

READING 66: OPERATIONAL RISK

Hull, Chapter 23

EXAM FOCUS

This reading introduces operational risk by defining operational risk and discussing the types of operational risk and bank business lines that must be considered when calculating operational risk capital requirements. Collecting data for loss frequency and loss severity distributions is an important component of allocating operational risk capital among various business lines. Methods for finding the necessary operational loss data points are based on both internal and external data and historical and forward-looking approaches.

MODULE 66.1: OPERATIONAL RISK REGULATORY CAPITAL

Some firms define operational risk as all risk that is not credit or market risk. However, most people agree that this definition is far too broad. Past industry definitions of operational risk include:

- Financial risk that is not caused by market risk (i.e., unexpected asset price movements) or credit risk (i.e., the failure of a counterparty to meet financial obligations).
- Any risk developing from a breakdown in normal operations (e.g., system failures or processing mistakes).
- Any risk from internal sources (e.g., internal fraud), excluding the impact of regulatory action or natural disasters.
- Direct or indirect losses that result from ineffective or insufficient systems, personnel, or external events (e.g., natural disasters or political events), excluding business risk (the risk of earnings volatility resulting from business conditions).

In 2001, the Basel Committee on Banking Supervision attempted to incorporate industry views and build a consensus on the definition of operational risk. The Committee's statement of operational risk is as follows:

“The risk of direct and indirect loss resulting from inadequate or failed internal processes, people, and systems or from external events.”

The Basel Committee defines operational risk to include internal functions or processes, human factors, systems, firm infrastructure, and outside events. Problems with any of these areas can lead to direct and indirect losses, both expected and unexpected. The operational risk definition explicitly includes **legal risk**, but does not address **reputational risk** or **strategic risk**, presumably because they can be difficult to quantify. This definition concentrates on sources of losses and the impact of operational losses.

Sometimes operational risks interact with market and credit risks. For example, exceeding limits or misreporting positions may only result in losses if the market moves adversely (i.e., market risk). As another example, an error made during a loan documentation process may only become known if the counterparty defaults (i.e., credit risk).

LO 66.a: Compare three approaches for calculating regulatory capital.

The Basel Committee has proposed three approaches for determining the operational risk capital requirement (i.e., the amount of capital needed to protect against the possibility of operational risk losses): (1) the basic indicator approach, (2) the standardized approach, and (3) the advanced measurement approach. The **basic indicator approach** and the **standardized approach** determine capital requirements as a multiple of gross income at either the business line or institution level. The **advanced measurement approach** (AMA) offers institutions the possibility to lower capital requirements in exchange for investing in risk assessment and management technologies.

With the basic indicator approach, operational risk capital is based on 15% of the bank's annual gross income over a 3-year period. Gross income in this case includes both net interest income and noninterest income. For the standardized approach, the bank uses eight business lines with different **beta factors** to calculate the capital charge. With this approach, the beta factor of each business line is multiplied by the annual gross income amount over a 3-year period. The results are then summed to arrive at the total operational risk capital charge under the standardized approach. The beta factors used in this approach are shown as follows:

- Investment banking (corporate finance) 18%
- Investment banking (trading and sales) 18%
- Retail banking 12%
- Commercial banking 15%
- Settlement and payment services 18%
- Agency and custody services 15%
- Asset management 12%
- Retail brokerage 12%

