

KEY CONTRIBUTIONS OF OWN RISK SOLVENCY ASSESSMENT (ORSA) TO THE IMPROVEMENT OF THE ERM OF INSURANCE COMPANIES: A PRACTICAL AND INTERNATIONAL VISION

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Resumen

EIOPA (European Insurance and Occupational Pensions Authority), NAIC (National Association of Insurance Commissioners), OSFI (Office of the Superintendent of Financial Institutions) junto con otros reguladores a nivel mundial están desarrollando un nuevo requisito regulatorio denominado ORSA (Own Risk Solvency Assessment). ORSA ha sido diseñado para mejorar el proceso de gestión, valoración y reporting de los riesgos a nivel global (ERM) por parte de las compañías de seguros, presentado una especial atención a la optimización del proceso de toma de decisiones relacionando el nivel de solvencia de la compañía y su riesgo de exposición. El objetivo de los reguladores es proporcionar una mayor estabilidad al sector asegurador estableciendo una mejora proceso de gestión global del riesgos (ERM) desde el punto de vista regulatorio. Esta mejora incluye aspectos como la inclusión en el proceso de la fijación del apetito de riesgo de cada compañía, proceso de validación del capital de solvencia mediante la utilización de diversas metodologías como backtesting, stress testing, proyección de escenarios e incluso la inclusión de técnicas como reverse testing.

En este artículo las principales diferencias y similitudes entre los principales reguladores es descrita, así como las principales contribuciones de ORSA son analizadas, mostrando un especial interés al proceso de backtesting con el ánimo de validar la valoración desarrollada en relación al capital de

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solvencia requerido. Por último, se desarrollaran dos ejemplos prácticos en el objetivo de analizar de forma práctica el proceso de backtesting presentado en el artículo desde el punto de vista teórico.

Palabras clave: ORSA, NAIC, EIOPA, OSFI, VaR, TVaR, Stress testing, Backtesting, Reverse Testing.

Abstract:

EIOPA (European Insurance and Occupational Pensions Authority), NAIC (National Association of Insurance Commissioners- US regulator) OSFI (Office of the Superintendent of Financial Institutions -Canadian regulator) and other regulators are working on a new regulatory requirement called ORSA (Own Risk Solvency Assessment). ORSA is designed to improve the risk management, reporting and assessment process of insurance companies, especially in the decision-making process with regard to the level of solvency according to their risk exposure. In this presentation the differences and similarities between the jurisdictions are described.

The objective of the regulators is to improve the stability of the insurance sector establishing an adequate risk management requirement that includes important aspects such as definition of the risk appetite, validation of the solvency requirement using, for example a backtesting methodology, stress testing, scenarios projection and the inclusion of technique such as reverse testing.

In addition, the analysis of the main contributions of ORSA for the insurance companies is developed, highlighting points such as stress, scenario projection and the back-testing process with the aim to accurately assess the solvency capital requirement according to the situation of the company. Practical examples and real-life business cases will be provided to illustrate the process.

Key Words: ORSA, NAIC, EIOPA, OSFI, VaR, TVaR, Stress testing, Backtesting, Reverse Testing.

1. Introduction

The European and U.S regulators among other jurisdictions are working on a new regulatory framework called ORSA (Own Risk Solvency Assessment) to comply with the Insurance Core Principal 16 enacted by IAIS. ORSA is designed to improve risk management, assessment and reporting of insurance companies. This is not just a regulatory requirement for the calculation of the level of solvency according to the main risks of the company; it is the calculation of the solvency capital according to the whole risks of each company. ORSA encourages insurance companies to set up their own risk management procedure to identify, assess, measure, monitor, control and mitigate the risks. ORSA is not a prescriptive regulation in general but the companies should develop an analysis describing how they should manage risk and capital at the corporate level.

But what is ORSA? A general definition of ORSA is complicated because every regulatory jurisdiction defines it considering different aspects. ORSA is a set of processes constituting a tool for decision-making and strategic analysis.

The main characteristics are:

- ORSA encourages insurance companies to improve the ERM
- Its aim is to enhance decision making of companies considering their own risks in a global vision
- ORSA requires insurers to form their own view of their risk profile and capital needs.
- Other requirement is that every insurer must embed risk analysis and solvency assessment in their strategic planning and day-to-day business management.

Insurance companies have a lot of issues related to the development and implementation of ORSA. They consider that ORSA, from a theoretical point of view is one of the most important contributions from the regulator. They agree that ORSA makes a great contribution to the improvement of ERM process carried out by insurance companies. ORSA is not just the implementation of an adequate enterprise risk management process; the implementation of ORSA satisfies more objectives such as:

- Improve the risk decision making and validation of the risk

assessment.

- Include more types of risks than the traditional regulatory risks such as reputational or strategic risks.
- Enhance the risk assessment calculation and to implement additional methodologies to verify the quality of the measure of the risks. Methodologies such as stress testing, reverse testing, assessing scenarios and circumstances that would render its business model unviable, thereby identifying potential business vulnerabilities and to make a multi-year projection of the insurer's business plan under a range of different financial and business conditions.

The paper is divided into the following sections: first, we describe in Section 2 the regulatory framework and latest updates of ORSA in different systems like: Europe, US and Canada. In Section 3 a proposal of the ORSA process is presented from a practical point of view. In this section the stress testing, shock scenario projection, backtesting processes and capital projection are explained using illustrative examples and case studies. This article ends by presenting the main conclusions, final remarks and further steps.

2. ORSA: Regulatory framework and latest updates

The regulators are increasingly concerned to receive adequate risk control and reporting by insurance companies in a more globalized and interconnected environment. ORSA is one of the regulator's requirements according to this new framework.

