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Impact of insurance for operational risk: Is it worthwhile to insure or be insured for severe losses?

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ABSTRACT

Under the Basel II standards, the Operational Risk (OpRisk) advanced measurement approach allows a provision for reduction of capital as a result of insurance mitigation of up to 20%. This paper studies different insurance policies in the context of capital reduction for a range of extreme loss models and insurance policy scenarios in a multi-period, multiple risk setting. A Loss Distributional Approach (LDA) for modeling of the annual loss process, involving homogeneous compound Poisson processes for the annual losses, with heavy-tailed severity models comprised of α-stable severities is considered. There has been little analysis of such models to date and it is believed insurance models will play more of a role in OpRisk mitigation and capital reduction in future. The first question of interest is when would it be equitable for a bank or financial institution to purchase insurance for heavy-tailed OpRisk losses under different insurance policy scenarios? The second question pertains to Solvency II and addresses quantification of insurer capital for such operational risk scenarios. Considering fundamental insurance policies available, in several two risk scenarios, we can provide both analytic results and extensive simulation studies of insurance mitigation for important basic policies, the intention being to address questions related to VaR reduction under Basel II, SCR under Solvency II and fair insurance premiums in OpRisk for different extreme loss scenarios. In the process we provide closed-form solutions for the distribution of loss processes and claims processes in an LDA structure as well as closed-form analytic solutions for the Expected Shortfall, SCR and MCR under Basel II and Solvency II. We also provide closed-form analytic solutions for the annual loss distribution of multiple risks including insurance mitigation.

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1. Motivation

Operational risk (OpRisk) has become increasingly important to the banking industry as a result of globalization, complex financial products and changes in information technology, combined with a growing number of high-profile operational loss events worldwide. As a result, new international regulatory requirements (Basel II and Basel III) have been developed for the banking industry. There was no widely accepted definition of OpRisk when the Basel Committee on Banking Supervision (BCBS) began discussions on OpRisk management at the end of the 1990s; see BCBS (1998). Often, OpRisk was defined as any risk not categorised as market or credit risk. Some banks defined it as the risk of loss arising from various types of human or technical error. Some earlier definitions can be found in a 1997 survey conducted by the British Bankers Association (BBA). In January 2001, the BCBS issued a proposal for a New Basel Capital Accord (referred to as Basel II) where OpRisk was formally defined as a new category of risk, in addition to market and credit risks, attracting a capital charge. In the working paper BCBS (September 2001) on the regulatory treatment of OpRisk and in the revised Basel II framework BCBS (2004), the following definition of OpRisk was adopted. "*Operational risk is defined as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. This definition includes legal risk but excludes strategic and reputational risk.*"

This definition did not change in the latest version of the Basel II framework, BCBS (2006, p. 144). The International Actuarial Association, IAA (2004), has adopted the same definition of operational risk in the capital requirements for insurance companies. One area of OpRisk still to be explored methodologically involves insurance within an OpRisk framework.

Modeling the impact of insurance mitigation for different risk cells and business units is an important challenge in the setting of OpRisk management yet to be fully understood and therefore adopted in practice. The slow uptake of insurance policies in OpRisk for capital mitigation can be partially attributed to the limited understanding of their impact in complex multi-risk,

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multi-period scenarios, under heavy-tailed losses and the fair premium to charge for such policies, as well as a relatively conservative Basel II regulatory cap of 20%. Therefore, although OpRisk models are maturing, OpRisk insurance mitigation is still in its infancy (Brandts, 2004; Bazzarello et al., 2006).

In a financial institution, typically there are numerous insurance policies against different risk types, some affecting single risks and some affecting several risk cells at once. These insurance policies can be considered per risk type and per business unit, however in OpRisk, all policies must satisfy the Basel II regulatory requirements.

The Basel II OpRisk regulatory requirements for the Advanced Measurement Approach, BIS (2006, p. 148), states "*Under the AMA, a bank will be allowed to recognize the risk mitigating impact of insurance in the measures of operational risk used for regulatory minimum capital requirements. The recognition of insurance mitigation will be limited to 20% of the total operational risk capital charge calculated under the AMA.*" Therefore from the perspective of a financial institution, such as a bank, there is a strong incentive to understand the effect of insurance mitigation on the OpRisk capital.

From the insurers perspective a quantitative understanding of the impact of insurance in OpRisk extreme loss scenarios will allow for accurate pricing of insurance premiums. In addition, by studying the risk transfer from bank to insurer, this will aid in modeling of the required capital for an insurer under Solvency II. As discussed in the initiatives developed by the International Association of Insurance Supervisors (Kawai, 2005; Linder and Ronkainen, 2004), the Solvency II framework was developed as a similar system to the Basel II three pillar system. It specifies the financial resources that a company must hold to be considered solvent. In Sandström (2006) the IAIS guidances under Principal 8 discuss minimum capital whereby "*A minimum level of capital has to be specified*", this is then a quantitative challenge. In the second phase of the EU project Solvency II, the commission introduced two distinct levels of solvency: these are measured according to an upper level, the Solvency Capital Requirement (SCR) and a lower level, the Minimum Capital Requirement (MCR), see Sandström (2006).

