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Internal Risk Based Approach

-- Evolutionary Approaches to Regulatory Capital Charge for Operational Risk--

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Internal Risk Based Approach

-- Evolutionary Approaches to Regulatory Capital Charge for Operational Risk--
(Discussion paper[1])

1. Introduction

Since the Basel Committee proposed an explicit capital charge in its consultation paper issued in June 1999, various approaches to measuring operational risk have been developed by both the industry and supervisors. Among them was the Internal Risk Based (IRB) approach, in which individual banks' internal loss data would be effectively taken into account while the structure of the scheme would be kept relatively simple and comparable compared to the structure of "full model" type approaches. IRB approach can bridge the gap between a basic approach and a more advanced approach, providing a clear and evolutionary path that leads banks to more sophisticated approaches on a business line by business line basis.

The purpose of this paper is to explain the structure of the IRB approach and its application to regulatory capital calculation. Of course, the authors of the paper fully recognize that the IRB approach is still under development. Until now, the Bank of Japan has conducted research on operational risk measurement along with a series of dialogues with the industry[2]. In writing this paper, the authors tried to incorporate the industry's view toward regulatory capital for operational risk, while emphasizing simplicity, comparability, and objectivity from the supervisors' point of view.

2. Evolutionary framework

(1) Background discussions

A spectrum of approaches to operational risk capital charge can be considered; i) a Basic approach, ii) a Standardised approach based on business lines, and iii) a Modelling approach. Firstly, in the Basic approach, the required capital could be determined by multiplying a financial indicator, such as non-interest income, and perhaps a constant coefficient. Secondly, in the Standardised approach based on business lines, banks can divide their business activities into multiple business lines. Then the required capital for each business line would be determined by multiplying a broad indicator and risk weights determined by supervisors. And, as

[1] By Toshihiko Mori, Senior Manager, and Eiji Harada, Financial Analyst.

[2] Some of the outcomes of the research have been posted on the website of Bank of Japan (http://www.boj.or.jp/en/ronbun/ronbun_f.htm). Please see "Measuring Operational Risk in Japanese Major Banks" on the website. It is fully appreciated that the authors of the paper have received a lot of comments and questions from the industry and others on a global basis that result in the content of this paper.

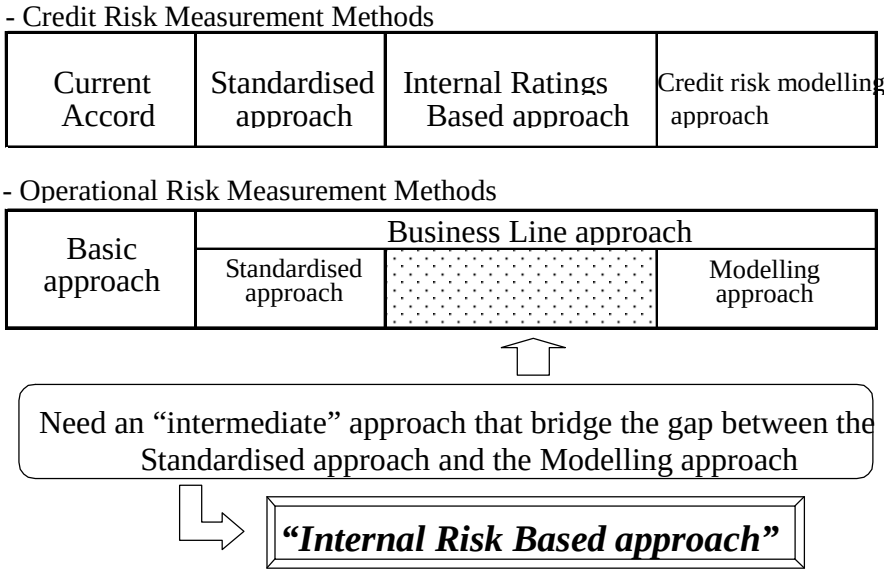
the most advanced stage, such as an approach using loss distribution, the regulatory capital could be determined by directly using individual banks' own estimates of operational VAR.

Without the IRB approach being added on the list, a giant step exists between the Standardised approach and the Modelling approach. In other words, when a bank moves from the Standardised approach to the Modelling approach, supervisors need to give banks discretion on two issues: 1) process of collecting and using internal loss data, and 2) methods to calculate the required capital based on the internal loss data.