The regulators have different visions about ORSA but the point in common is the idea to improve the risk management and assessment process of the insurance company according to the level of solvency of each company. ORSA is based on ERM (Enterprise Risk Management), in order to establish a regulatory framework for insurance companies to carry out adequate risk identification, assessment and reporting. The importance of analyzing each type of risk that insurance companies might face is vital.

The term was originated with the U.K. insurance regulator, the Financial Services Authority (FSA). Starting in 2005, under what was known as the Individual Capital Adequacy Standards Regime or ICAS, the FSA required insurers to evaluate their own risks and report the capital the insurer believed it needed to support those risks. The FSA discovered, however, that

companies generally treated the ICAS as more of a compliance exercise than an integral part of the insurer's risk management. Those that did the work to support ICAS were not necessarily tied in to the business operations. The FSA wanted to have the internal capital assessment process "owned" by the insurer (including the insurer's board of directors) and integrated into the operations of the business. Individual(s) within the FSA developed the concept of an Own Risk and Capital Assessment, based on the ICAS concept, and pushed for its acceptance within new Solvency II requirements. The European Commission endorsed the concept, but made a request that the 'C' (Capital) be changed to 'S' (for Solvency) to make it consistent with what they were generally calling their reforms: Solvency II. As a result, ORCA was changed to ORSA. The concept was also added to the International Association of Insurance Supervisors' (IAIS) list of Insurance Core Principles, or ICPs. (It is currently included in the latest version of ICP 16, dealing with ERM requirements, adopted in October 2010.)

2.1. EU Solvency II Version

In 2004 the European regulator and other institutions related to the insurance and financial sector started to work under a new solvency regulation. This new regulation, called Solvency II introduces a new solvency regime, which will be characterized by an integrated risk approach, which allows the risks an insurer is facing to be better taken into account than under the current solvency regime. Solvency II is based on a three pillar approach which is similar to the banking sector but adapted for insurance.

The first pillar contains the quantitative requirements. There are two capital requirements, the Solvency Capital Requirement (SCR) and the Minimum Capital Requirement (MCR), which represent different levels of supervisory intervention.

The SCR is a risk-based requirement and the key solvency control level. Solvency II sets out two methods for the calculation of the SCR: the European Standard Formula or firms' own internal models. The SCR will cover all the quantifiable risks an insurer or reinsurer faces and takes into account any risk mitigation techniques. The MCR is a lower requirement and its breach triggers the ultimate supervisory intervention: the withdrawal of authorization. The second pillar contains qualitative requirements on undertakings such as risk management as well as supervisory activities and additional quantitative requirements such as stress testing, reverse stress

testing and scenarios analysis, in summary the improvement of the risk assessment. The third pillar covers supervisory reporting and disclosure. Firms will need to disclose certain information publicly, which will bring in market discipline and help to ensure the stability of insurers and reinsurers (disclosure).

ORSA emerged in the context of Solvency II, within Pillar II. According to the European Regulator in the principles of one of the issues papers of May 2008, they consider that ORSA should be based on adequate ERM, validation and assessment processes and should form an integral part of the management process and decision making framework of the undertaking. At the heart of the prudential Solvency II directive, the Own Risk and Solvency Assessment (ORSA) is defined as a set of processes constituting a tool for decision-making and strategic analysis. It aims to assess, in a continuous and prospective way, the overall solvency needs related to the specific risk profile of the insurance company.

According to the Solvency II directive we would like to remark in relation to ORSA:

“.. Properly identify and assess the risks it faces in the short and long term and to which it is or could be exposed. The undertaking shall demonstrate the methods used in that assessment”(article. 45 Solvency II Directive)

In relation with that the insurance companies should show to the regulator what methods, metrics and risk measures are used for the assessment and if this metrics are adequate to their data and real situation to prevent undesirable situations.

“..When an internal model is used, the assessment shall be performed together and the recalibration and transforms the internal risks numbers in the SCR risk measure and calibrations”...(article. 45 Solvency II Directive)

The ORSA shall be conducted on a regularly basis and be an integral part of the business process and be a part of the strategic decisions that the company makes. As a minimum, its should include:

- The overall solvency needs, including non-quantifiable risks.
- Compliance with the requirements related to the technical provisions and capital.
- Any deviations between the company's own risk profile and the assumptions underlying the SCR calculation, resulting in recalibration of

(partial) internal models.

There are companies that consider it better to develop an internal model for the calculation of the solvency capital requirement to comply with the first Pillar. According to the second Pillar it is necessary to evaluate whether the methodology applied is adequate for the data of the company and to include in the methodology and calculation other types of risks, stress testing methodology, reverse testing methodology and back testing process, with the aim to avoid risky or undesirable situations.

2.2. NAIC: US Version

The NAIC's Solvency Modernization Initiative (SMI) began in June 2008. The SMI is a critical self-examination of the United States' insurance solvency regulation framework and includes a review of international developments regarding insurance supervision, banking supervision, and international accounting standards and their potential use in U.S. insurance regulation. While the U.S. insurance solvency regulation is updated on a continuous basis, the SMI will focus on five key solvency areas: capital requirements, international accounting, insurance valuation, reinsurance, and group regulatory issues.

The Own Risk and Solvency Assessment (ORSA) is set to become a key part of the regulatory framework for US insurers. In November 2012, the NAIC described its proposed expectations for the assessment and resulting ORSA filing in its ORSA Guidance Manual. This paper explores the Manual's key features and its implications for insurers as they prepare for the expected US ORSA requirement, in particular: the requirements of the NAIC's ORSA Guidance Manual and what regulators are expecting, what ORSA filings will look like in practice and how insurers can start preparing for them, what the ORSA will mean for business planning and how it could lead to a stronger process, and next steps.

The current effective date for the requirement is January 1, 2015, with insurers expected to file their first ORSA Summary Report during that year.

