

Example 27.2: FRM Exam 2002—Question 117

- a. The CME clearinghouse (along with the NYMEX) collects gross margins, that is, separate margins for all clients. Other exchanges collect net margins, that is, allow the broker to mingle client positions. The gross margin system is safer for the client.

Example 27.3: FRM Exam 2001—Question 124

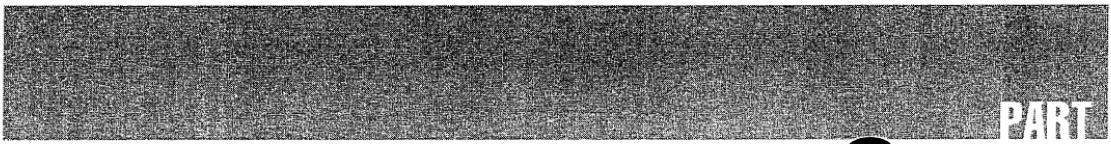
- d. Most derivatives contracts are based on the standard form provided by the ISDA, which ensures uniformity in contracts and reduces legal uncertainty.

Example 27.4: FRM Exam 2000—Question 22

- b. A master agreement will contain a list of obligations, credit provisions, and boilerplate statements. There is no reason to have historical market prices.

Example 27.5: FRM Exam 2004—Question 62

- a. Default includes misrepresentation and bankruptcy. Termination includes tax events.



PART

Seven

Regulation and Compliance

Regulation of Financial Institutions

We now tackle the last part of this book, which deals with regulatory capital. Banks and securities houses must now comply with risk-based capital requirements. These regulatory capital requirements have been the catalyst for advances in risk management of the last decade. They have spurred the industry into better understanding and management of their risks. In turn, regulators are now forced to upgrade their requirements to keep up with modern developments in risk management. Analyzing the rationale behind these regulations yields interesting insights into broader issues that we have not addressed yet, such as systemic risk.

Section 28.1 provides a broad classification of financial institutions subject to regulation. Section 28.2 then discusses systemic risk, which is a major rationale for the regulation of financial institutions. Next, Sections 28.3 and 28.4 describe the regulation of commercial banks and securities houses, respectively. Finally, Section 28.5 concludes with a summary of the tools and objectives of financial regulation.

28.1 DEFINITION OF FINANCIAL INSTITUTIONS

Financial institutions are fundamentally different from other firms. When an industrial corporation goes bankrupt, shareholders, bondholders, and other creditors suffer financial losses. The overall effects of the failure, however, are limited to direct stakeholders. In contrast, the failure of a financial institution can be potentially much more harmful.

But first, we need to define financial institutions. These include:

- **Commercial banks**, whose primary function is to hold customer deposits and to extend credit to businesses, households, or governments.¹
- **Securities houses**, whose primary function is to intermediate in securities markets. These include **investment banks**, which specialize in the initial sale of

¹ Similar intermediaries are **savings institutions**, which specialize in residential mortgages, and **credit unions**, which extend mortgage and consumer credit. These are generally local and relatively small institutions whose failure is unlikely to destabilize financial markets.

securities in the primary markets,² and **broker-dealers**, whose primary function is to assist in the trading of securities in the secondary markets.³

- **Insurance companies**, which provide property and casualty (P&C) or life insurance coverage.

In some countries, the first two types are separated and subject to different regulators. This was the case in the United States until the recent repeal of the Glass–Steagall Act, which separated banking and securities functions. This is an example of **asset restrictions** on financial institutions. In other countries with a so-called **universal bank** model, a bank can engage in traditional banking and securities activities.

Financial institutions also include other intermediaries that constitute the “buy side” of Wall Street, as opposed to banks and brokers, the “sell side” that intermediates in financial markets. The buy side consists of professional (as opposed to private) investors, called **institutional investors**, which include insurance companies, pension and endowment funds, investment companies (e.g., mutual and closed-end funds), and hedge funds. These are subject to different regulatory requirements from banks and securities houses.

At the outset, we should ask the question of whether the regulation of financial institutions is at all necessary. After all, other industries are not regulated (except for antitrust reasons, i.e., to avoid monopolies such as in the recent Microsoft case). Private corporations already have their own governance mechanism, which is shareholder supervision. Shouldn’t shareholders decide on the appropriate risk-return profile for the company in which they have invested their own funds? Why should governments intervene in free markets? Why do we need regulators?