(2) Necessity of an intermediate stage

Comparison between the lists of approaches to regulatory capital for credit and operational risks brings a clear view on necessity of an intermediate stage between the Standardised approach and the Modelling approach.

Chart 1: Credit and operational risk measurement approaches



As for credit risk, firstly there is the current accord, secondly there is the Standardised approach, in which external credit ratings will be used, thirdly there is the Internal **Ratings** Based approach, in which individual bank's internal credit assessment will be used, and finally there is the Credit risk modelling approach.

On the other hand, as for operational risk, it is clear that there need to be an intermediate stage that bridges the giant step between the Standardised and Modelling approaches. That is the reason why the Internal **Risk** Based approach should be added on the menu.

(3) Structure of Internal Rating Based approach for credit risk

Under the Internal Rating Based approach to credit risk, required capital is determined based on parameters, such as Exposure at default (EAD), Probability of

default (PD), and Loss given default (LGD)[3]. A certain index that reflects the degree of diversification of portfolio could also be taken into account. PD and other parameters could be estimated by individual banks based on the banks' historical default experience as well as external data. In this approach, banks will be given discretion on the estimation of some parameters, while supervisors will provide the formula that converts the estimated parameters into required capital.
Using this terminology, expected loss is given by "EAD*PD*LGD." For example, if the exposure is 1000 dollars, PD is 1%, and LGD is 0.3, then the expected loss will be estimated as 3 dollars.

(4) Structure of Internal Risk Based approach for operational risk

Under the Internal Risk Based approach for operational risk, banks are to divide its operational risks into multiple business lines and risk types. Then, the required capital can be determined using the following formula.

Required capital for each business line/risk type = Exposure indicator (EI) * Risk weight * Granularity index (GI) Risk weight = α * Probability of loss event (PE) * Loss given event (LGE) Total required capital = Σ { Required capital for each business line/risk type }

In the formula above, the exposure indicator (EI) is an indicator that represents the size of operational risk exposure. For example, "total transaction amount handled per year" can be used as this indicator. Risk weight is determined using a function of probability of loss event (PE) and loss given event (LGE). PE and LGE would be estimated by individual banks based on the banks' historical operational loss experience as well as effective use of external data. For example, PE can be defined as "the number of loss events / the number of transactions", and LGE can be defined as "the average of (loss amount / transaction amount) of each loss event". The effect of risk mitigation techniques, such as insurance, can be taken into account as a reduction of LGE. As shown above, the authors propose to use a simple linear function to calculate risk weight for regulatory capital purpose. Granularity index (GI) is an index that reflects the degree of the lumpiness or "granularity" of the transactions. This concept can be compared with the degree of diversification in the field of credit risk. (You will see more detailed discussions regarding risk weights and GI later in this paper).
In this scheme, the expected loss is given by "EI*PE*LGE." Again, in this approach, banks will be given discretion on the estimation of some parameters, while supervisors will provide the formula that converts these "bank-specific" parameters into required capital in order to keep simplicity and comparability of

[3] LGD is defined as "1 – recovery rate". Recovery rate would reflect the effect of risk mitigation techniques, such as collateral and guarantee.

this approach.

(5) Comparison between credit risk IRB and operational risk IRB

As described in the previous paragraphs, the structure of operational risk IRB is very similar to that of credit risk IRB. Especially, the risk weight in credit risk IRB is determined based on banks' own estimation of PD and other parameters, and LGD, one of the parameters, takes account of risk mitigation techniques, such as collateral and guarantee. Similarly, the risk weight in operational risk IRB is determined based on banks' own estimation of PE and LGE, and LGE may take account of risk mitigation techniques, such as insurance.

Also, the concept of multiple portfolios in credit risk management and the concept of multiple business lines in operational risk IRB may be comparable. In measuring credit risk, some banks divide its portfolio into multiple portfolios, such as commercial and industrial (C&I) loan portfolio, retail portfolio, and so on. One of the merits of having multiple portfolios in credit risk is that it can better address particular risk profile of each portfolio, and it can allow banks to apply different approached on each portfolio.

Similarly, in measuring operational risk capital charge, it is proposed that banks divide its operational risks into multiple business lines, such as investment banking, retail business, and so on. One of the merits of having multiple business lines in the measurement of operational risk capital charge is that it can better address differing risk profile of each business line, and it can allow banks to apply different approach to different business line. So, for example, if a bank develops internal loss data collecting systems only for retail business and obtain approval from its supervisor to use them, it can apply the IRB approach only for that business line while applying the more Basic approaches for other business lines.