The ORSA Summary Report developed by NAIC, contains three sections: Section 1 – Description of the Risk Management policy: This section discusses the insurer's risk culture and governance; risk identification and prioritization; risk appetite, tolerances and limits; risk management and controls; risk reporting and communication. The insurer's risk policies

should also be included in this section of the document to evidence it has a well-thought-out and comprehensive risk framework in place.

Section 2 – Quantitative Measurements of Risk Exposure in Normal and Stressed Environments: In this section will contain the calculations and numbers regarding to the measurements of risk exposure in normal and stressed environments. Companies should be prepared to discuss expected values in normal and stressed environments, reverse stress test factors, measurement types, etc. Section 2 may include detailed descriptions and explanations of the material and relevant risks identified by the insurer, the assessment methods used, key assumptions made and outcomes of any plausible adverse scenarios assessed. The assessment of each risk will depend on its specific characteristics. For some risks, quantitative methods may not be well established and, in these cases, a qualitative assessment may be appropriate. Examples of these risks may include certain operational and reputational risks. Additionally, each insurer's quantitative methods for assessing risk may vary; however, insurers generally consider the likelihood and impact that each material and relevant risk identified by the insurer will have on the firm's balance sheet, income statement and future cash flows. Methods for determining the impact on future financial position may include simple stress tests or more complex stochastic analyses. In the risk assessment process, the insurer provide on analysis of the results in both normal and stressed environments. Lastly, the insurer's risk assessment should consider the impact of stresses on capital, which may include consideration of risk capital requirements, available capital, as well as regulatory, economic, rating agency or other views of capital requirements. The ORSA Summary Report should demonstrate a general description of the insurer's process for model validation, including factors considered and model calibration. Unless a particular assumption is stochastically modeled, the group's management should set assumptions regarding the expected values based on its heir current anticipated experience, studies and what they expect to occur during the next year or multiple future years, and consideration of expert judgment.

Section 3 – Group Economic Capital and Prospective Solvency Assessment, this section contains an assessment of economic capital at the group level and a prospective solvency assessment. As part of the economic capital assessment, insurers should explain and calculate, as necessary, their definition of solvency, time horizon of risk exposure, risks to be modeled, how risks are quantified, and measurement metric and target capital level.

2.3. OSFI: Canada Version

The Office of the Superintendent of Financial Institutions Canada (OSFI) is proposing new and modified guidance for federally-regulated life and property and casualty insurers and was posting draft versions for public consultations until April 12, 2013. Both guidelines are to become effective on January 1, 2014. The first proposal is a release of a new guideline: Guideline E-19: Own Risk and Solvency Assessment (ORSA). This new guideline will set out OSFI's expectations on how insurers assess their own risks. The second proposal sought to amend its current Guideline A-4: Internal Target Capital Ratio for Insurance Companies to become Guideline A-4: Regulatory and Internal Target Capital Ratios. The revised guideline will set out OSFI's expectations with regards to the capital and solvency assessment requirements of insurers.

The elements of ORSA according to the Canadian regulator are a comprehensive identification and assessment of risks, establishing the relationship between risk and capital developing qualitative and quantitative analysis using the methodologies of stress-testing and scenarios, In addition ORSA should imply board oversight and senior management responsibility, good monitoring and reporting, internal controls and independent review. In relation to the first point, a comprehensive identification and assessment of risks, the regulator considers at the very least ORSA should explicitly address insurance, market, credit and operational risks. For the identification and assessment the insurers could take into account the E-18 guideline and supervisory framework for the stress testing. Therefore in this section the descriptions and considerations of some not-easily-quantifiable risks are included. The analysis of risks which are difficult to evaluate is one of the most complicated issues involved in the ORSA process.

In the second consideration from the Canadian regulator, the nature, scale and complexity of an insurer will be taken into account.

Furthermore, the insurer should estimate the amount of capital needed for the risks they assume, incorporating these amounts into their overall assessment of capital adequacy. In addition the insurance company, in order to develop an adequate ORSA process, should determine their own capital needs, their own risk appetite and they should make a clear determination for each risk, an explicit amount (quantity) and type (quality) of capital which they should hold.

OSFI assumes that insurers will develop appropriate risk assessment of available methodologies and tools with the aim to determine the most adequate own risk capital needs and capital composition. OSFI does not provide a list of approaches, methodologies or tools but they require that a number of factors should be considered, such as differences of risks and LoBs, concentrations of insurance and capital needs in order to contribute to the financial strength of the company, among others factors.

Therefore, OSFI considers that the insurer should apply methods or techniques such as combined stress and reverse stress tests, including an adequate DCAT (Dynamic Capital Adequacy Testing) in order to be prepared for unexpected situations or potential risks. In addition OSFI establishes that an insurer that has determined its capital needs should make additional adjustments based on scenario and stress testing which may be required to set the internal targets.

Moreover, the insurer according to OSFI should integrate ORSA process in the management and decision making of the company. Another important issue that it should take into account in order to implement ORSA is the implication of the board and senior management in the process. The board should determine the risk appetite and risk tolerance limits and the senior management should have a good understanding of the nature and level of all the risks taken by the insurer.

What is more, an adequate ORSA process should include a complete monitoring and reporting process in which the company describes the minimum requirements established by OSFI in order to get approval from the regulator, as previously described. It is important to highlight that, according to OSFI, the insurer should be subject to periodic independent reviews, in addition to the internal controls established to improve the quality of ORSA.

There are important similarities between jurisdictions; all of them are focused on the implementation of an adequate ERM by the insurance companies, a suitable analysis of the definition of the risk appetite according to the objectives and policy of the company, a correct risk assessment of all the risks of the company, carrying out the most appropriate validation of the assessment. In addition all systems determine the importance of the implication of the board and the senior management of the company and the calculations of the own capital needs according to risks taking into account

the different LoBs. Furthermore the insurer should include a scenario analysis projection, stress testing and reverse testing techniques.