28.2 SYSTEMIC RISK

Unlike other entities, banks and securities houses play a special role of intermediation. They facilitate payment flows across customers and maintain markets for financial instruments. This very role, however, can also make bank failures much more disruptive for the economy than the failure of other entities. The primary threat is systemic risk.

Systemic risk is defined as the risk of a sudden shock that would damage the financial system and create ripple effects throughout the economy. Systemic risk involves contagious transmission of the shock due to actual or suspected exposure to a failing bank. This is usually accompanied by a **flight to quality**, which reflects an increased demand for government securities, pushing up the relative cost of capital for the corporate sector. If prolonged, this can lead to a fall in investment

²The term *bank* in *investment bank* is a misnomer, since these institutions do not extend credit like commercial banks.

³Brokers act as pure intermediaries and simply match buyers with sellers. As a result, they take no market risk. In contrast, dealers stand ready to buy and sell securities at given prices. Therefore, they must maintain an inventory of securities and are exposed to market risk.

spending. Higher rates will also dampen consumption spending, slowing down the entire economy.

Indeed, failures in the domestic banking system have been particularly damaging. Among emerging markets, domestic financial collapses have often cost more than 10% of a country's gross domestic product (GDP). In each case, the government (rather, the taxpayer) has paid for the failure, hoping that this would be less costly than allowing a domestic banking failure to spread to the rest of the economy.

This threat largely explains why governments have come to the support of the banking system after September 2008. In October, the British government launched a 500 billion pound bailout plan, of which 50 billion was injected as new capital in banks. Many European governments followed suit, as well as the U.S. government, where the **Emergency Economic Stabilization Act of 2008** allowed spending up to \$700 billion on the financial system. The goal was not to bail out Wall Street bankers, but rather to avoid collateral damage to the rest of the economy.

Systemic risk can come from two sources:

- *Panicky behavior of depositors or investors.* This can arise from the failure of an institution or a political shock. In a **bank run**, depositors become worried about the stability of their bank (when there is no deposit insurance) and demand an immediate return of their funds, which may lead to a failure of the bank. Similarly, a sudden drop in securities prices may lead to margin calls, forcing leveraged investors to liquidate their positions, which puts further pressure on prices. Some institutions may fail, resulting in a loss of liquidity and a credit crunch.
- *Interruptions in the payment system.* This can arise from the failure of an institution or from a technological breakdown in the payment system. Banks and securities houses are central to the payment system by which transactions for goods, services, and assets are cleared and settled. When an institution cannot pay, it may expose the payment system to a breakdown.

28.3 REGULATION OF COMMERCIAL BANKS

28.3.1 Bank Runs and Deposit Insurance

Our experience with systemic risk is profoundly marked by the banking crisis of the 1930s in the United States. The banking system was subject to **bank runs**, when depositors lost faith in the ability of their deposit bank to make full payment and consequently "ran to the bank" to withdraw their funds.

This can happen even though the bank is perfectly solvent, that is, have assets (e.g., loans, real estate) whose value exceeds its liabilities (e.g., demand deposits). Because such assets are illiquid, however, the bank may not be able to meet redemptions immediately, leading to default. Indeed during the U.S. banking crisis of the 1930s, one bank in three failed, causing a severe contraction of credit.

In response, the United States established federal deposit insurance in 1933. The insurance fund protects investors if their bank fails, thereby eliminating the need for a bank run. This scheme was widely credited for stopping bank runs. By now, most countries have a compulsory deposit insurance program. As of 1980, all U.S. bank accounts were insured up to a limit of \$100,000.

The fear of bank failure was a major factor during the credit crisis that started in 2007. Northern Rock, a British bank, ran into difficulties rolling over its short-term debt during 2007. Because deposit insurance in Britain was limited to 90% of the first 35,000 pounds, depositors queued to get their money back. Northern received a liquidity support facility from the Bank of England and was eventually nationalized in February 2008.

During the sudden worsening of the crisis that started with Lehman's failure in September 2008, depositors became increasingly worried about the safety of the banking system. In response, many governments increased their deposit insurance limit. In October, European governments increased the limit to 50,000 euros or above. The U.S. temporarily increased the limit to \$250,000.