Internal **Credit Risk** Management	Internal Risk Based (IRB) for **Operational Risk**
Portfolio composition - C&I loan portfolio - Retail portfolio - Project finance portfolio - ...	Business line composition - Investment banking - Retail/commercial - Asset management - ...
Merits of multiple portfolios - Better address differing risk profile of each portfolio. - Allow banks to apply different approach on each portfolio.	Merits of multiple business lines - Better address differing risk profile of each business line. - Allow banks to apply different approach on each business line.

(6) 4 stages for operational risk measurement

To summarize the discussions above, here is the brief comparison between the 4 stages for operational risk measurement.

- Stage 1: Basic approach:
  Required capital = Indicator * Risk weight
- Stage 2: Standardised approach
  Required capital = Σ { Broad indicator * Risk weight }
- Stage 3: Internal Risk Based approach
  Required capital = Σ { Exposure indicator * Risk weight * GI }
- Stage 4: Modelling approach
  Required capital = f { frequency & severity distributions }

Although the Standardised approach and the Internal Risk Based approach use similar formula to calculate required capital, the most significant difference between these approaches lies in the determination of the risk weights. That is, while the risk weight for the Standardised approach is determined and fixed by supervisors, risk weight for the Internal Risk Based approach is risk sensitive and unique to each individual bank, reflecting the bank's own PE and LGE, while using the supervisory-determined formula to keep simplicity and comparability.

(7) Merits and challenges of the IRB approach

There are many merits of introducing the Internal Risk Based approach. Firstly, the scheme is risk sensitive, while it is not too complicated. Secondly, the approach provides discretion to banks on the use of internal loss data, while the method to calculate the required capital is uniformly set by supervisors. As such, it reflects the banks' own risk profile while preserving comparability across banks, and paves an evolutionary path to the Loss Distribution approach. Thirdly, the approach gives banks incentives to collect internal loss data step by step.

Of course, there still exist many challenges. One of the critical issues is that we need to clarify definition of loss events. Also, we need to conduct further feasibility study on how to implement the simple approximation defined above.

3. Design of the Internal Risk Based approach

(1) Components of the formula

As described in the previous section, in the operational risk IRB approach, the required capital for each business line/risk type is determined using the following formula.

Required capital for each business line/risk type = Exposure indicator (EI) * Risk weight * Granularity index (GI) = EI * PE * LGE * α * GI ($\leftarrow$ Risk weight = α * PE *LGE)

The components of the formula can be decomposed as follows.

*Part 1: EI * PE * LGE*

Exposure indicator (EI) represents a size of operational risk exposure. For example, "total transaction amount handled per year" can be used as this indicator. Probability of loss event (PE) represents the probability of occurrence of loss events. For example, "the number of loss events / the number of transactions" can be used as PE parameter. Loss given event (LGE) represents how much proportion of transaction would be expensed as loss, given a loss occurrence. For example, "the average of (loss amount / transaction amount) of each loss event" can be used as LGE parameter[4]. As such, the product of EI, PE and LGE gives the average $ amount of loss per year. There are several options on how to estimate the "expected" "future" PE using historical data of loss amount.

Option 1: Determine PE by directly using the historical average of PE of each bank.

Option 2: Determine PE by adding a "safety buffer" to "historical average of PE", with "supervisors-determined" procedures to calculate the "safety buffer".

Option 3: Determine PE by adding a "safety buffer" to "historical average of PE". In this option, the process to calculate the "safety buffer" is determined by individual banks, subject to supervisors' approval.

The merit of option 3 is that it would align regulatory capital with individual bank's economic capital more closely, while the challenges of this option is that supervisors need to establish validation standards for the process of estimating PE.

*Part 2: EI * PE * LGE * α*

The term α is a constant that is used to transform expected losses (EL) into unexpected losses (UL). UL is defined as the maximum amount of loss per year within a certain confidence interval. The scale of α will be determined and fixed by supervisors for each business line/risk type, assuming a linear relationship between EL and UL. In determining the specific figure of α that will be applied across banks, supervisors are to draw a "typical" distribution of total loss amount per one year[5], and use the ratio of UL to EL of the distribution.

