The Fundamentals of Designing an Integrated Model of Financial Risk and Operational Risk within an Enterprise Risk Management Framework: Findings of an Empirical Study

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Abstract

The objective of this article is to identify and explore the fundamental issues necessary to design an integrated model of financial risk (hereinafter referred as "FR") and operational risk (hereinafter referred as "OR") within the framework of enterprise risk management (hereinafter referred as "ERM") for the insurance[2] industry. The objective was achieved by conducting an exploratory study on four major European insurers in connection with their ERM practice. The result suggests that quantification of OR is itself complex and the aim to integrate OR with FR for diversification purpose is theoretically problematic given their nature in the insurance business. However, a balance between the quantitative and qualitative approaches towards the management of OR could best serve the purpose.

[2] Insurance includes reinsurance.

1. Introduction

Following the initiative of the banking sector in managing OR within the Basel II framework, there appears to be an increasing focus on this topic in the insurance industry. A recent study on ERM[3] (Acharyya, 2006a) suggests that the existing knowledge is still inadequate to conceptualize the true spectrum of "OR" in the insurance industry. Traditionally, the OR is well understood in the insurance business—in particular, those related to the underwriting and claims functions. However, it is evident that the insurance industry recognizes the definition of OR as suggested by Basel II in practice. The Basel II definition of OR was designed to meet a specific purpose (i.e., charging capital) within a limited scope. Another study (Acharyya, 2006b) discovered a wide range of areas where a typical insurance company is vulnerable for operational errors within an ERM framework. There are many built-in mechanisms in the insurance business (e.g., policy cancellation clause, excess clause, etc.) which protect insurers from many known ORs (e.g., undetected fraud while writing the policy). This criticizes the methodology and effectiveness of the modern initiatives of insurers in modeling OR within the scope of Basel II.

The article is structured as follows. First, the literature relevant to OR with particular reference to ERM is reviewed. The paper summarizes the literature in three headings—the nature of OR; the challenges of measuring and modeling OR; and the relation of OR with ERM. Second, the methodology employed to investigate the data is described. Third, the original data are analyzed and the results/findings are noted. Fourth, findings are discussed and policy implication issues are derived. Finally, the contribution of the paper is pointed out and a brief conclusion is drawn.

2. Literature

The literature defines OR in a number of ways (Foot, 2002; Chorafas, 2004). Historically, OR in the insurance industry was defined as all risks other than the FR and insurance risk (FSA, 2003). The role of internal auditing in managing OR was traditionally influential and essentially limited to the reactive approach of internal control for financial reporting and compliance of regulations. It was found that the introduction of the Basel II definition of OR in

[3] ERM is defined as the management of all risks within a holistic framework whatever sources and nature of risk.

the banking industry suggested OR as "the risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems or from external events." However, the definition includes legal risk (the risk of loss resulting from failure to comply with laws as well as prudent ethical standards and contractual obligations) but excludes strategic and reputational risks. This essentially derived the current practice of OR in the banking industry.

The banking concept recently influenced the insurance industry, in particular, Solvency II within EU. It is evident that the current development of practices of OR management mostly remains within the regulatory capital requirements. However, deregulation and competition in the marketplace are also vital issues (Brink, 2001). Following the regulatory concerns on OR, the actuarial community concentrates on the non-traditional view of developing methodology of managing OR in practice within the ERM (risk-capital) framework (CAS, 2003; Tripp, 2004; Dexter, 2006) in the insurance industry. In addition, COSO initiated the practice of OR within the ERM (risk-control) framework (COSO, 2003). The initiatives of these two professional bodies (i.e., those of actuaries and accountants) in conceptualizing OR are similar, but their approaches towards managing OR are different and essentially motivated by their core professional ethics and training. On the other side, the academic response towards understanding and conceptualizing OR is very limited. In fact, OR has never been considered as a researchable topic by academics. Some previous works (Mehr, 1974) addressed OR within the broader concept of business risk. Most recently, academics (Power, 2005) showed interest in OR following the interest of the practitioner community. However, no original OR research was completed by academics. Indeed, the key source of data to research OR is the works of the practitioner community. Moreover, as the literature suggests, the techniques of managing OR within the framework of ERM differ even within the practitioner community. After in-depth review of the works of both the practitioner and academic communities, a summary of the literature for OR is noted for the purpose of this article.