3. A practical vision of the ORSA process

In this section several issues of ORSA will be analyzed, as insurance companies are deeply concerned about their implementation. In addition, a proposal of the ORSA process implementation is presented; developing several examples with the aim to clarify various quantitative issues related to the implementation of this process and, to a lesser extent, other qualitative issues.

Our objective is to simply present the analysis of the most important keys related to ORSA in a practical vision to serve as a guide and to complement existing implementations. There is not a unique form to embed ORSA in the business process of the company due to the fact that each company has its own corporate culture, governance, management depth and strategic vision. Our approach is based on the modeling vision because the ORSA process needs to have a quantitative foundation that is consistent with the insurer's other business metrics and regulatory capital processes. ORSA is based on the ERM process which is defined by Lloyd's as *"a structured and disciplined risk management approach considering strategy, process, people, technology and knowledge with the purpose of continually evaluating and managing risks to business strategies and objectives on an enterprise-wide basis"*.

In addition, it is important to remark that ERM is a continuous activity that aggregates all types of risks in order to achieve maximum risk-adjusted returns. Further to this consideration applicable to ORSA, it is important highlight that ORSA is focused on the level of the solvency of the insurer according to the risks under regulatory vision.

The steps of the ORSA process proposal are:

- Definition of the risk profile and vision of the company: The insurer's risk culture and governance, risk appetite, tolerance and limits.
- Risk identification: Risk drivers analysis and elaboration of the map

of risks according to the ERM of the company

- Risk Assessment and Quantitative measurement: Risk measures, validation of the model, stress testing, shock scenarios, reverse testing and other techniques with the aim to improve the risk assessment process.
- Risk decision making (I): Risk treatment such as the decision related to the acceptance, control, reduction, avoidance and transfer of the risks and other decisions related to the stress and scenario analysis in order to prevent undesirable situations.
- Economic capital and risk solvency capital requirement: In this step the capital projection and ratio analysis will be considered.
- Risk decision making (II): Decisions related to economic capital and capital allocation according to the risks will be analyzed.
- Control and monitoring the ORSA process
- Elaboration of the regulatory report included in the previous steps and analysis.

Now, several issues are going to be explained in greater detail.

3.1. Definition of the risk profile and vision of the company:

According to the first step of the proposal, the risk profile of a company is going to be presented in a practical vision, highlighting the analysis of the risk appetite, tolerance and limits according to the ORSA framework.

The risk profile of the company is going to include the insurer's risk culture and governance, risk appetite, tolerance and limits.

First of all, the risk culture and governance is defined by Lloyd's as "effective risk management requires the appropriate definition and assignment of roles, responsibilities, accountabilities and authorities to support managed risk taking. Risk governance is an integral aspect of corporate governance"

This issue in the ORSA framework is connected to the ERM process established by the insurer. ORSA is focused on the solvency requirement according to the whole risks of the company but the main questions are:

- How is the insurer going to develop the ORSA report according to the risk culture and governance of the company?
- What information from the ERM process is going to be necessary to include in the ORSA report in relation to this first section?
- What information is necessary to be analyzed or considered by the insurer in order to develop an adequate ORSA report?

In relation to the Risk Culture and governance, the following agents should be considered:

- **The Board:** At the top of the pyramid, this has the ultimate accountability for the risk and related control environment, and is responsible for approving and reviewing risk policies. Its role and responsibility in relation to ORSA is the full understanding of the solvency needs, the capital requirement and the significance with which the risk profile deviates from the assumptions underlying the solvency capital.
- **The Executive committee:** It is responsible for reviewing and challenging risk information and referring issues to the Board. For the senior management team, ORSA offers the opportunity and the framework for a focused and reasoned risk discussion with the Board, related to risk appetite, risk policies and the understanding of solvency needs in order to comply with the regulation requirement and to be prepared for undesirable situations.
- **The Risk Management Division:** The risk management function will likely be the overall owner of the ORSA process. It will be responsible for the governance of the process and will contribute to ORSA by assessing the risks currently faced by the company including short- or long-term risk.
This will include, at least, information on underwriting and reserving, asset-liability management, investments/derivatives, liquidity and concentration risks, operational risk management and reinsurance and other risk mitigation techniques. Additional reporting is required where partial or full internal models are used. (Article 44. DIRECTIVE 2009/138/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2009)
- **Business Departments:** They are the “risk-takers” and are responsible for identifying, assessing, measuring, monitoring and reporting risks associated with their business or functions. In this section it is important

to highlight the role and responsibilities of the actuaries and actuarial departments of the company involved in the ORSA process. The actuarial function is responsible for many of the quantitative elements. It will contribute to the ORSA projections and scenarios, assumptions setting and calculation of the technical provisions and capital requirements.

As the actuarial function is also required to express an opinion, for example, on the underwriting policy and adequacy of reinsurance arrangements, it is expected that the actuarial function develops a revision and analysis of the ORSA material. (Article 48. DIRECTIVE 2009/138/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2009).

Another example of the contribution of the finance and investment department to the ORSA process consists of providing input into the balance sheet projections and will use the ORSA results in the day-to-day management of the business.

- Internal Audit is responsible for independently assessing the effectiveness of risk management processes and practices and for providing timely objective assurance on the control of risk. (Article 46 and Article 47 of DIRECTIVE 2009/138/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2009).

The next important issue is the definition of risk appetite, but this is not easy because this process involves the whole company from the highest to the lowest level of the company.

When a company sets its risk appetite it should consider the following questions: Investor expectations, financial strength, the attitude to risk taken by the Board and senior management, the proposed business plan such as: risk classes, line sizes, territories, aggregates and exposures, potential gross and net realistic disaster scenarios particularly for high hazard classes.