*Part 3: EI * PE * LGE * α * GI*

While α is constant across banks, in reality, risk profile of one bank is different from that of another (see chart below). Granularity index (GI) is a factor that incorporates each bank's differing features of loss distribution, or specifically the

[4] For example, in a loss situation where $1000 was falsely withdrawn on a forged bank check with face value of $100, "loss amount/transaction amount" would be equal to 0.9 (=900/1000). In this case, transaction amount used for EI would be $1000. Of course, the authors recognize that, in order to have banks estimate LGE in regulatory capital calculation, scope of loss amount should be clearly defined by the supervisor's side.

[5] The authors take one year as the holding period in this paper. Of course, further discussions will be needed in choosing an appropriate holding period.

ratio of UL to EL, representing the degree of lumpiness of the transactions, which leads to the diversification or concentration of operational risks. As α is determined by assuming a loss distribution of a "typical" bank, GI for "typical" bank is equal to 1. On the other hand, GI for a bank with less diversified risks can be set larger than 1, while GI for a bank with more diversified risks can be set smaller than 1. The concept of GI is just easy, as it is an application of "mean-variance" analysis which you can see in finance textbooks.

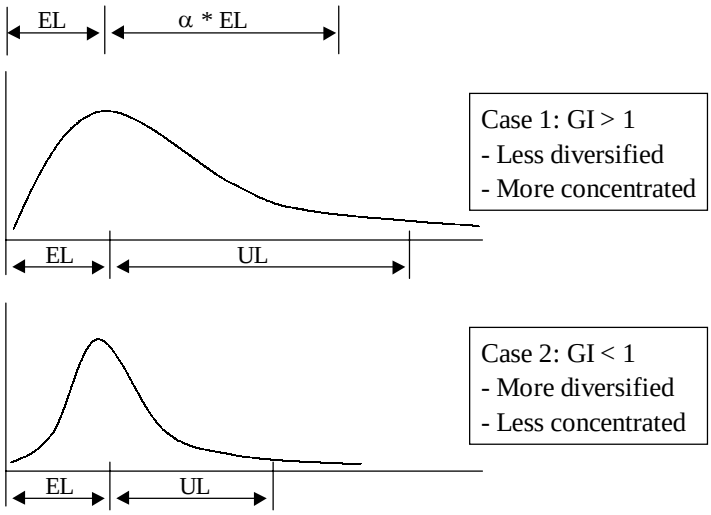
There are several options on how the figures of GI can be quantified by each bank.

Option 1: Not consider GI (GI = 1 for all banks)

Option 2: Consider GI, with "supervisors-determined" procedures to calculate GI.

Option 3: Consider GI. In this option, the process to calculate GI is determined by individual bank based on its own estimation of loss distribution, subject to supervisors' approval.

Chart 2: Various shapes of loss distributions



(2) Relative and absolute capital

The required capital calculated using the formula above represents a "relative" term of required capital, making certain assumptions. The absolute level of required capital may be determined by considering the desired level of soundness standards for operational risk as well as the level that provides incentives for banks to improve their risk management practices. To provide such incentives, it may be desirable to set the level of capital requirements so that the more advanced and sophisticated approaches would attract lower charges compared to the more basic approaches.

(3) Business line and risk type

In IRB approach, banks are to divide its operational risks into multiple business lines. It is also proposed that operational risks in each business line then be divided into multiple risk types based on, for example, causes of loss events. By having multiple risk types, the scheme can better address differing characteristics

of loss events, while sacrificing simplicity of the calculation scheme and increasing room for regulatory arbitrage.

There are two options on how to define business lines and/or risk types.

Option 1: Supervisors define a "uniformed" grid of business lines and/or risk types.

Option 2: Individual banks define their own grid of business lines and/or risk types.

The first option can enhance comparability across banks, while there may be difficulty in determining a grid that fits all banks. On the other hand, the second option can align the process of regulatory capital calculation with individual banks' internal risk management more closely, while there may be challenges in setting validation standards. Dialogue with the industry tells us that majority of banks will use mapping techniques under option 1 to apply their internal loss database to supervisory-determined grid of business lines.

(4) Definition of indicators and parameters

Another issue is the definition of indicators and parameters. Again, there are two options regarding how to define types of indicators and parameters.

Option 1: Supervisors define types of indicators and parameters.

Option 2: Individual banks define their own indicators and parameters.

Again, the first option can enhance comparability and simplicity, while the second option can maintain consistency between regulatory and economic capitals. In option 1, indicators and parameters should be chosen so as to capture banks' exposure to operational risks. As such, the process of choosing indicators for IRB will give a practical recommendation to the process of choosing broad indicator for the Standardised approach.