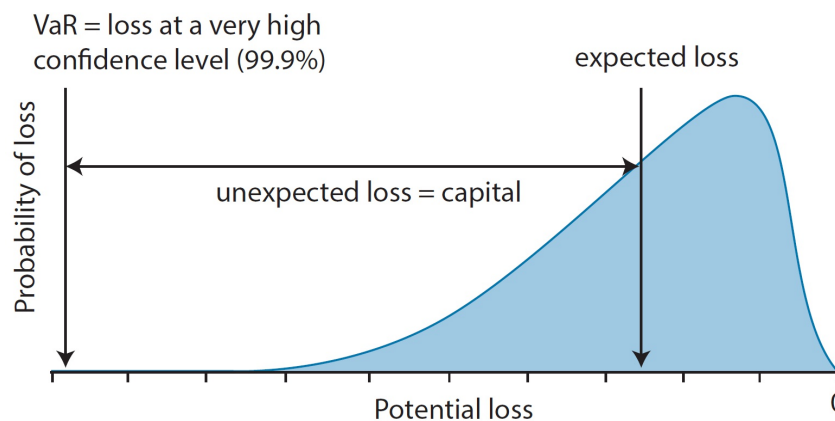
Banks that want to take advantage of the possible lower capital requirements available by using the AMA will be required to determine the operational risk capital charge based on internal criteria that are both qualitative and quantitative in nature. The Basel Committee recommends that large banks move from the standardized approach to the AMA. In order to use either approach, banks must satisfy a number of conditions.

In order to use the standardized approach, banks must: (1) have an operational risk management function that is able to identify, assess, monitor, and control this type of risk, (2) document losses for each business line, (3) report operational risk losses on a regular basis, (4) have a system that has the appropriate level of documentation, and (5) conduct independent audits with both internal and external auditors.

In order to use the advanced measurement approach, banks must satisfy these requirements in addition to being able to approximate unexpected losses. The calculation of unexpected losses is based on external and internal loss data as well as scenario analysis. With this estimate, the bank is able to find the necessary amount of capital to allocate to each business line based on

the bank's operational value at risk (VaR) measure. The operational risk capital requirement currently proposed by the Basel Committee is equal to the unexpected loss in a total loss distribution that corresponds to a confidence level of 99.9% over a 1-year time horizon. This concept is illustrated in [Figure 66.1](#).

Figure 66.1: Capital Requirement



PROFESSOR'S NOTE

The calculation of operational risk capital using all three methods will be discussed in more detail in the FRM Part II curriculum.

Operational Risk Categories

LO 66.b: Describe the Basel Committee's seven categories of operational risk.

The Basel Committee on Banking Supervision disaggregates operational risk into seven types. A majority of the operational risk losses result from clients, products, and business practices.

1. *Clients, products, and business practices.* Failure (either intentional or unintentional) to perform obligations for clients. Examples include mishandling of confidential information, breaches in fiduciary duty, and money laundering.
2. *Internal fraud.* Disobeying the law, regulations, and/or company policy, or misuse of company property. Examples include misreporting data or insider trading. Well-known case studies dealing with internal fraud include Barings, Allied Irish Bank, and Daiwa.
3. *External fraud.* Actions by a third party that disobey the law or misuse property. Examples include robbery or computer hacking.
4. *Damage to physical assets.* Damage occurring from events, such as natural disasters. Examples include a terrorist attack, earthquakes, or fires.
5. *Execution, delivery, and process management.* Failure to correctly process transactions and the inability to uphold relations with counterparties. Examples include data entry errors or unfinished legal documents.
6. *Business disruption and system failures.* Examples include computer failures, both hardware- and software-related, or utility outages.
7. *Employment practices and workplace safety.* Actions that do not follow laws related to employment or health and safety. Examples include worker compensation,

discrimination disputes, or disobeying health and safety rules.

Assuming that a bank was active in each of the eight business lines discussed previously, it would have 56 different measures of risk to aggregate into a single operational risk VaR measure. Institutions that are not active in each of the lines of business would require fewer risk measures.