But, what is risk appetite? According to Lloyd's, risk appetite reflects the amount of risk taking that is acceptable to an organization. Risk appetite is a function of the organization's capacity to bear risks and of its attitude towards managed risk-taking. Risk appetite can also be viewed as assigned or allocated risk capacity. Risk appetite plays an important part in supporting risk assessment and activities of monitoring and control. It does this by helping staff to understand the relative significance of the risks faced by the organization.

Risk appetite plays a key role in maximizing return on capital invested as it acts as a driver for the allocation of capital to identified risks. Better understanding of risk appetite entails more efficient allocation of capital across the organization. It is really important to observe that the constraints on risk appetite include the capital which needs to be maintained to support a target rating agency's rating and regulatory capital requirements.

It is important to take into account the effective strategy of the company needs to incorporate the risk appetite considering aspects such as: the insurer's target market, customer segments, core products, as well as a number of key performance targets which could affect return on equity and growth in regulatory surplus.

In order to define the risk appetite, under a quantitative vision, the following quantitative aspects are considered within the ORSA (E.U Solvency II) framework:

- Level of Solvency Capital requirement: The SCR, whether calculated from the Standard Formula or otherwise, is the capital level corresponding to the Value-at-Risk (VaR) of the basic own funds of an insurance or reinsurance undertaking subject to a confidence level of 99.5% over a one-year period. Sometimes referred to as the 99.5% one year VaR standard. This is a level intended to be sufficient such that the insurer could withstand a 1 in 200 year shock within one year with sufficient assets remaining to allow for the sale or transfer of its remaining liabilities to another insurer. In addition to the SCR, each insurer also calculates a Minimum Capital Requirement (MCR). The MCR represents a threshold below which the national supervisor would intervene. The MCR is intended to reflect an 85% probability of adequacy over a one-year period and is bounded between 25% and 45% of the insurer's SCR.
- Solvency Ratio. (Own funds/SCR). In ORSA the insurer should have the ability to understand how the regulatory and solvency capital requirements will behave under different feasible future business and financial circumstances, taking into account the different types of own funds that the company has, under the tiering vision. (Tier 1, 2 or 3)
- Assets quality: The quality of assets to cover the SCR is focused on

the own funds of the company, defined by the excess of assets over liabilities, less own shares; and Subordinated debt and ancillary own funds which are not basic own funds but can still be called upon to absorb losses.

Finally, in addition to the above mentioned risk appetite parameters, it could be necessary to determine the limits of these parameters defined by the insurance company, considering aspects such as historic performance, current and future exposure, and volatility of underlying factors among other factors.

3.2. Risk Identification: In relation to the risk identification, the risk drivers are analyzed and the elaboration of the map of risks according to the ERM of the company and definition of the key risk indicators are going to be critical. The insurance company in order to comply with the ORSA regulation should include whole risks of the company, all risks considered in the Pillar I of Solvency II or the risks taken into account by the US regulator (Risk Based Capital and Initiative Solvency Modernization) or by the Canadian regulator (Target Solvency Ratio).

In addition, in order to complete the whole risk map of the company considering risks is necessary to consider other types of risk such as strategic, reputational and liquidity among others. The outcome of this process should be the identification of all the risks of the company presenting a risk list based on the solvency regulation, aligned with the industry and classification of rating agencies. Additional sub-categories for classification are developed to tailor the risk list to the company. Afterwards, the company develops the risk heat map in order to facilitate the prioritization of key risks based on their likelihood and impact, allowing the company to focus risk management activities on the most significant risks.

It is necessary to take into account that risk mapping techniques can be used when historical data is unavailable but in these cases frequency and severity will be calculated based on the different opinions from experts which evaluate the risks according to their experience. Risk heat maps provide the management with comprehensive risk information needed to effectively understand and manage their risks.

3.3. Risk Assessment and quantitative measurement: Risk Measures: In choosing metrics and processes for conducting an Own Risk and Solvency Assessment (ORSA), one needs to be clear about what the purpose of an

ORSA is. For ORSA to be a serious part of running a business, it needs to improve risk decision making, and in a tangible way. So it is necessary to take into account the following aspects: the traditional risk measures such as VaR, CVaR, and other possible risk measures, the validation of these risk measures and the stress scenarios and economic capital projection.

To maximize the decision support provided, with the aim of achieving ORSA's objectives, the risk quantification will need to satisfy a number of requirements:

- Different stakeholders have different levels of interest in different parts of the distribution – the perspective of the decision-maker is important. Regulators and rating agencies will be focused on the extreme downside where the very existence of the company is in doubt. On the other hand, management and investors will have a greater interest in more near-term scenarios towards the middle of the distribution and will focus on the likelihood of making a profit as well as a loss.
- The approach taken to measure risk needs to be suitable for the purpose for which it is being used. This refers to both the properties of the risk measure selected as well as the risk tolerance selected for a given measure. For example, risk is commonly measured by looking at the result for a specific return period. What are the limitations in using such a measure? In what circumstances can such limitations affect the analysis? Which return periods might be considered for the stakeholders?
- Is the risk measure understood by the decision-maker? A detailed technical understanding may not be essential if there is a good appreciation of how the measure should be used and its values interpreted.

First of all, it is necessary to remark that there are multitudes of risk metrics that have been used in the insurance industry, highlighting the VaR and CVaR among other risk measures. The firm's own assessment of the economic capital requirements of the business could be calculated under a definition of capital that is specific to the business and hence different from regulatory capital requirements such as Solvency II Pillar I's 1-year 99.5% VaR capital or the CVaR 90 run-off capital used in the US principle-based approaches to reserving and capital.