(5) Sub-stages of IRB approach (stages 3A and 3B)

Based on the argument above, the authors of the paper would propose to divide the IRB approach into two sub-stages, namely the stages 3A and 3B. That is, in 3A, supervisors determine the grid of business lines/risk types and definition of EI, PE, LGE, and GI, while banks could use their own estimates of these parameters. In 3B, individual banks determine their own grid of business lines/risk types and definition of EI, PE, LGE, and GI.

Chart 3: stages 3A and 3B of IRB

	Stage 3A	Stage 3B
Grid of business lines and risk types	Supervisor determined	Each bank determined
Definition of EI, PE, LGE, and GI for each business line and risk type	Supervisor determined	Each bank determined
Estimation of EI, PE, LGE, and GI under the definition above	Each bank determined	Each bank determined
α (scaling factor)	Supervisor determined	Supervisor determined

4. Supplemental discussions

(1) Quality adjustment

The phrase “quality of operational risk management” can mean two ways. On the one hand, it can mean “quality of loss control,” or the degree of a bank’s ability of reducing operational losses. On the other hand, it can mean “quality of risk measurement systems,” or the degree of a bank’s ability of estimating parameters such as PE and LGE.

There are various arguments on whether to incorporate “adjustment factor” reflecting “quality of loss control” in calculation process of required capital.

Argument in favor of use of “quality adjustment factor”:

- Quality adjustment would give banks proper incentives to improve their internal risk management processes. (This argument could be accommodated in Pillar 2)

Argument against use of “quality adjustment factor”:

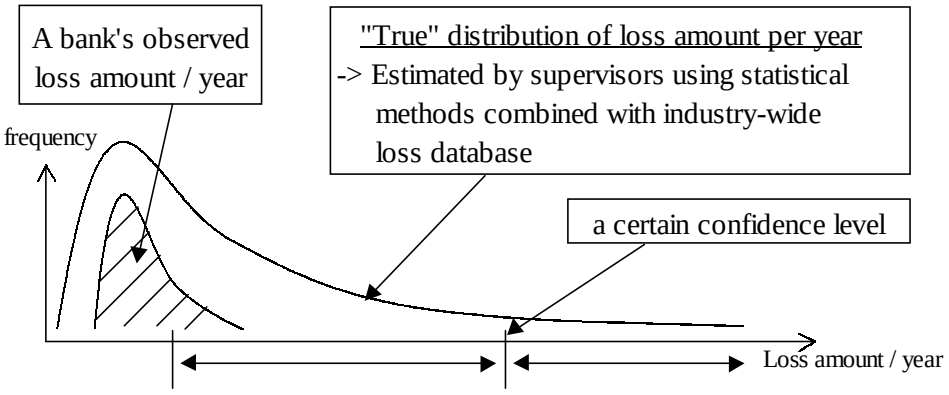
- Quality factor of each bank has already been embedded in its historical loss data, which the IRB approach incorporates in its formula.
- When a bank would move toward more advanced approach, quality of internal risk control must be examined by supervisors in validation process. As such, there is no need for additional qualitative adjustment in calculating required capital.
- Quality of internal control is not objectively quantifiable. As such, the adjustment based on the quality of control is not suitable for regulatory capital calculation of Pillar 1.

As for “quality of risk measurement systems”, it is proposed that, if a bank failed to demonstrate validity of its estimates of parameters such as PE and LGE, a punitive factor be applied on the bank in a similar fashion as the add-on factor in the market risk capital charge.

(2) Capturing “low frequency, high impact” event

As the occurrence of a loss event is a matter of statistics, “low frequency, high impact” event, or extreme event, may not always be captured during the observation period. Chart below visually explains this argument.

Chart 4: Low frequency, high impact event



In this chart, the X axis represents loss amount per year and the Y axis represents frequency. The shaded area represents a bank's observed loss amount per year, and the outside curve represents the true distribution of loss amount per year of a "typical" bank, which is estimated by supervisors using statistical methods combined with industry-wide loss database.

As shown in the chart, low frequency high impact events would be divided into two ranges. Firstly, in order to address the range below a certain confidence level, supervisors should design the scheme of IRB approach, especially in determining the scale of α, in such a way that the required capital calculated using the IRB would be large enough to cover risks within this range.