MODULE QUIZ 66.1

1. In constructing the operational risk capital requirement for a bank, risks are aggregated for:
 - A. commercial and retail banking.
 - B. investment banking and asset management.
 - C. each of the seven risk types and eight business lines that are relevant.
 - D. only those business lines that generate at least 20% of the gross revenue of the bank.
2. According to current Basel Committee proposals, banks using the advanced measurement approach must calculate the operational risk capital charge at a:
 - A. 99 percentile confidence level and a 1-year time horizon.
 - B. 99 percentile confidence level and a 5-year time horizon.
 - C. 99.9 percentile confidence level and a 1-year time horizon.
 - D. 99.9 percentile confidence level and a 5-year time horizon.
3. Which of the following is not one of the seven types of operational risk identified by the Basel Committee?
 - A. Failed business strategies.
 - B. Clients, products, and business practices.
 - C. Employment practices and workplace safety.
 - D. Execution, delivery, and process management.
4. The Basel definition of operational risk focuses on the risk of losses due to inadequate or failed processes, persons, and systems that cannot protect a company from outside events. The definition has been subject to criticism because it excludes:
 - A. market and credit risks.
 - B. indirect losses.
 - C. failure of information technology operations.
 - D. impacts of natural disasters.
5. Which of the following measurement approaches for assessing operational risk would be most appropriate for small banks?
 - A. Loss frequency approach.
 - B. Basic indicator approach.
 - C. Standardized approach.
 - D. Advanced measurement approach (AMA).

MODULE 66.2: LOSS DISTRIBUTION APPROACH

LO 66.c: Derive a loss distribution from the loss frequency distribution and loss severity distribution using Monte Carlo simulations.

Operational risk losses can be classified along two dimensions: loss frequency and loss severity. **Loss frequency** is defined as the number of losses over a specific time period (typically one year), and **loss severity** is defined as the value of financial loss suffered (i.e., the size of the loss). It can be reasonably assumed that these two dimensions are independent.

Loss frequency is most often modeled with a **Poisson distribution** (a distribution that models random events). The mean and variance of the Poisson distribution are equal to a single parameter, λ . Over a short time horizon, the probability of losses is then equal to $\lambda \times \Delta t$. Over a time horizon, T , the probability of n losses using this distribution is equal to:

$$e^{-\lambda T} \times \frac{(\lambda T)^n}{n!}$$

The parameter λ is equal to the average number of losses over a given time horizon. So if ten losses occurred over a 5-year period, λ would equal two per year ($= 10 / 5$).

Loss severity is often modeled with a **lognormal distribution**. This distribution is asymmetrical (the frequency of high-impact, low-frequency losses is not equal to the frequency of low-impact, high-frequency losses) and fat-tailed (rare events occur more often than would be indicated by a normal distribution). The mean and standard deviation are derived from the logarithm of losses.

Loss frequency and loss severity are combined in an effort to simulate an expected loss distribution (known as **convolution**). The best technique to accomplish this simulation is to use a **Monte Carlo simulation** process. With this process, we make random draws from the loss frequency data and then draw the indicated number of draws from the loss severity data. Each combination of frequency and severity becomes a potential loss event in our loss distribution. This process is continued several thousand times to create the potential loss distribution.

Having created the loss distribution, the desired percentile value can be measured directly. For example, the 99th percentile would correspond with the loss amount that is greater than 99% of the distribution's data. The difference between the losses at the selected percentile and the mean loss of the distribution equals the unexpected losses at the corresponding confidence level, as was illustrated in [Figure 66.1](#).

Data Limitations

LO 66.d: Describe the common data issues that can introduce inaccuracies and biases in the estimation of loss frequency and severity distributions.

The historical record of operational risk loss data is currently inadequate. This creates challenges when trying to accurately estimate frequency and severity. Given the extreme risk that operational problems create, firms are beginning to build a database of potential loss events. Compared to credit risk losses, the data available for operational risk losses is clearly lacking. For example, firms can rely on credit rating agencies to get a clear view of default probabilities and expected losses when assessing credit risk.

It is recommended that banks use internal data when estimating the frequency of losses and utilize both internal and external data when estimating the severity of losses. Regarding external data, there are two data sources available to firms: sharing agreements with other banks and public data.