Value-at-Risk (VaR) is the loss at a predefined confidence level (e.g. 99.5%). Thus if the company holds a capital of VaR, it will remain solvent (in the sense of having assets at least as great as its regulatory liabilities) with probability of the confidence level (e.g. 99.5%). And Conditional Value-at-Risk (CVaR) is the expected value of the loss in those cases where it exceeds the predefined confidence level. It is sometimes also called Conditional Tail Expectation (CTE), Expected Shortfall (ES) or Expected Tail Loss. Thus the CVaR is equal to the average loss a company will suffer in case of (extreme) situations where losses exceed the predefined confidence level (of 99.5%). It is necessary to consider both risks measures and their validation process according to the data of the company. In the case of Value at-risk (VaR), it is necessary to mention that it has been a popular metric for setting capital, as it can capture tail risks and is relatively easy to explain and understand; but it cannot be forgotten that VaR has limitations as it fails to meet the characteristics of the sub-additivity which implies that VaR is not a coherent measure. With non-subadditivity it could be the case that a well-diversified portfolio requires more regulatory solvency capital than a less-diversified portfolio. The sub-additivity condition plays a fundamental role in risk measurement. In addition, VaR does not consider what happens in the tail of the distribution, so it is necessary to consider other risk measures such as CVaR.

In summary, in the ORSA framework, it is very important to analyze the correct validation risk assessment process and the risk measures used according to the situation and the data of the company, but of course, the first step consists of the consideration of the VaR and CVaR, because they are the risk measures required/advised by the regulator and their properties are really convenient in order to measure the most common risks of insurance companies, especially CVaR due to the fact that it is a coherent measure, which means it could adapt better to the characteristics of the insurance portfolio data, allowing the analysis of the diversification between risks and the consideration of the tail insurance losses.

3.4. Validation of the model: The Backtesting process : In this section we are going to highlight the back testing method to validate the accuracy of the model over time used for the assessment of quantitative risks which are evaluated using risk measures. The motivation to backtesting is to improve risk management efficiency and accuracy of the risk measures. In this paper is presented the application of the QCRM backtesting to ORSA process due to this test introduces new hypothesis testing in which the null and

alternative hypothesis are exchanged, improving the control of the probability of accepting a wrong model. QCRM test enhances the risk decision making of the company and it is one of the requirements of ORSA.

Backtesting is a reliable tool for decision making. The benefits of backtesting from an insurance company perspective are numerous. Backtesting can lead to increased accuracy in risk management and to get more adequate solvency capital. Backtesting contributes to the sustainable development of risk management, because it is not only risk reporting and control but also continuous improvement of the risk assessment process. Backtesting is a statistical procedure where actual profits or losses are systematically compared to corresponding risk measure estimates. The Backtesting process is going to be included in ORSA (Pillar II- EU Solvency II) in the validation process to help the insurers to determine whether the measure used in the assessment is adequate for the specific situation of the company, offering them a comprehensive, clear report to present to the regulator and a good method to validate and certify the control of risk measurement. Backtesting is focused on sections 2 and 3 of NAIC's ORSA and it will be applied to the risk validation process for the assessment of the quality of risk measures. A variety of tests were used to perform backtesting of risk measures (focused on VaR), such as Kupiec's Proportions of Failures test, Kupiec's Time until First Failure test, Lopez's Magnitude loss function test, Christoffersen's interval forecast test, Mixed Kupiec-Test, Basel Backtesting VaR and (Qualitative Control Risk Measure) QCRM test. The most widely-known test based on failure rates has been suggested by Kupiec (1995). Kupiec's test, also known as the POF-test (proportion of failures), measures whether the number of exceptions is consistent with the confidence level. Under null hypothesis of the model being 'correct', the number of exceptions follows the binomial distribution discussed in the previous section. Hence, the only information required to implement a POF-test is the number of observations (T), number of exceptions (x) and the confidence level (c). Another well-known test of conditional coverage was proposed by Christoffersen in 1998. He uses the same log-likelihood testing framework as Kupiec, but extended the test to include also a separate statistic for independence of exceptions. In addition to the correct rate of coverage, his test examines whether the probability of an exception on any day depends on the outcome of the previous day. This assumption was assumed by Basel for the banking industry in 2006. The testing procedure described was explained, for example, in Jorion (2001), Campbell (2005), Dowd (2006) and in greater detail in Christoffersen (1998). Christoffersen's interval

forecast test is a useful back-test in studying independence of VaR violations but unfortunately it is unable to capture dependence in all forms because it considers only the dependence of observations between two successive days. It is possible that the likelihood of a VaR violation today does not depend on whether a violation occurred yesterday but whether the violation occurred, for instance, a week ago. (Campbell, 2005). In this paper the Quality Control Risk Measure (QCRM) is going to be analyzed with more detail because it provides additional advantages in relation to the other backtesting methods such as, for example, to enhance the ability of the test to reject an incorrect model. QCRM was described by Victor de la Peña (2006) with the aim to improve the backtesting process. QCRM introduced the exchange of the hypothesis, a technique to obtain accurate estimates of the acceptance /rejection regions and a new definition of the power of the test that allowed the comparison of QCRM and other backtesting procedures. The QCRM test is a statistical improvement approach of Basel Backtesting VaR and QCRM was designed to control the type II, to control the probability of accepting the VaR model when the model is incorrect.

Each outcome (losses or profits) either produces a VaR violation exception or not. This sequence of successes and failures is commonly known as Bernoulli trial. The number of exceptions follows a binomial probability distribution. Usually the number of observations increase, the binomial distribution can be approximated with a normal distribution. By utilizing this binomial distribution, the accuracy of the VaR model is examined. QCRM like Basel Backtesting VaR established traffic-light zones in order to improve the decision-making by the bank or in our case by the insurance company. As we mentioned, the differences between the banking sector and the insurance sector are relevant and the current economic situation determines a more conservative. According to Solvency II, VaR should be calculated by 99.5%. By analogy to the Basel supervisory framework and QCRM applied to the banking industry, QCRM for insurance companies defines the following new zones. Following the main characteristics of Quality Control Risk Measure are presented.