On the other hand, in order to address risks beyond a certain confidence level, banks should periodically conduct stress tests. Also, the effective use of insurance might play a significant role in addressing low frequency, high impact event.

(3) Addressing new businesses

Basically, it is very difficult to quantify operational risk of brand new businesses for the industry where internal loss data is not available. However, this is the case not only for the IRB approach but also in more simple approaches, because, for example, broad indicator for Standardised approach is not usually available for new businesses.

In addressing new businesses for a bank, external comparison may be used. For example, if there are other banks operating the same kind of businesses, the bank may consider using external data obtained by these banks. Similar approach is also used in credit risk analysis.

(4) Stability of risk weight

As required capital is calculated based on a bank's actual loss experience in IRB approach, the $ amount of required capital may unstably fluctuate depending on whether the bank has experienced a severe loss during the observation period. In order to stabilize parameters estimated by each bank, two alternatives may be used. Firstly, the authors propose to estimate PE based on "the number of loss events/the number of transactions" rather than "the $ amount of total loss/the $ amount of transactions in total". Generally speaking, the number of loss events is more stable than the $ amount of total loss, representing "true" probability of loss event inherent in each business line. Secondly, the authors propose to apply a certain "cap" on risk weight. For example, risk weight for the Standardised approach can be used as the cap.

(5) Validation standards

Chart 5: Evolutionary validation standards

	Basic approach	Standardised approach	Internal Risk Based approach 3A	Internal Risk Based approach 3B	Modelling approach
Effective risk control		- Existence of independent risk control unit - Effective use of risk reporting systems - Involvement of senior management, etc.			
Measurement of indicators		- Clear definition of the scope of indicators - Clear definition of boundaries between business lines - Documentation of the process of measuring indicators			
Collection of internal loss data			- Scope and definition of operational losses - Infrastructure of loss database systems - Sound loss-data reporting practices		
Estimation of risk-rate			- Criteria for estimating Risk-rate / Granularity - Other quantitative standards		- Criteria for process of determining loss distributions
Internal/external validation					- Statistical validatio - External compariso - Usage standard

As a bank would move toward more advanced approaches in the evolutionary framework, more rigorous validation standards would be imposed on the bank.

5. Conclusion

(1) Overview of approaches

To summarize, chart below shows an overview of the approaches.

Chart 6: Overview of approaches

- Credit Risk

Name	Current Accord	Standardised approach	Internal Ratings Based approach	**Credit risk modelling approach**
			less advanced ⟶ more advanced	

- Operational Risk

Names	Top-down (Allocate a certain proportion of current capital to ope. risk)		Bottom-up (Estimate operational risk based on actual internal loss data)	
	Basic approach	Standardised approach	**Internal Risk Based approach** **3A** / **3B**	Modelling approach
Structure	Σ { Indicators * Risk weight }			Ope. VaR
Business Lines	Single business line	Multiple Business Lines and Risk Types: Standardized by supervisors	Defined by individual banks	
Parameters	Broad indicator only	Exposure indicator, PE, LGE, and GI		Frequency and Severity distributions
	Standardized by supervisors		Defined by individual banks	

(2) Plans to future work

In order to implement IRB approach in practice, we need to develop several contents of the approach, such as definition of loss events, choice of parameters, structure of formula, determination of α (scaling factor), and validation standards. In challenging these issues, dialogue with the industry is important.

While the industry has requested to implement IRB approach as a method of regulatory capital calculation, the authors of the paper recognize that the challenges noted above are not an easy task. However, the same types of issues have been addressed in the field of credit risk. For example, challenges regarding definition of loss event can be regarded as equivalent of challenges regarding definition of default in credit risk. Therefore, outcomes in that field might provide good input into the development of the IRB in operational risk.

(3) Summary

In designing an approach to quantify capital charge for operational risks, supervisors need to consider the balance between practical feasibility and analytical rigorousness. With this in mind, the followings are the summary of the paper:

- The Internal Risk Based approach can bridge a gap between the Standardised and Modelling approaches, providing a clear and evolutionary path that leads banks to more sophisticated approaches on a business line by business line basis.
- It can be regarded as an analogy to Internal Ratings Based approach to credit risk capital charge, in a sense that both approaches are risk sensitive while maintaining comparability across banks, using the same concepts and methodologies.
- There still exist a lot of critical issues to be resolved for operational risk IRB. However, similar issues have been addressed in the field of credit risk. So, we could make good use of outcomes in that field in developing the operational risk IRB.