When incorporating both internal and external operational risk loss data, firms should adjust for inflation. In addition, when viewing external data from other banks it is necessary to use a scale adjustment that applies the loss event to your bank's situation. For instance, if Bank Z has a \$5 million operational risk loss, how would this loss apply to your bank? A simple mathematical proportion will likely over or underestimate the actual loss. As a result, the accepted scale adjustment for firm size is as follows:

$$\text{estimated loss}_{\text{Bank Y}} = \text{external loss}_{\text{Bank Z}} \times \left(\frac{\text{revenue}_{\text{Bank Y}}}{\text{revenue}_{\text{Bank Z}}} \right)^{0.23}$$

EXAMPLE: Firm size scale adjustment

If the observed loss for Bank Z is \$5 million and it has \$1 billion in revenue, what will be the estimated loss adjusted for firm size for Bank Y, which has revenue of \$2 billion?

Answer:

$$\text{estimated loss}_{\text{Bank Y}} = \$5 \text{ million} \times \left(\frac{\$2 \text{ billion}}{\$1 \text{ billion}} \right)^{0.23} = \$5,864,175$$

Notice that this loss is much less than the proportional estimate of a \$10 million loss given that Bank Y has twice the revenue.

Scale-adjusted loss data and other data obtained through sharing agreements are useful when constructing a firm's loss severity distribution. Public data, however, is less reliable given the inherent reporting biases. Public loss data likely only contains relatively large losses from firms that have weak internal controls. As a result, public data is more appropriate when used relative to internal losses. This would involve assigning a multiple to internal data estimates (i.e., mean and standard deviation) that reflects the severity of public external data.

LO 66.e: Describe how to use scenario analysis in instances when data is scarce.

Another method for obtaining additional operational risk data points is to use **scenario analysis**. Regulators encourage the use of scenarios since this approach allows management to incorporate events that have not yet occurred. This has a positive effect on the firm since management is actively seeking ways to immunize against potential operational risk losses. The drawback is the amount of time spent by management developing scenarios and contingency plans.



MODULE QUIZ 66.2

1. In modeling risk frequency, it is common to:
 - A. use a Poisson distribution.
 - B. assume that risks are highly correlated.
 - C. assume risk frequency and severity are the same.
 - D. use straight-line projection from the most recent loss data.

MODULE 66.3: OPERATIONAL RISK MANAGEMENT

Forward-Looking Approaches

LO 66.f: Describe how to identify causal relationships and how to use Risk and Control Self-Assessment (RCSA) and Key Risk Indicators (KRIs) to measure and manage operational risks.

It is important for management to use forward-looking approaches in an attempt to prepare for future operational risk losses. One way to accomplish this objective is to learn from the mistakes of other companies. For example, in Book 1 we learned about a number of financial disasters, including Barings and Allied Irish Bank, which both suffered losses due to rogue traders. Another example is the Hammersmith and Fulham case, where banks took note of a court ruling dealing with counterparty risk.

In the Hammersmith and Fulham case, two traders entered into 600 interest rate swaps totaling 6 billion British pounds over the span of two years. The traders had a low level of understanding of these derivative contracts, and losses quickly grew to millions of pounds. Counterparties became very concerned about the level of credit risk. The auditor at Hammersmith and Fulham was able to void the swap agreements by convincing the court that

the traders and, in turn, the company did not have the authority to enter into these transactions. The court agreed with the company and as a result, the swap counterparties were left with unhedged positions and were unable to collect payments from Hammersmith and Fulham.

Causal relationships are a convenient method of identifying potential operational risks. Relationships are analyzed to check for a correlation between firm actions and operational risk losses. For example, if employee turnover or the use of a new computer system demonstrates a strong correlation with losses, the firm should investigate the matter. It is necessary to conduct a cost-benefit analysis if significant relationships are discovered.

