impaired and therefore the results.
- The authors provide a tool for defining the parameters most appropriate to the business strategy.

Based on the paper "Some characteristics of an equity security next-year impairment", Review of Quantitative Finance and Accounting, by Julien Azzaz, Stéphane Loisel and Pierre Thérond, and on an interview with Pierre Thérond.

Since 2005, International Financing Reporting Standards (IFRS) have governed the financial reporting of listed companies in Europe. In particular they codify unrealized gains or losses of AFS (available for sale) equities. For this category of securities, unrealized gains (the difference between the fair value at year N and the purchase value) are reported in equity, with no impact on earnings. However, when the difference is negative and reveals unrealized losses, it must, under certain conditions, be registered as a loss in the income statement.

According to the IFRS, an unrealized loss must be recorded in the income statement if the decline in fair value compared to the acquisition value is "significant" or if the decline is "prolonged". These two rather vague criteria leave considerable room for manoeuvre to businesses regarding the application parameters of these rules.

However, depending on the parameters set, the accounting result will differ. The definition of these criteria is particularly important for companies whose impairments cannot be reversed. Thus, when an impairment is recorded in the earnings in year N, it cannot be offset for the following year by an unrealized capital gain, since it will be included in equity.

The parameters used vary greatly from one insurance company to another

Disparate practices

Given this regulatory context, how do insurance companies interpret and apply these standards? What parameters do they set for defining a "significant" decline and a "prolonged" decline? What is the impact of these criteria on the impairments recorded? The paper provides answers for analysing the implementation of the regulations and the impact on the income statement.

As a first step, the authors observed the practices of insurers and found large disparities between them. The parameters used to define a significant or prolonged

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Methodology

The methodology used by the authors involves, in the first step, the mathematical formulation of the principles of IAS 39 relating to the assessment and accounting of equity instruments (shares, funds, etc.). Based on the Black & Scholes model, the authors use results from stochastic calculus and the theory of options (particularly barrier options) to explain the distribution of the level of impairment at a given time horizon. The results are expressed analytically, enabling easy implementation (choice of impairment parameters, integration of effects of impairment within a provisional budget, etc.)

decline are indeed very different from one company to another. For Axa or Allianz, for example, a significant decrease is 20% or more, while for Generali or CNP, it is a decrease of at least 50%. Similarly, a prolonged decline is deemed to begin after six months at Axa, whereas at Generali it is 36 months.

The criteria used obviously affect impairment practices. With lower parameter settings, impairments are more frequent but small. Conversely, if the parameters are high, impairments are less frequent but larger.

Pierre Thérond and his co-authors have developed a mathematical formula to describe the impact of parameters on the level of impairment. Depending on the criteria used, it is possible to calculate the expected amount of impairments for the year and to determine their distribution.

Optimal management of impairments

Such a method can facilitate the daily management of insurance companies by allowing their CFOs to better anticipate impairments and update provisions on a day-to-day basis. But it also applies upstream in defining the company's strategy. It is then a matter, for insurers, of using this decision aid tool to choose the impairment criteria suited to their characteristics.

Arbitrage is particularly difficult to ascertain since there is no single optimal set of parameters. The choice of parameters should take into account the specificities of the company, whether these be its business, its liquidity needs, the goals set by its shareholders or the type of securities management used (dynamic or otherwise).

These initial results open the way to a more complex tool. The authors are currently continuing their work so as to develop a formula incorporating an objective specified by the company. Such a formula would then be able to define the optimal parameters according to the characteristics of the company and the objective set by shareholders, such as having a relatively stable results over time. In this case impairments should be regular but small.

Finally, as well as operational applications, this work highlights the usefulness of financial mathematics in resolving accounting issues. "Little research has been carried out on this topic because it intersects the two disciplines of financial accounting and stochastic calculus", Pierre Thérond says. Mathematical models are, however, increasingly used in accounting standards, reinforcing the need for this type of research.

Find the
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