- Nature: OR risk is context-driven and heavily depends on the management style, culture and arrangement in place. Consequently, prioritization within organizations' risk landscape is a real issue rather than measuring OR precisely.

- Scope of Measuring and Modeling OR: The current initiative of measuring OR is limited to assigning a numerical value of the quality of control and

governance issues in relation to capital assessment for solvency purposes. However, this initiative will broaden the OR attached to the entire business including the capability of decision making at the senior management level. The key challenge is to achieve the right balance between quantification of OR and mitigation of the causes of OR. Nevertheless, the success of quantification techniques depends on the adequacy, accuracy, consistency and validity of data.

- OR & ERM: Risk is conceptualized differently by the practitioner as well as the academic community within the scope of professional ethics and training (Wang, 2006). Consequently, the definition and understanding of ERM varies extensively. In addition, the perception of risk differs across different levels of the management hierarchy. It is suggested that when the perception of the people moves from bottom to top, then risk gradually shifts from silo to holistic issue. Consequently, risk needs to be managed holistically (Chicken, 1998) because of its heterogeneous nature. ERM encompasses all types of risk, where OR is an element.

3. Methodology

The study utilizes the findings of the author's original work (Acharyya, 2006a), which has achieved a Ph.D. award. The data used for this article is selected from the original database (collected during 2004-06). The sources of data were interviews with staff members of four major European insurance companies (hereinafter referred as "Case") followed by a questionnaire survey. However, the database was updated with particular reference to this article by re-interviewing some key respondents of the Cases. The data were analyzed by comparing and contrasting the views of respondents. The findings of the literature were also referred to, where necessary, to resolve the conflicting arguments.

3.1 Analysis of Data

The issues revealed from the analysis of data are structured into seven headings. They are:

- Evolution of OR
- Importance of OR

- Understanding of OR
- Overlapping character of OR
- Challenge in identifying OR
- Challenges in quantifying OR
- Influence of regulations on OR.

They are discussed below in turn.

3.1.1 Evolution of OR

The study revealed that the source of insurers' OR management is particularly the area of business continuity management. One respondent, who headed the Group Risk Management Team of a major insurer, suggests "…that [business continuity management] was almost the sole focus of our current activities for OR management."

3.1.2 Importance of OR

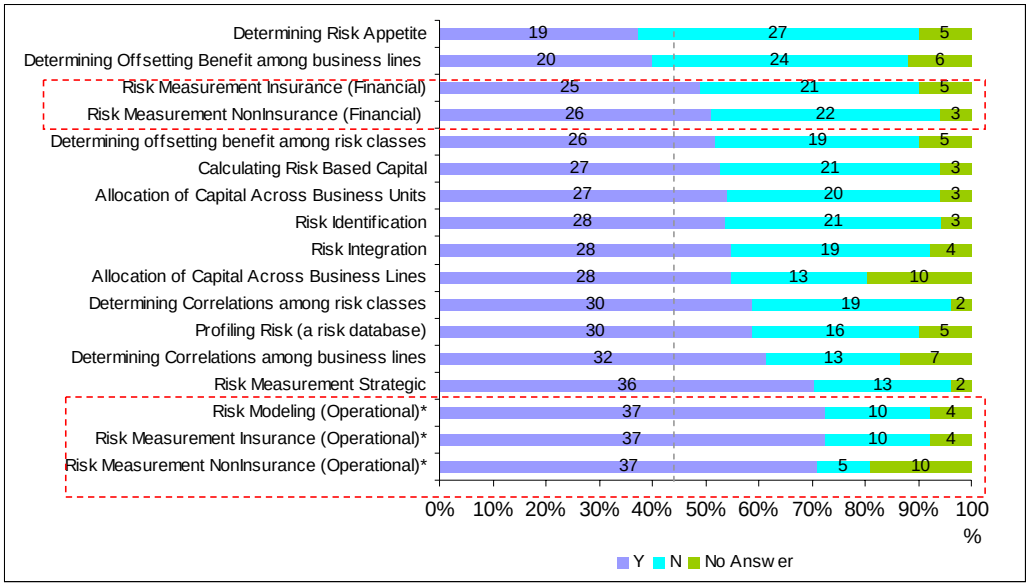
It is argued by the respondents that the current effort on OR is a top management agenda. One respondent, who works in the investment department, argues "we are not dealing much on OR, which I think should be integrated at the higher level." However, there are several reasons why OR is not a prominent issue in the insurance sector. OR in insurance is not an issue as it is in a bank, partly because insurance companies historically maintain conservative remuneration policies for risk taking. Moreover, the asset allocation is completely different in insurance than it is in banks. One respondent states, "I think that because of these reasons OR is much less for insurance companies." Another respondent, who is an expert on FR, argues, "it is true that the insurance industry is underdeveloped in practicing risk management tools to manage OR but one should consider that the banking industry is exposed to a huge systemic risk because of a dynamic payment system but it is different in the insurance industry." The study finds that this may be one of the reasons why regulations in the insurance industry for OR are not strong as in the banking industry.