- New hypothesis testing problem in which the null and alternative hypothesis is exchanged with the aim to control the probability of accepting a wrong model
- QCRM starts with the hypothesis that VaR model is incorrect and then tests this against the alternative hypothesis that the VaR model

is correct.

- p_0 is the probability of an exception when the VaR model is correct
- p_1 is the unknown probability value when the model is correct

Accepting the null hypothesis then implies the rejection of the VaR model, while rejecting the null hypothesis leads to the acceptance of the model. Under the assumptions of Basel I, our exceptions are independent so that the number of exceptions

$$S_n = Y_1 + Y_2 + \dots + Y_n = \sum_{i=1}^n Y_i = X \rightarrow B(n, p)$$

The statistic S_n is also a sufficient statistic for P . The test rejects

$$H_0^Q : p < p_1 \text{ vs } H_1^Q : p \leq p_0 \Leftrightarrow \{S_n \leq s(p_1)\}$$

is uniformly most powerful level α test, where $\alpha = P_{p_1}(S_n \leq s(p_1))$

QCRM for insurance companies defines the following new zones (rejection and acceptance zones):

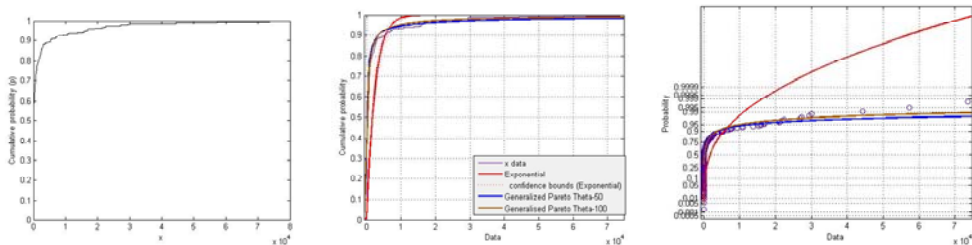
- New green zone: The VaR model is certified as correct if P_0 is in the 99% one side confidence interval for $p \rightarrow (p_l(x,0,01),1]$
- New yellow zone: When P_0 is not the one-sided 99.5% confidence interval but it is on the 99% one-sided confidence interval for $p \rightarrow (p_l(x,0,005),1]$ then the validity of the model is questioned.
- New red zone: if P_0 is not in the 99.5% confidence interval for $p \rightarrow (p_l(x,0,005),1]$ then the VaR model is rejected.

Regions	99,5%	99%
K=1	(0,00028784,1]	(0.00041314,1]
K=2	(0,00094068,1]	(0.0012,1]
K=3	(0,0019,1]	(0.0023,1]
K=4	(0,0030,1]	(0.0036,1]
K=5	(0,0043,1]	(0.005,1]
K=6	(0,0057,1]	(0.0065,1]
K=7	(0,0072,1]	(0.0081,1]
K=8	(0,0088,1]	(0.0098,1]
K=9	(0,0104,1]	(0.0116,1]
K=10	(0,0121,1]	(0.0134,1]

Table1: 99% and 99.5% right-sided confidence intervals for the probability of an exception after observing exceptions in 360 days

According to this methodology for defining the zones, using QCRM the green zone is established for (1 or 4 exceptions), the yellow zone (5 exceptions) and the red zone (6 or more exceptions).

In the following case study the implications of the QCRM back testing process will be analyzed. The data that we will be using for this case study is the insurance property losses of a captive insurance company. It is necessary to highlight that this is a simple example in order to describe the application of the QCRM to real data. The captive belongs to a Hotel Chain-Group and the LoBs this captive has are property and casualty. The LoB selected for this analysis was property claims data and the period considered is 2007/2008. First of all, an analysis of the empirical data has been developed, as we can see in the graphical analysis the empirical insurance data fits a Generalized Pareto distribution (Theta=100), as is sometimes common in this distribution the expected value and variance are infinite.



Graph 1: Empirical data of cumulative distribution, cumulative probability plot and density probability plot

According to previously-presented QCRM methodology the optimal confidence intervals have been determined analyzing the number of VaR exceptions which occurred in 2007 and 2008, given $\alpha = 0,005$, $\alpha = 0,01$ and $\alpha = 0,05$. As we can observed in the analysis, if the company calculates the VaR when $\alpha = 0,005$ and $\alpha = 0,01$, It is in the green zone which indicates the situation is safe and VaR⁴ is therefore an adequate risk measure for this data and this situation for 2007 and 2008. However when $\alpha = 0,05$ the company in this LoB is in a dangerous situation because the company considers the maximum losses⁵ could be incurred 21.097 € and the number of VaR exceptions has increased placing the company in the red zone. Obviously, as a consequence VaR (95%) is not the most adequate risk measure for this data with our methodology; we give the companies the possibility to analyze scenarios determining if VaR or other risk measures are appropriate.

1 year (2007)	99,5%	99%	95%
VaR	41.295€	30.756€	21.097€
Exceptions	1	1	7

1 year (2008)	99,5%	99%	95%
VaR	65.888€	45.248€	7.596,5€
Exceptions	1	2	10

3.5. Stress testing, shock scenarios and capital projection

Fundamental to ORSA is the ability to understand how regulatory and economic capital requirements will behave under different feasible future business and financial circumstances. This creates the need to determine appropriate multi-year scenarios (deterministic stress tests or stochastic) in which to project the insurer's business; and the ability to accurately assess the capital requirements that would be created within these scenarios.

In summary in this section it is necessary to include two points:

⁴ It is crucial to remark that the VaR calculated is daily due to our data are daily, of course according to Solvency II, it is necessary to obtain the VaR annual, so it should be to approximate the VaR daily to VaR annual. This research group is working in this last issue.

