# The Impact of Solvency II on Surety Bonds

# and Surety Insurance Premiums

### 1. Introduction

There is a strong worldwide tendency towards the adoption of *Solvency II*, the regulatory framework for insurance companies developed by the European Union. This regulatory framework has certain technical features concerned, among other things, with the calculation of reserves and solvency capital requirement (*SCR*), and with governance or corporate government.

Some countries, such as Mexico, have already adopted this regulatory framework, while Chile, Brazil, Colombia and Peru, among others, are currently (2017) in the process of implementing it.

Surety bond and surety insurance premiums are more significantly affected by some technical features of Solvency II than other types of insurance.

The main purpose of Solvency II is to set up principles and standards for reserves, solvency capital requirements and corporate government, without addressing premium-related issues, even though it is the general belief that the adoption of Solvency II has a positive effect on prices and on the quality of customer service.

Based on the above, the aim of this work is to set out clearly the effect of the adoption of Solvency II on surety bonds and surety insurance premiums.

A correct estimate of the costs that make up surety bond and surety insurance premiums provides a more solid basis to make decisions and set up pricing policies and allows a better assessment of each business at the time of underwriting. Likewise, knowing how Solvency II affects premiums enables more adequate handling of the effects of adopting such framework before the regulatory authorities.

The actuarial elements for calculating surety bond premiums and surety insurance premiums are the same, and the formulae for this calculation are the same from the point of view of theory; because of this, it is possible to examine the premiums for both types of contracts following the same approach. This is the reason why in this article both premiums are analyzed using the same elements.

#### 2. Formula for surety bond premiums and surety insurance premiums

The net premium or risk premium (RP) for surety bonds or surety insurance is the estimated cost of the covered risk and consists, basically, in calculating the amount of the claims that could be paid in the future; however, it is necessary to estimate which

part of these expected claims, once paid, could be recovered and which part could not, since, in these contracts said recovery could come through counterguarantees, collaterals or other kinds of interest.

Little has been written by way of formal technical analyses regarding how to measure, on an actuarial basis, the risk premium for surety bond and surety insurance. A particularly clear analysis that contains all the elements involved in the risk underwritten in surety bonds and surety insurance contracts is the one proposed by Pedro Aguilar and Juliana Gudiño (2007).

According to this approach, the risk premium must be calculated by adding up two parts:

- I. The first part is the cost of pure risk (CR) and consists of those claims that are expected to be paid and are deemed irrecoverable.
- II. The second part is the financing  $\cot(FC)$  or  $\cot$  of finances which consists of those claims that are expected to be paid and are deemed to be totally or partially recoverable. In this sense, the risk premium formula proposed by Aguilar and Gudiño (2007) can be expressed as the addition of cost of pure risk and financing cost.

$$RP = FC + CR \tag{1}$$

In order to estimate the cost of pure risk as well as the financing cost as are both stated in formula (1), it is first necessary to calculate the cost of future claims (E(r)). This is calculated by multiplying the probability of the claim P(r), the severity of the claim S(r) and the insured amount (*IA*), as well as a present value factor which refers to the average time  $t_1$  during which the claim is expected to be made, that is:

$$E(r) = v^{t_1} * IA * P(r) * S(r)$$
$$v^{t_1} = \frac{1}{(1+i)^{t_1}}$$

This part can also be expressed in terms of a claims ratio ( $\omega$ ), which, on an actuarial basis, is equivalent to the concept of frequency and severity, calculated as the total claimed amount (*TCA*) divided by the stated total insured amounts (*TIA*).

$$\omega = P(r) * S(r) \approx \frac{TCA}{TIA}$$

Once the future claims expected amount has been estimated, it is possible to calculate the financing cost corresponding to the part of claims  $(1 - \varepsilon)$  that is expected to be recovered in an average time *T*, which goes from the moment the claim is paid to actual recovery.

$$FC = v^{t_1} * IA * P(r) * S(r) \left(\frac{(1+r)^T - 1}{(1+i)^T}\right) (1-\varepsilon)$$
$$= v^{t_1} * IA * \omega * \left(\frac{(1+r)^T - 1}{(1+i)^T}\right) (1-\varepsilon)$$

As we can see, calculating the financing cost involves using the financing cost rate (r), which is the nominal rate of return the company wishes to obtain on the investment of the resources which they must use to finance the payment of claims during the time (T) demanded for the recovery of counterguarantees.