It was established that there may be two reasons that an organization is exposed to risk—"bad luck" and "bad housekeeping." The former is purely external and organizations may have little control over it. However, in order to develop a sound foundation for doing business through managing other types of risks, the significance of managing OR comes into play. An insurer can only add

value for its stakeholders if the household is in order. One respondent argues, "operational risk is all about how to run our household."

The arguments made by the respondents were also supported by the questionnaire survey conducted in 2005 for the purpose of the author's Ph.D. project (Acharyya, 2006a). The survey concludes that measurement and modeling of OR risk are the key technical challenges of implementing ERM. Graph 1 illustrates the results.

Graph 1: Key Operational Challenges of ERM



From Graph 1 it can be noted that amongst the 52 respondents of four major European insurers, 37 (i.e., 71 percent) identified the measurement of OR (both non-insurance and insurance-related) followed by the modeling as major challenges while implementing ERM within their organizations. The measurement of FR was listed on the bottom of the list, with around 50 percent of respondents viewing it as a key challenge in implementing ERM.

3.1.3 Understanding of OR

The study found that although some system-related risks (e.g., IT risk) come under OR, a big chunk of OR falls within the area of legal risk in terms of non-compliance of regulations. Consequently, one respondent, who is responsible for capital allocation, argues "OR is mostly an internal auditor's issue." Another respondent, who is responsible for monitoring the underwriting functions of foreign subsidies, holds similar views and suggests, "to monitor and

balance and to reduce the OR of our global insurance operations we work with our internal auditing team." A further comment came from a respondent suggesting: "The responsibility of safety from fire, IT back-up, etc. [which are OR] are increasingly coming under the agenda of our group internal auditing." It is suggested the absence of proper incentive within the regulatory criteria discourages some insurers from investing more in the management of OR. One respondent argues, "within the current regulatory framework, I don't see any incentive that encourages companies to improve their OR control." Consequently, some companies prefer to leave the management of OR to people like the internal auditors, who are believed to be specialists in managing people, systems and fraud, etc. However, some respondents do differentiate the modern thinking of OR from day-to-day operational errors. One respondent, who held the position of the chief risk officer of a major insurer, argues, "I think that identification and management of OR is an important issue for us because we may have large losses just for not controlling our ERM process correctly." The same respondent also finds competitive advantage while managing OR as a part of ERM in addition to the compliance of regulatory capital requirements. S/he argues, "it is a challenge for us to reasonably estimate the amount of capital for our exposure to OR—although I'm very skeptical personally about the accuracy of the estimate." Insurers find it very difficult to detect which risks belong to the category of OR, where they exist and, in particular, to prioritize significant OR in terms of frequency and severity in any specific timeframe.

Moreover, there appears a clear distinction between the nature of OR in various functions of insurance companies. For instance, the OR attached to the insurance functions (e.g., processing of claims, selling of products, pricing risks, etc.) is different by nature from that of investment functions (e.g., choosing derivatives for hedging purposes, maintaining the limits, etc.). However, its management, irrespective of nature, is based on a common risk-management framework (i.e., assessment, measurement, controlling and monitoring). One respondent, who plays a consulting role in the industry, says, "It is really important to combine and put them in the common framework despite the feelings of insurance and investment professionals towards OR." Consequently, a common standard is necessary across the organization.

3.1.4 Overlapping Character of OR

Regarding the question of overlapping character of OR with FR, which suggests that the root cause of all FR includes the elements of OR, a range of contradictory views was noted. The concern of such overlapping (or doubling

effect) provides significant challenge for the measurement of OR on a stand-alone basis. One respondent suggests, "I think there is no solution—it is my fear—I think what you have to do is try to reduce OR as much as possible." The analysis suggests that practically (even theoretically) it is impossible to reduce OR to zero. This is because insurers only get very few large ORs, which are also very difficult to quantify. Moreover, one respondent states, "a lot of ORs are unobserved."