The problem with deposit insurance, however, is that some of the financial risk is now passed on to the deposit insurance fund (i.e., ultimately the government or taxpayer). This creates a **moral hazard** problem.⁴ The banks can alter their behavior, increasing their risks at the expense of the deposit insurance fund. This possibility justifies regulation of insured institutions.

28.3.2 Payment Failures

Turning next to the other source of systemic risk, the prime example of a breakdown in the payment system was the June 1974 failure of Bankhaus Herstatt, a small German bank active in the foreign exchange market. The bank was shut down by noon, U.S. time, after having received payments in German marks. In exchange, the counterparty banks were due to receive payment on the same afternoon in U.S. dollars. These payments never came, however, creating a serious liquidity squeeze for counterparties. This event caused severe disruption in the payment system and was perhaps the most extreme shock experienced in the foreign exchange market. What has become known as **Herstatt risk** has led to a concerted effort by bank regulators to try to avoid such situations, which ultimately gave birth to the Basel Committee on Banking Supervision (BCBS).

28.3.3 Bank Regulators

The BCBS consists of central bankers from the Group of Ten (G-10) countries.⁵ Its primary objective is to promote the **safety and soundness** of the global financial

⁴ Moral hazard is the name given to problematical (immoral) behavior, which increases the possibility of negative outcomes (hazards).

⁵ The Basel Committee's members are senior officials from the G-10 (Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, United Kingdom, and the United States plus Luxembourg and Switzerland), who meet four times a year, usually in Basel, under the aegis of the Bank for International Settlements. Its web site is <http://www.bis.org>.

system, that is, to try to control systemic risk. Another objective is to create a system that ensures a level playing field for global financial institutions.⁶

The Basel Committee has established minimum risk-based capital standards that apply to so-called **core institutions**. These represent internationally active *commercial* banks, which are major players in large-value payment systems. The capital adequacy rules are described in a series of documents known as the **Basel Accord**, which will be analyzed in the following chapters.

It should be emphasized that core institutions are ultimately regulated by their domestic banking regulators. Although pronouncements of the Basel Committee are not legally binding, member countries have implemented them. Even countries that are not part of the Basel Committee often feel obligated to abide by the same regulations. By now, over 100 countries have adopted the framework of the Basel Accord. In fact, the Accord applies to all internationally active commercial banks.

In the United States, for instance, commercial banks are regulated by the **Board of Governors of the Federal Reserve System** (the “Fed”),⁷ the **Office of the Comptroller of the Currency** (OCC),⁸ and the **Federal Deposit Insurance Corporation** (FDIC).⁹ This fragmentation of supervision is somewhat puzzling but is common among U.S. agencies.

In the United Kingdom, the regulatory framework is more logical, with only one regulator for banks, securities markets, and insurance firms—the **Financial Services Authority** (FSA).¹⁰ This all-powerful regulator was created in October 1997, taking over banking supervision from the Bank of England.

Banks in the **European Union** (EU) are subject to minimum standards, which are binding over all member countries.¹¹ A new **Capital Adequacy Directive** (CAD) implementing Basel II was adopted in June 2006 and applies to all EU banks.

In Japan, supervision of financial markets, including banking, securities business, and insurance, rests with the **Financial Services Agency** (FSA), established in July 2000. This responsibility is shared with the central bank, or **Bank of Japan**, which conducts monetary policy and ensures the stability of the financial system by monitoring financial institutions.¹²

⁶ At that time, one concern was that Japanese banks were expanding into global markets and were able to undercut their competitors due to more lenient Japanese regulations.

⁷ The Federal Reserve supervises all bank holding companies and state-chartered banks that are members of the Federal Reserve System. Its web site is <http://www.federalreserve.gov>.

⁸ The principal function of the OCC is to supervise U.S. national banks and branches and agencies of foreign banks in the United States. National banks are defined as those chartered by the federal government, as opposed to state banks. The OCC is a bureau of the Treasury Department. Its web site is <http://www.occ.treas.gov>.

⁹ The FDIC is a U.S. government agency whose mission is to maintain the stability and public confidence in the nation’s financial system. It has provided deposit insurance since 1933. Its web site is <http://www.fdic.gov>.