One of the most frequently used tools in operational risk identification and measurement is the **risk and control self assessment (RCSA)** program. The basic approach of an RCSA is to survey those managers directly responsible for the operations of the various business lines. It is presumed that they are the closest to the operations and are, therefore, in the best position to evaluate the risks. The problem with this assumption is that you cannot reasonably expect managers to disclose risks that are out of control. Also, a manager's perception of an appropriate risk-return tradeoff may be different than that of the institution. A sound risk management program requires that risk identification and measurement be independently verified.

The identification of appropriate **key risk indicators (KRIs)** may also be very helpful when attempting to identify operational risks. Examples of KRIs include employee turnover and the number of transactions that ultimately fail. In order to be valuable as risk indicators, the factors must (1) have a predictive relationship to losses and (2) be accessible and measurable in a timely fashion. The idea of utilizing KRIs is to provide the firm with a system that warns of possible losses before they happen.

Scorecard Data

LO 66.g: Describe the allocation of operational risk capital to business units.

Allocating operational risk capital to each business unit encourages managers to improve their management of operational risks. Less capital will be allocated to those business units that are able to reduce the frequency and severity of risks. The reduction in capital will increase the unit's return on invested capital measure; however, reducing capital may not be ideal if the costs of reducing certain risks outweigh the potential benefits. It is, therefore, necessary for each business line manager to be allocated the optimal amount of operational risk capital.

One method for allocating capital is the **scorecard approach**. This approach involves surveying each manager regarding the key features of each type of risk. Questions are formulated, and answers are assigned scores in an effort to quantify responses. The total score for each business unit represents the total amount of risk. Scores are compared across business units and validated by comparison with historical losses.

Examples of survey questions include: (1) the ratio of supervisors to staff, (2) employee turnover rate, (3) average number of open positions in the business unit at one time, and (4) the presence of confidential information. The objective of the scorecard approach is to make business line managers more aware of operational risks and the potential for losses from those risks. It also encourages senior management to become more involved with the risk management process.

The Power Law

LO 66.h: Explain how to use the power law to measure operational risk.

The power law is useful in extreme value theory (EVT) when we evaluate the nature of the tails of a given distribution. The use of this law is appropriate since operational risk losses are likely to occur in the tails. The law states that for a range of variables:

$$P(V > X) = K \times X^{-\alpha}$$

where:

V = loss variable

X = large value of V

K and α = constants

The probability that V is greater than X equals the right side of the equation. The parameters on the right side are found by using operational risk loss data to form a distribution and then using a maximum-likelihood approach to estimate the constants. The power law makes the calculation of VaR at high confidence levels possible since low values of α will represent the extreme tails and, hence, the value at risk from potential operational risks.

Insurance

LO 66.i: Explain the risks of moral hazard and adverse selection when using insurance to mitigate operational risks.

Managers have the option to insure against the occurrence of operational risks. The important considerations are how much insurance to buy and which operational risks to insure. Insurance companies offer policies on everything from losses related to fire to losses related to a rogue trader. A bank using the AMA for calculating operational risk capital requirements can use insurance to reduce its capital charge. Two issues facing insurance companies and risk managers are moral hazard and adverse selection.

A **moral hazard** occurs when an insurance policy causes an insured company to act differently with the presence of insurance protection. For example, if a firm is insured against a fire, it may be less motivated to take the necessary fire safety precautions. To help protect against the moral hazard issue, insurance companies use deductibles, policy limits, and coinsurance provisions. With coinsurance provisions, the insured firm pays a percentage of the losses in addition to the deductible.

An interesting dilemma exists for rogue trader insurance. A firm with a rogue trader has the potential for profits that are far greater than potential losses, given the protection of insurance. As a result, insurance companies that offer these policies are careful to specify trading limits, and some may even require the insured firm not to reveal the presence of the policy to traders. These insurance companies are also banking on the fact that the discovery of a rogue trader would greatly increase the firm's insurance premiums and greatly harm the firm's reputation.