The study noted a consensus among the respondents suggesting that the definition of OR needs to broaden, as it is regarded as one of the biggest risks in the financial services industry. For instance, one respondent, who is an ERM consultant, suggests, "OR needs to be defined in a broader perspective including how the users manage models, how the organization manages the managers' integrity, etc."

Uneven understanding about FR and OR also remains. Some respondents believe that in most cases they are the same and others believe that they are totally different. Another group believes that they overlap. For instance, a respondent states, "…it is often very difficult to separate OR from FR ….in my view most ORs that interest us are financial risks … the insurance risks are financial risks too."

It is noted that the respondents often confuse OR with strategic risk (hereinafter referred as "SR"). For instance, one respondent states "if the interest rate moves inversely with our payment policies of guaranteed life insurance products, then we will face severe OR." Although the decision of the management on whether and how to change the equity exposure seems an SR, some respondents believe it is an OR. A respondent, who leads the capital allocation team, argues: "No, it is an OR, but to me both OR and SR are the same."

3.1.5 Identification of OR

Risk identification was found to be a key challenge for the management of OR. The study revealed that some insurers identify typically through the total risk profile (TRP) exercise, which is a key part of developing the ERM framework. The chief risk officer of a major insurer states, "We have to do that [TRP] systematically and this gets everybody thinking about risk, which helps us to identify OR."

3.1.6 Challenges in Quantifying OR

The respondents mentioned various challenges in quantifying OR. For instance, inconsistency among the OR events provides a key challenge in developing a reliable database for measurement purposes. Such inconsistency challenges the reliability of the amount of capital derived by statistical models. One respondent argues, "there is a quantification problem—once you have detected an OR and you implement things—but it does not happen again—there will be another one—much more severe than the previous." This argument realistically challenges the accuracy of any figure derived by quantification methods. In this sense the value of OR management should not only be judged in terms of the accuracy and technical efficiency of the models, but the strength of check and balance in place to detect the gaps within the operating system is of paramount importance. One respondent states, "I'm hoping that the situation will definitely change in future due to the sophistication of technology but this fundamental problem will still exist." Another respondent argues, "I think quantifying or measuring OR is helpful; but it is always about knowing it. It is more a question of ranges and setting priorities and not being too precise."

However, there appear to be two approaches of quantifying OR capital—one is a top-down analogy approach, which is very much like a standardized approach in Basel II, and the other is more of a bottom-up communication approach in terms of individual risk, process and control, which is very much like the AMA (Advanced Measurement Approach) in Basel II. However, both of them have weaknesses. For example, the top-down approach doesn't reflect the control environment, and the bottom-up approach requires a lot of data, which is not currently available in the industry. However, one respondent, who is a financial consultant, suggests, "I think the next generation of OR measurement will live with an average of these two approaches."

Regarding the methodology for quantification, a respondent, who is the head of the OR modelling team of a major insurer, says, "we usually use a 'black & white' model to identify and quantify OR (e.g., new product risk, new regime risk, etc.) and actually it is quite difficult to quantify them because we don't have enough experience on them." In addition, the scenario process doesn't expressly say what will happen; rather, it can only guess what could happen, leaving a lot of room for expert judgements and intuitions. Another respondent, who headed the risk engineering department of a major insurer, suggests "…although we are currently working towards quantification and measurement of OR, I personally think that the concept of OR in the insurance industry is fully misunderstood

and in my view we have a totally wrong approach to OR and OR quantification." In contrast, a respondent, who is professionally a risk modeller, argues, "I'm surprised to see the misconception of some people on the reliability of the quantification methodologies that are in place for OR." According to this respondent, quantification of OR is possible, and this is gradually getting recognition in the insurance industry. However, it is true that quantification of OR is difficult, and it is a question of whether it is worth it to give more emphasis on the quantification side where the ERM model of an insurer is concerned. One respondent, who headed the group risk management of a large insurer states, "Our group risk model includes insurance risk, market risk and credit risk and largely excludes OR and SR." The same respondent further states, "it is not meaningful to quantify all risks, however, special cases may be OR where we can say that part of OR is actually included into the model because certain parts of the model are based on calibrated historical loss data, which contains operational losses."