Likewise, it is possible to estimate the cost of risk, which is the part of claims ( $\epsilon$ ) that is deemed irrecoverable:

$$CR = v^{t_1} * IA * P(r) * S(r) * (\varepsilon) = v^{t_1} * IA * \omega * (\varepsilon)$$

This explains the formula in Aguilar and Gudiño (2007), which is the following:

$$RP = IA * v^{t_1} * \omega \left( \frac{(1+r)^T - 1}{(1+i)^T} \right) (1-\varepsilon) + IA * v^{t_1} * \omega * (\varepsilon)$$

To be able to apply this formula, it is necessary to define the value of each of the parameters stated in it, which depend on the characteristics of each type of risk covered by the surety insurance or bond. For example, in a surety insurance or bond where the policyholder has a poor credit rating, the  $\varepsilon$  parameter in relation to the part which is deemed irrecoverable will be higher than it would be for the same surety insurance or bond if the policyholder had a better credit rating, which will result in a higher premium for the policyholder with a poor credit rating. In this sense, as the parameters are set at the time of the underwriting, the formula applied allows the amount of the premium to reflect the level of risk assumed in each transaction.

On the other hand, the insurance premium or gross premium is the addition of all costs associated to the transaction; according to this, the insurance premium is the addition of the risk premium and all the other costs of covered risk management, as are administrative expenses (AE), acquisition costs (AC), capital costs (CC) and profit margin (PM).

Once the risk premium has been obtained, the insurance or gross premium is calculated with the following formula:

$$IP = \frac{RP}{1 - AE - AC - PM}$$

In the formula above, AE, AC and PM are percentages representing the portion of premium which will be used to cover administrative expenses, acquisition costs and profit margin.

#### 3. Solvency II impact on surety insurance and surety bond premiums

As we have already said, there is little in Solvency II about premiums, since this framework is focused on setting up standards for reserves, solvency capital and governance; however there are certain aspects of Solvency II that have a direct impact on the way premiums are calculated, as stated below:

The first aspect of Solvency II that has an impact on the way of calculating surety bond premiums and surety insurance premiums is the principle establishing that technical provisions must be the addition of best estimate liability (*BEL*) and risk margin (*RM*).

#### Technical Provision = BEL + RM

The best estimate (*BEL*) must be the expected value (average value) of future liabilities cash flows; then, this concept, established by Solvency II, has no impact on the way of calculating the premium, since, in theory, the premium is also based on the expected value of future liabilities cash flows. However, it is the concept of risk margin that has a significant impact; risk margin is defined as the cost of regulatory capital that the company is required to hold in relation to the volume of their operations. This component of the reserve is new and, in the case of surety insurance and surety bonds it is particularly expensive.

As per above, the risk margin is a cost that must be part of the reserve and, because of that, its inclusion in the risk premium should be considered. Said cost is not explicitly shown in Aguilar and Gudiño's formula (2007) which, however, includes the financing cost related to the recovered claims. Therefore, this would be another component of the cost of financing because, from this perspective, the company would be financing not only the payment of recovered claims but also the cost of the regulatory capital associated to it. In this sense, it is necessary to analyze how the risk margin must be included in the risk premium formula.

The risk margin is calculated as the cost of capital arising from the difference between the risk-free rate (i) and the rate of return on capital (R), multiplied by the amount of solvency capital requirement (*SCR*) and the length of time (duration) during which the company will have the *SCR* locked in. The actuarial formula to be applied to calculate the margin risk is the following:

$$RM = (R - i) * SCR * \sum_{t=0}^{T} \beta_t$$

In this formula, T represents the estimated time during which the liability will be outstanding, and the  $\beta_t$  factors represent the rate of reduction of regulatory capital requirement for each year during which the liability is in effect. The higher time T is, the higher the risk margin will be. In fact, the duration is defined as follows:

$$Duration = \sum_{t=0}^{T} \beta_t$$

In the case of surety bonds and surety insurance, the duration value is a determining factor for risk margin, since it represents the average time for regulatory capital financing. This value may be high because claims risk regularly concentrates at the end of the estimated term of the contract as is shown in the following example:



Let us imagine a surety bond or surety insurance contract in which the duration is 8 and the R - i value is 10%; the risk margin would be:

$$RM = (0.1) * SCR * 8 = 0.8 * SCR$$

This means that the risk margin would reach a value of up to 80% of the regulatory capital; that is to say, the reserve must hold an amount of resources that sometimes is almost equal to the regulatory capital; these resources are additional to the estimated value of liabilities since, as already pointed out, the provision under Solvency II must be the addition of best estimate liability (*BEL*) and risk margin (*RM*).