Adverse selection occurs when an insurance company cannot decipher between good and bad insurance risks. Since the insurance company offers the same policies to all firms, it will attract more bad risks since those firms with poor internal controls are more likely to desire insurance. To combat adverse selection, insurance companies must take an active role in

understanding each firm's internal controls. Like auto insurance, premiums can be adjusted to adapt to different situations with varying levels of risk.



MODULE QUIZ 66.3

1. One of the basic requirements of a risk control process that a risk and control self-assessment program (RCSA) fails in is the:
 - A. expert opinion of managers.
 - B. identification of expected losses.
 - C. independent verification of risk identification and measurement.
 - D. ongoing assessment of the effectiveness of risk management activities.

KEY CONCEPTS

LO 66.a

The Basel definition of operational risk is “the risk of direct and indirect loss resulting from inadequate or failed internal processes, people, and systems or from external events.”

The three methods for calculating operational risk capital requirements are: (1) the basic indicator approach, (2) the standardized approach, and (3) the advanced measurement approach (AMA). Large banks are encouraged to move from the standardized approach to the AMA in an effort to reduce capital requirements.

LO 66.b

Operational risk can be divided into seven types: (1) clients, products, and business practices, (2) internal fraud, (3) external fraud, (4) damage to physical assets, (5) execution, delivery, and process management, (6) business disruption and system failures, and (7) employment practices and workplace safety.

LO 66.c

Operational risk losses can be classified along two dimensions: loss frequency and loss severity. Loss frequency is defined as the number of losses over a specific time period, and loss severity is defined as the size of a loss, should a loss occur.

LO 66.d

Banks should use internal data when estimating the frequency of losses and utilize both internal and external data when estimating the severity of losses. Regarding external data, banks can use sharing agreements with other banks (which includes scale-adjusted data) and public data.

LO 66.e

Scenario analysis is a method for obtaining additional operational risk data points. Regulators encourage the use of scenarios since they allow management to incorporate events that have not yet occurred.

LO 66.f

Forward-looking approaches are also used to discover potential operational risk loss events. Forward-looking methods include: (1) causal relationships, (2) risk and control self assessment (RCSA), and (3) key risk indicators.

LO 66.g

Allocating operational risk capital can be accomplished by using the scorecard approach. This approach involves surveying each manager regarding the key features of each type of risk. Answers are assigned scores in an effort to quantify responses.

LO 66.h

The power law is useful in extreme value theory (EVT) when we evaluate the nature of the tails of a given distribution. The use of this law is appropriate since operational risk losses are likely to occur in the tails.

LO 66.i

Two issues facing insurance companies that provide insurance for operational risks are moral

hazard and adverse selection. A moral hazard occurs when an insurance policy causes a company to act differently with insurance protection. Adverse selection occurs when an insurance company cannot decipher between good and bad insurance risks.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 66.1

1. **C** The construction of the operational risk capital for a bank requires that risks be aggregated over each of the seven types of risk and each of the eight business lines that are relevant for the particular bank. (LO 66.b)
2. **C** Current Basel Committee proposals require that operational risk capital be calculated at the 99.9th percentile level over a 1-year horizon. (LO 66.a)
3. **A** Failed business strategies are not included in the definition of operational risk, which includes (1) clients, products, and business practices; (2) internal fraud; (3) external fraud; (4) damage to physical assets; (5) execution, delivery, and process management; (6) business disruption and system failures; and (7) employment practices and workplace safety. (LO 66.b)
4. **A** The Basel definition excludes credit or market risks. All of the other choices are incorporated in the definition of operational risk. (LO 66.a)
5. **B** The basic indicator approach is more common for less-sophisticated, typically smaller banks. There is only one indicator of operational risk: gross income. (LO 66.a)

Module Quiz 66.2

1. **A** It is common to use a Poisson distribution to model loss frequency. A Poisson distribution has a single parameter that can be varied to accurately describe loss data. (LO 66.c)

Module Quiz 66.3

1. **C** An RCSA provides no independent verification of risk measurement and identification. (LO 66.f)