3.1.7 The Influence of Regulations

It was revealed that the regulators (e.g., FSA in the UK) put quite high priority on governance—the way that the decisions are made, making sure that the directors know that they are accountable for the risks that their organizations are exposed to. The directors' (who oversee the whole business) responsibility of managing risk is then cascaded down throughout the organization, making everybody responsible for the risk of the organization. One respondent, who is a renowned risk management academic, argues, "….I mean the Company Secretary, who is implementing the governance issues is also managing OR of his/her organization."

Although OR is a growing agenda for regulators, some insurance companies do not find it as important because, as one respondent, who is responsible for capital allocation at the corporate office, states: "Yes, it is true that we run OR but again there isn't enough knowledge and information out there—we don't want to waste our time and money right now. At the moment our biggest challenge is to get the measurable risks understood."

4. Findings and Discussions

The above analysis suggests a number of findings. They are discussed below.

4.1 Regulations are a Key Driving Force of Modern OR Management

The history suggests that a lot of sophistication happened in the area of FR but less emphasis was given to OR (D'Arcy, 2001; Nielson, 2005). However, due to some corporate scandals during the 1990s, major financial firms, in particular, banks, realized their lack of expertise in managing OR. The regulatory initiatives added further momentum. The financial community expanded their view on OR with the tools and expertise they developed and utilized for the management of FR. The underwriting and claims functions are believed to be the key sources of OR in the insurance industry. The OR from insurance functions (e.g., underwriting, claims and reinsurance) was traditionally managed by policy wordings and changing operating techniques. However, the approach and application of techniques originally developed for FR remain limited to the measurement of capital for the solvency purpose. Indeed, this is relatively new in the insurance industry. Inevitably, the banking approach of measuring OR, which itself is limited by many constraints, is clearly challenging in the insurance industry. However, ERM could provide solutions in taking a balanced view of all risk that an insurer faces.

4.2 A Proper Definition of OR Is Necessary

In defining OR, fraud, litigation, underwriting and inclusion of their effects in pricing, are usual in the insurance industry. They are traditionally managed by internal auditing and controls, revising operations, outsourcing, etc. These techniques are well established in the insurance industry. However, identification of ORs is a difficult task because they are hidden and have not yet triggered considerable losses. The study suggests that they probably need management by non-traditional means.[4] Nevertheless, the key question is: "Why should insurance companies consider non-traditional means of managing OR?" Is not the traditional means enough? Is it just because of the worry of a group of stakeholders who had observed bad experience in banking?

[4] It is important to note that the modern approach towards the management of OR focuses only on potential large losses, which may bring down the organization.

4.3 Quantification of OR is Problematic

A difference of opinion on the quantification of OR is obvious. The quantitative community believes that it is essential to quantify risk in terms of numbers to develop effective risk management tools. However, they understood that there are some significant risks that are not quantifiable using the tools and techniques in place for financial risks. Conversely, the qualitative community opposes the concept of the quantitative people that suggests, "if not quantifiable then it is not manageable." The belief that the exploration of the concept of promoting the cultural change through ensuring more awareness and transparency, broadening the depth of knowledge, does not always provide solutions under limitations where corporations realistically operate.

Although it is comparatively easy to put a numerical value of the consequences (i.e., loss) subject to constraints (e.g., time), the same approach can't be justified for root causes which trigger events that lead to the financial loss. In fact, it is subjective, and the probability of hypothetical events depends on emotion. Moreover, the size and nature of operational losses are inconsistent and extensively differ over the time where the historical data are of little help. In essence, whatever quantification techniques and approach (e.g., extreme value theory; Bayesian network; stress testing; scenario analysis; dynamic financial analysis, etc.) are used, the data fed into the models are the views of persons and the accuracy of the results depend significantly on the level of modelers' judgment and experience. Indeed, the ethical behaviour is an integral part of operational risk management, which can be achieved by promoting a culture of risk awareness across the organization. However, lack of trust among the parties is a key issue (Schiro, 2005). Indeed, integrity and accountability of the associated parties as well as transparency are essential to build relationships with different stakeholders, which may create opportunities for dialogue and participation (Goodijk, 2003).