Let us suppose the *SCR* is somewhat similar to *BEL* (which is frequently possible); in that case, there will be an increase in the reserve which may be of up to 80%, depending on how the provision was being set up.

Up to now, we have shown how the amount of the risk margin that must be included in the reserve may cause a significant increase in premiums.

We will now see how the cost of risk margin must be incorporated to the premium formula presented in Aguilar and Gudiño (2007). For this purpose, we put forward the following analysis:

As shown, the average cost of future best estimate liability in the ongoing risk reserve (expenses excluded) under Solvency II is  $E(\omega)$ , which coincides with the expected claims cost. In turn, *SCR* is, in theory, the difference between 99.5% percentile confidence interval ( $VaR(\omega)$ ) and  $E(\omega)$ , that is to say:

$$SCR = VaR(\omega) - BEL(\omega)$$

Thus, the company must provide financing for both, a part of the claims average cost and the *SCR* part; consequently, assuming that the *SCR* is a cost that can be transferred to the policy, the total financing cost for the insurance would be:

$$FC = IA * v^{t_1} * (BEL(\omega) + SCR) \left( \frac{(1+R)^D - 1}{(1+i)^D} \right) (1-\varepsilon)$$

which is equivalent to:

$$FC = IA * v^{t_1} * (VaR(\omega)) \left(\frac{(1+R)^D - 1}{(1+i)^D}\right) (1-\varepsilon)$$

Where D is the estimated duration of the transaction, considering this to be the period from the underwriting of the contract (the moment when the reserve and the regulatory capital are set up) to the moment when the effect of the transaction is expected to expire.

In turn, the cost of risk included in the premium, associated with the non-recoverable portion of the counterguarantees, is expressed as follows:

$$CR = IA * v^{t_1} * E(\omega) * (\varepsilon)$$

Thus, the risk premium would be:

$$RP = IA * v^{t_1} \left[ VaR(\omega) \left( \frac{(1+R)^D - 1}{(1+i)^D} \right) (1-\varepsilon) + E(\omega) * (\varepsilon) \right]$$

As we can see, this formula already includes the cost of solvency capital which makes up the part of the risk margin that must be added to the reserve.

Although this formula takes into account the cost of financing the solvency capital requirement, it is necessary to consider that, under Solvency II, *SCR* results not only from the technical risk, but also from the operational, financial and counterparty risks (*OR*, *FR* and *CR*) and so it is necessary to take into account these components of capital requirement. In this sense, if we consider that *SCR*, associated with financial, counterparty and operational risks, is proportional to the  $VaR(\omega)$  of technical risk, and taking as *FR*, *OR* and *CR* the relative value of *SCR* of the above mentioned additional risks, the cost of financing may be stated in this way:

$$CF = (IA * v^{t_1} * VaR(\omega) * (1 + FR + OR + CR)) \left(\frac{(1+R)^D - 1}{(1+i)^D}\right) (1-\varepsilon)$$

For the sake of simplicity, we can take *FR*, *OR* and *CR* values as a single value  $\beta$ , so that:

$$CF = (IA * v^{t_1} * VaR(\omega) * (1 + \beta)) \left(\frac{(1 + R)^D - 1}{(1 + i)^D}\right) (1 - \varepsilon)$$

Finally, the formula for the risk premium is:

$$RP = IA * v^{t_1} \left[ VaR(\omega) * (1+\beta) \left( \frac{(1+R)^D - 1}{(1+i)^D} \right) (1-\varepsilon) + E(\omega) * (\varepsilon) \right]$$

In this way, included in the risk premium is the cost of financing not only the reserve but also the regulatory capital (*SCR*), for the setting up of the risk margin that must be included in the ongoing risk reserve.

Up to this point, the topic seems fully developed; however, it should be added that a stricter approach to Solvency II views surety insurance and bonds as risks subject to systemic effects that can produce catastrophic losses. From this point of view, *SCR* is calculated as the probable maximum loss (*PML*) of the retained portfolio that the company could undergo in the event of an economic crisis with a systemic effect. In this sense, the formula for risk premium must be modified to read as follows:

$$RP = IA * v^{t_1} \left[ PML * (1 + \beta) \left( \frac{(1 + R)^D - 1}{(1 + i)^D} \right) (1 - \varepsilon) + E(\omega) * (\varepsilon) \right]$$

The probable maximum loss calculation is based on the impact produced by an event that causes a widespread increase in claims arising from defaults. Some market data indicate that a situation of this kind could result in a loss the amount of which could reach up to 20% of the retained insured amounts.