⁵ In addition, it is important to highlight that the examples presented, are focus on risk premium

- Stress testing: Shock scenarios and sensitivity analysis. The stress test is used in individual risks and/or risks aggregated analyzing the effect on the solvency capital requirement.
- Analysis of effect of the scenarios on the economic capital and on the balance sheet adding the projection of the capital. Time horizon: business planning period (likely 3-5 years)
- First of all, it is necessary to remark on the importance of stress testing, because is an important tool for senior management to use in making business strategy, risk management and capital management decisions. Stress testing attempts to determine the impact of situations where the assumptions underlying established models used in managing a business break down. Stress tests should cover a range of risks and business areas, as well as at the institution-wide level. Using a level of granularity appropriate to the purpose of the stress test, stress testing programs should examine the effect of shocks across all relevant risk factors, taking into account interrelations among them.

The stress testing process consists of determining the possible scenarios and then the calculation of the sensitivity analysis. It may also consider different forms of scenario:

- ‘Top-down’ macro-economic scenarios that capture their systematic exposures to adverse economic and financial market outcomes
- Systematic insurance risk scenarios (unexpected increases in longevity, behaviour of the underwriting cycle, natural catastrophes etc).
- ‘Bottom-up’ scenarios that reflect the specific risk of the company exposures arising from their unique strategic and / or operational profile (unexpected legal liabilities, operational failures, etc).
- And finally, the most complicated part is the consideration of the combinations of these scenarios in order to understand how interactions between these risk exposures can cause compounded losses.

In relation to the Economic balance sheet projection; the following steps are presented for an ORSA time horizon of 3 years.

- Step 1: Select best estimate assumption for projecting assets and

liabilities over 3 years.

- Step 2: Project best estimate assets and liabilities over 3 years, including new business according to the company business plans, and incorporating any other strategic action of the company over the time horizon. The projections need to be at a sufficient granular level to allow the calculation of the SCR.
- Step 3: Using the projections, construct an Economic Balance Sheet at time 1, 2, 3.
- Step 4: Calculate the SCR at time 1, 2, 3 and compare it to the Economic Balance Sheet.
- Step 5: Based on the main risks the company is exposed to, develop assumptions for “stressed” projections. The assumptions might be related to deviations in one or more risks from best estimate, lower or higher than expected new business sales, and historical scenarios, among others.
- Step 6: Repeat the projections for all the stressed scenarios selected at step 5.
- Step 7: Construct the Economic Balance Sheet at time 1, 2, 3 for all the stressed projections.
- Step 8: Calculate the SCR at time 1, 2, 3 for all the stressed projections and compare it to the current situation.

Finally, a stress test using the data of our example developed for the backtesting process but in this case an example of casualty data is going to be presented. The stress test based on a shock scenario such as an increment of the reclaims by the clients of the hotel. The effect on VaR of this stress scenario is the increment of the number and amount of claims.

Data: Casualty data. Year: From March 2007 to March 2008.

	VaR (99,5%)	VaR (99%)	VaR(95%)	VaR(90%)	VaR (85%)
R Value	28.802	26.564	5.357,4	1.028,8	426.5

Stress Scenario. Shock: Increase the amount and number of the claims.

	VaR (99,5%)	VaR (99%)	VaR(95%)	VaR(90%)	VaR (85%)
VaR Value	65.716	48.590	16.511	5.913,90	3.795,10
Variation (Sensitivity analysis)	0,43827987	0,54669685	0,32447459	0,17396304	0,11238176

The above presented analysis is a simple example of how the process could be developed, of course, it will be necessary to consider all risks previous analyzed and identified in the risk identification phase, according to the risk map of the company. In addition, it will be necessary to analyze and calculate the VaR after the application of the stress scenario and the effect on the solvency capital requirement, economic capital and balance sheet of the company.

After this evaluation, it is important to remark that the insurer will develop a capital projection (ORSA projection) and it should focus on:

- Sufficiency of Own Funds to cover capital requirements and qualitative assessment of Own Funds over the projection period (for example, reliance on future profits)
- Qualitative or quantitative assessment of capital requirements for risks not covered in the SCR or Economic Capital calculation
- Liquidity assessment – eg. liquid nature of Own Funds, potential collateral calls either to cover reinsurance or derivative positions, quality of collateral received.
- Sensitivities of results to changes in key assumptions
- Considerations on the adequacy of the calculation of SCR and/or Economic Capital (under Standard Formula and Internal Model, if applicable)
- If applicable, reasons for differences between Standard Formula and Internal Model SCR
- If applicable, reasons for differences between Economic Capital and SCR.

4. Conclusions and final remarks

In this paper, the analysis of the vision of ORSA in an international perspective was presented and the analysis of the main contributions of ORSA for the insurance companies was developed. The analysis was focused more on the validation process using backtesting methodology showing the advantages and the application of the QCRM test under a practical vision. It is a contribution to evaluate the adequacy of the VaR risk measure to assess the risks of an insurance company. Of course, we should remark that applying this methodology is the first step, due to the fact that other risk measures should be considered in the application of the QCRM backtesting process in the ORSA framework.

In addition, a proposal of the ORSA process was presented according to risk management methodology from Lloyd's, taking into account the different visions from the European, US and Canadian regulators. In this process, one of the most important issues was the incorporation in the ORSA process of the detail of the methodology in order to apply stress testing, shock scenarios and capital projection.

In summary, the insurance company should develop and implement ORSA under the enterprise risk management vision, global vision of the risks of the company and its effect on the solvency capital requirement, on the economic capital and the balance sheet of the company without forgetting the capital projection analyzing shock scenarios and developing an adequate sensitivity analysis in order to be prepared for unexpected situations.

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