4.4 OR Management Needs Multidisciplinary Approach

It is important to distinguish between the top-down and bottom-up approaches of risk management. It was found that the top-down approach is more relevant to the corporate governance issues, where the senior management including the board of directors is legally responsible for all risks of the organization. The relevant regulations (i.e., Combined Codes in the UK) are a direct hit at the policy makers within the organizations in order to ensure that there are risk management procedures in place to address all risks whatever the

sources and nature. The bottom-up approach to risk management is more likely a finance-related issue covering market, credit and liquidity risk, etc. Incidentally, OR, as the findings suggest, is everything else but also inherent to both types of risk (i.e., strategic and financial) to some extent. The interesting point, which the study concludes, is that OR is a concern for both groups of professionals having expertise in either discipline (i.e., strategic and financial). They apply their expert knowledge to conceptualize OR within their ethics and capacity but maintain a gap from each other as they are not familiar enough with each others' profession. However, there is evidence that the gap is gradually shrinking, and ERM is establishing a multidisciplinary subject with the development of OR management.

In addition to the current initiative of financial and management professionals to measure and model OR, the expert knowledge and experience of engineering judgments in terms of probabilistic risk analysis (Pate-Cornell, 1996; Bedford, 2001) may be utilized into this effort. For example, fuzzy logic (reasoning) is adopted to deal with incomplete and inconsistent risk information for engineering and military studies, which can be utilized in insurance (Cruz, 2000; Cho, 2002; Sánchez, 2003; Shah, 2003; An, 2006). Moreover, modeling and managing of human errors and reliability as adopted in space science[5] relevant to system theories is a potential area of multidisciplinary work for insurers' initiatives on OR (Cox, 1998; Turner, 1998).

5. Policy Implication Issues

Management of OR is not a new issue in the insurance industry. In fact, insurers are historically aware of fraud, failure in systems, writing good or bad business, etc., and, in practice, they always have risk managers to look after OR. Moreover, some OR is insurable. Consequently, management of OR is developed in the insurance industry more than what is seen in the banking industry. However, the new development, which has arisen from Basel II, is the calculation of capital necessary to protect the OR that an insurer is exposed to. The implication of the Basel II approach in the insurance industry, in particular in Solvency II, encountered many complexities and criticisms. Nevertheless, the key conflicting issue is that the nature of OR in the insurance industry is not similar to that of the banking industry; and the methodology which is applied to calculate OR is full of constraints and therefore does not reflect the true level of

[5] Several interesting papers are listed on http://human-factors.arc.nasa.gov/awards_pubs/publications.php.

OR that an insurance company is exposed to. Moreover, the initiative of correlating OR with FR is even more complex. The study noted several arguments, such as: the problems of quantifying OR; the inconsistency among ORs suggesting OR is itself uncorrelated; ORs are internal to the organization. They all suggest that unlike FR the exposure of an organization to OR can be mitigated to a certain level (but not to zero); and there exists non-linearity between OR and FR in terms of nature and methodology. In summary, the arguments suggest that the work for calculating capital for OR is a non-sensible job, where the true impact of OR is itself fuzzy. In addition, it is not the regulatory requirement for the insurance industry to measure the OR numerically. The initiatives of insurance regulators (e.g., FSA) and several rating agencies (e.g., S&P) towards OR actually focus more on the quality of the arrangement in place, which seems more from the crisis management perspective. Consequently, it is sensible that insurers have the opportunity to reduce OR to a satisfactory level through good risk management. Analyzing the data and reviewing the findings the study concludes that insurers have two choices in managing OR—first, holding capital for OR, and, second, reducing the level of OR by proper management. In reality, the role of quantification is important but essentially falls in between these choices. This suggests that insurers should not depend solely on either choice.

Another issue is defining and understanding OR. It came out from the discussion that the OR, FR and SR are fundamentally different although they apparently overlap. The key issue is conceptualizing risk, where the cause and the effect (or consequence) of risk are two different issues. Another argument is in terms of "bad luck" and "bad housekeeping," which are believed to be the sources of risk. The former is a result of external events and most relevant to financial risk. The organization may not have any control over its causation. However, the latter is totally internal for the organization, and they may reduce the financial consequence of "bad luck." It is true that the consequences of all risks, whatever the types, are measured in financial terms. However, this does not necessarily mean that all risks are FR. They are, in fact, either "OR" or "SR." Moreover, risks are hierarchical, which suggests that people in the different organizational levels perceived risk differently, and their awareness and responsibilities towards managing risks are also different. Moreover, OR and "operational error" are two different issues. Theoretically, formulation of corporate strategy and its execution are not only two different issues but they involve two different levels of people in the organizational hierarchy. However, both of them are exposed to risk. For instance, whether the organization will bid for a hostile takeover and executing the takeover (which involves resources) are