Once the risk premium formula has been modified, the insurance premium appears as follows:

$$IP = \frac{RP}{1 - AE - AC - PM}$$

Considering that the profit margin is in keeping with the cost of regulatory capital and that it has already been considered as part of the risk premium, then:

$$IP = \frac{RP}{1 - AE - AC}$$

That is to say:

$$IP = \frac{IA * v^{t_1} \left[ PML * (1+\beta) \left( \frac{(1+R)^D - 1}{(1+i)^D} \right) (1-\varepsilon) + E(\omega) * (\varepsilon) \right]}{1 - AE - AC}$$

This formula reflects, finally, how to incorporate the different costs of financing capital and the reserve in surety bonds and surety insurance when Solvency II is applied. Based on this formula, a company can assess the impact and adopt some ways of offsetting financing costs, using, for example, reinsurance, since the amount of SCR decreases in direct proportion to reinsurance.

## Conclusions

By means of actuarial models, it has been possible to obtain a risk premium formula that enables the incorporation of the effects of applying Solvency II regulatory framework. Furthermore, it has been found that said formula contains a high financing cost component due to the way in which the reserve and the capital requirement were changed under the new regulatory approach. In particular, it was possible to see that Solvency II effect on the risk premium formula is an important increase in the part corresponding to financing cost. This happens mainly for two reasons:

1. Under Solvency II, solvency capital (*SCR*) increases significantly due to the new risks considered (financing, operating and counterparty) and the systemic risk approach inherent to surety insurance and bonds.

2. Under Solvency II, companies must set up, since the very beginning and during the time the contract is in effect, the risk margin corresponding to the cost of regulatory capital. As a consequence of this, in the formula for the premium, the capital financing cost must be calculated considering the time D, which is the estimated time during which the risk coverage will be in effect; this has a direct impact on the financing cost, given the fact that the value of D may be high in a surety insurance or surety bond transaction.

The formula that has been developed allows taking into account, at the time of underwriting and in a very precise manner, the financing cost of reserves and capital; thus, at the moment of underwriting a risk, it is possible to set up a price which is consistent with the level of risk assumed and with the cost of capital associated with said risk, all of which harmonizes with the changes brought about under Solvency II.

The formula we have proposed here could seem unnecessary; however, if said financing costs of capital and reserves are not incorporated in the premium in an appropriate way–although the effects might not become evident at the beginning and the consequences might not be noticed by the company–there would be, in the course of time, a significant impairment of capital resources, since the company would have to finance reserves and capital during some years without the necessary return and with the consequent damage to their financial position.

#### **Bibliography**

Aguilar, P., Gudiño, J., *Fundamentos Actuariales de Primas y Reservas de Fianzas*, Mapfre, Madrid (2007).

Albarrán Lozano, I., *Métodos estocásticos de estimación de las provisiones técnicas en el marco de Solvencia II*, Fundación Mapfre, Madrid (2010).

Brown, R., Gottlieb L., Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance, Waterloo, Ontario (1993).

Comisión Nacional de Seguros y Fianzas, "Ley Federal de Instituciones de Fianzas", Mexico (2006).

- "Circular Única de Seguros y Fianzas", Mexico (2016).

- "Ley de Instituciones de Seguros y de Fianzas", Mexico (2016).

Gudiño, J., "Bases Técnicas de Fianzas", Tesis de Maestría, (Master's Thesis), Instituto Tecnológico Autónomo de México, Mexico (1998).

Hossack, I. B.; Pollard, J. H.; Zehnwirth, B, *Introductory Statistics With Applications in General Insurance*, Cambridge University Press, Cambridge (1983).

Hoyos Elizalde, C., El Seguro de Caución, Fundación Mapfre, Madrid (2012).

London, D. FSA, *Survival Models and their Estimation (Second Edition)*, ACTEX Publications, Connecticut (1988).

López Cachero, M.; López de la Manzanara, J., *Estadística Para Actuarios*, Mapfre, Madrid (1996).

Molina Bello, M., *La Fianza. Cómo Garantizar sus Obligaciones con Terceros.* McGraw-Hill/Interamericana, Mexico (1994).

Organization for Economic Co-Operation and Development, OECD, *Catastrophic Risks and Insurance* (2005).

Riegel, R., Miller, G., *Seguros Generales: Principios y Práctica*—(Insurance, Principles and Practices), CECSA, Mexico (1965).