The framework we develop in this paper for the Basel II LDA capital reduction analysis will also naturally extend to allow for calculation of required insurer capital under Solvency II. That is we can utilize the LDA claim process models from the Basel II OpRisk studies to estimate the MCR and SCR of the insurer. The MCR and SCR measures for an insurance underwriter differ from the Value at Risk (VaR) that a banking institution must hold. In particular, unlike the capital measure obtained by a 99.95% VaR for banking institutions under Basel II, the SCR or (target capital requirement) is the target level of corrections in a going concern. The SCR as proposed under Solvency II is treated as a 'soft' level since "*there are no intervention measures restricting management of the business, ..., there might be measures taken by the authority to let the company, for example, submit a plan about restoring the capital level.*" (Sandström, 2006, p. 186). Contrary to the SCR, the MCR measures the normal target level of capital that enables an institution to absorb significant unforeseen losses. As such MCR is considered to be a 'hard' solvency margin which defines the level at which management of a company is taken over by the supervisory authority.

In this paper, we make explicit the estimation of the MCR which we define to be the Solvency II analog of the capital requirement in Basel II. That is, given our LDA OpRisk model under the Basel II framework, with any particular insurance policy, we can define the MCR as the 95% VaR or Expected Shortfall (ES) of the claims process. This is obtained as a by-product of the simulation of the annual loss distribution in OpRisk under the LDA framework when estimating the insurance mitigated bank capital. In the OpRisk context, measuring the MCR according to the percentile of the claims process, simulated from the OpRisk LDA model claims process allows for diversification in the form of the four levels proposed in Sandström (2006, p. 188). These relate to accounting for risk exposures, subportfolios, main risk categories and subrisk classes and business units. In some insurance settings we will even obtain closed-form analytic solutions for evaluation of MCR.

Therefore, in this paper we will study from the perspective of both the banking sector and the insurer, the basic transfer of risk and therefore capital requirements from financial institution to insurer for several important examples of OpRisk insurance policies. In particular we will focus on the interplay between the capital reduction in OpRisk for different insurance polices as measured by the VaR of the annual loss in an LDA OpRisk model and the MCR in Solvency II as measured by the VaR of the claims process.[1] An understanding of such processes for fundamental policies will also provide an instructive analysis for regulatory bodies who will be better able to understand the extent that capital reduction can be offset by such insurance policies, allowing for an informed conservatism to be applied.

In particular we focus our analysis on the scenarios involving heavy-tailed severity models in the rare-event extreme consequence context. Thereby providing analysis of the loss process most likely to have significant consequences on a financial institution, those which may lead to ruin. This involves introducing to OpRisk modeling an important family of severity models, utilized in insurance claims reserving in Adler et al. (1998), given by the α-stable severity model. This family of severity model is flexible enough to incorporate light-tailed Gaussian loss models through to infinite mean, infinite variance severity loss models such as the Cauchy model.

The three questions of particular interest to this paper are posed as:

- When would it be equitable for a bank or financial institution to purchase insurance for heavy-tailed OpRisk losses under different insurance policy scenarios?
- How does the SCR and MCR capital measures for insurers under Solvency II behave relative to the Basel II VaR capital mitigation due to OpRisk insurance under different insurance policy structures?
- From an insurers perspective, what is the fair premium to charge as a percentage above the expected annual claim for basic building blocks of different insurance policies?

To address these questions we consider the standard LDA Basel II structures, involving an annual loss in a risk cell (business line/event type) modeled as a compound random variable,

$$Z_t^{(j)} = \sum_{s=1}^{N_t^{(j)}} X_s^{(j)}(t) . \quad (1.1)$$

Here $t = 1, 2, \ldots, T, T + 1$ in our framework is discrete time (in annual units) with $T + 1$ corresponding to the next year. The upper script j is used to identify the risk cell. The annual number of events $N_t^{(j)}$ is a random variable distributed according to a frequency counting distribution $P^{(j)}(\cdot)$, typically Poisson. The severities in year t are represented by random variables $X_s^{(j)}(t), s \geq 1$, distributed according to a severity distribution $F^{(j)}(\cdot)$, typically lognormal. Severities represent actual loss amounts per event. The total bank's loss in year t is calculated as

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[1] However we ignore the fact that insurers can transfer the risk to a 'collective' by diversifying through selling many policies. This is somewhat justified for some risks where policies are client specific as would be the case in extreme events in OpRisk.

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