two different issues. Following the findings of the study, it is sensible to call the former "SR" and the latter "OR." However, the study suggests that the latter has a comparatively smaller effect than the former. The evidence suggests that the concern and focus of the regulators are to the former making liable the top management of the organization. Consequently, the study suggests a big question to both organizations and regulators where they will use the term "SR" or "OR" to continue the work, which currently falls under the title of "OR." In this sense, it is possible to reduce the "OR" (which is the result of "operational error") by managing "SR." However, the converse is not always true. Essentially, it is understood from the study that the lack of clarity of definitions causes all the problems in the issue of the management of OR.

A further issue has arisen on the inclusion of OR in calculating risk appetite of the entire organization. It is important to differentiate "risk appetite" from "risk tolerance"; the latter essentially means "how much risk an organization can afford." It is purely an internal exercise for the organizations because the organizations have no control over the external event, although they may expose themselves to severe damage. It is important to mention that risk appetite of an organization differs with another organization simply because they have different risk tolerance levels. For instance, an organization can invest £200m to an equity believing that it can tolerate a risk of losing £100m if the market goes down by 50 percent. This example suggests that organizations knowingly accept a certain level of risk and ultimately if there is a loss for which the organization loses £100m then it is just due to "bad luck" even there was "good housekeeping." The conclusion is that an organization's risk appetite plays a significant role in defining risk differently from another organization.

6. Contribution

The objective of this paper was to explore the issues necessary to develop an integrated model of OR and FR. The paper suggested the following which may influence the actuaries: (i) in conceptualizing OR and its relevance with other types of risk; (ii) the potential challenges to measure OR; and (iii) deciding to what extent the OR is quantified and modeled within the framework of ERM seeing its inherent nature. The paper clarifies the definition of OR. Moreover, the relation of OR with other types of risks (e.g., FR and SR) was clearly established. The problems associated with the quantification of OR were elaborately discussed in view of the comments of the respondents. The future role of regulators in relation to OR was predicted. The study expects that the future

generation of regulations for OR will hit the root cause of the faulty decisions at the top management level of the organizations for prescribing actions and penalty for the wrongdoers from the crisis management perspective using principle-based regulations. Alternatively, instead of focusing on financial outputs, the regulators will likely set organizational culture (e.g., the capability of affording risk, the way of handing risk and the governance system in place) at the heart of assessing organizations' risk management initiatives. The study finds that transparency is a key concern of regulators in relation to OR. In addition, the study observed an interesting relation between the degree of diversification of businesses and the degree of OR to which a global insurer is exposed. The less the organization is diversified, the lower the OR it holds. However, the disadvantage is that less diversified organizations are exposed to more concentration of risk.

7. Conclusion

Indeed, measurement and modeling are two steps towards achieving the ultimate objective of OR management within an ERM framework. However, justification of capital necessary to protect OR should not merely depend on the robustness of the models. The key issue is the inputs, which is robustness (e.g., adequacy, accuracy, consistency and validity) of data. Clearly, prioritization and categorization of OR are difficult because they involve a significant amount of subjective and behavioral issues. Consequently, the fundamentals of the quantification of OR need to be supported by a strong qualitative risk management while ensuring the quality of data and the effectiveness of the balance and control in place within the organization. Indeed, this is an area of cognitive psychology, and the several approaches adopted by the risk and reliability studies in engineering science (e.g., cautionary principle, safety culture, etc.) can be utilized in the attempt of understanding and managing OP risk (e.g., human errors) in insurance business. In reality, there is no one-size-fits-all solution for the management of risks. It is concluded that the future studies should aim to develop methodologies in order to achieve a suitable balance between qualitative and quantitative approaches towards measuring and managing OR and integrating OR with FR. Nevertheless, the desirable outcome can only be achieved by interdisciplinary research on ERM, which encompasses all risks. Finally, it is predicted that there will unlikely be any universal or purely theoretical ground of such study; rather an industry-oriented best practice could provide economic solutions.

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