¹⁰ Its web site is <http://www.fsa.gov.uk>.

¹¹ The EU includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom, plus former Eastern bloc countries. This covers all countries in Western Europe except for Switzerland and Norway.

¹² The web sites for the FSA and the Bank of Japan are <http://www.fsa.go.jp> and <http://www.boj.or.jp>.

28.3.4 Regulatory Capital

The Basel Accord sets *minimum* risk-based levels of capital for core institutions. The measurement of regulatory capital will be examined in detail in the next chapter. National authorities, however, are free to adopt arrangements that set higher levels or other criteria. The Federal Reserve board, for example, has an additional requirement based on the bank's leverage ratio.¹³ This places a constraint on the degree to which a banking organization can leverage its equity capital base. Failure to meet the capital-adequacy requirements triggers regulatory action, affecting the types of activities in which institutions can engage and requiring **prompt corrective action** (PCA), including the possible appointment of a receiver.

Note that regulatory capital can differ from **economic capital**, which is the amount of capital that a financial institution estimates is needed to secure survival in a worst-case scenario. Banks should have enough actual, **equity capital** to cover both regulatory capital (otherwise, the regulator would step in) and economic capital (otherwise, the bank would take too much risk by its own measures). Ideally, the two measures should be in line with each other and reflect the true risks that the bank is taking.

To summarize, the regulation of commercial banks is motivated by two objectives:

1. *Minimizing systemic risk*
2. *Protecting the deposit insurance fund*

28.4 REGULATION OF SECURITIES HOUSES

The regulation of securities houses substantially differs from that of commercial banks. Broker-dealers hold securities on the asset and liability side (usually called long and short) of their balance sheet. Because securities are much more liquid than bank loans, there is no rationale for bank runs.

The objectives of regulation for securities houses are

- *Protecting the customer.* One goal is to protect the firm's customers against a default of their broker-dealer. The rationale here is that small investors (e.g., the traditional "widows and orphans") are less capable of informed investment decisions. Another goal is to protect consumers against excessive prices or opportunistic behavior by financial intermediaries.
- *Ensuring the integrity of markets.* The goal is to ensure that failure by one institution does not destabilize financial markets, causing systemic risk.

Let us first examine the consumer protection argument. First, it must be emphasized that investors are risk takers by definition. As Philip McBride

¹³ The ratio of (tier 1) capital to total consolidated assets must be greater than 3% plus an additional cushion of 100 to 200 basis points. Tier 1 capital will be defined in the following chapter.

Johnson, former chairman of the Commodities Futures Trading Commission, has put it,

Regulation is not meant to insulate investors from the consequences of free economic forces, or from their own poor judgment, but rather from abuses perpetrated by other persons.

Regulation, however, is generally considered necessary when the market fails in two respects, either through excessive prices or opportunistic behavior.

In a free market with informed customers, prices can be excessive only if sellers collude to maintain high prices. This is why there is a need for antitrust legislation to prevent collusion among financial intermediaries.

Opportunistic behavior can arise if sellers have more information than buyers, which can result from access to inside information. This justifies laws against trading on **inside information**. Or brokers may have **conflicts of interest** that push them to give bad advice to their clients for the brokers' personal profit. Likewise, accounting standards and **disclosure rules** help to reduce asymmetries of information in financial markets, which is ultimately socially beneficial as it increases participation in financial markets.

Finally, brokers are subject to **suitability standards** when making recommendations to clients. Broker-dealers are obligated to recommend only transactions that are suitable to the client's financial situation, investment objectives, and sophistication. Unsuitable recommendations may constitute fraud, which is punishable by law.

Securities regulators require a prudent capital reserve to achieve the goals of protecting consumers and markets. The purpose of this capital is to ensure an orderly *liquidation* of the institution, in contrast to banks, for which capital is measured on an ongoing basis. These minimum reserves are calculated using different methods that use the total amount of debt, the total amount of money owed customers, and, more recently, measures of market risk based on VAR.

As with commercial banks, securities regulators meet in a global forum, the **International Organization of Securities Commissions (IOSCO)**, based in Montréal.¹⁴ Its Technical Committee addresses regulatory problems related to international securities transactions. The IOSCO and the Basel Committee collaborate on common regulatory issues. Likewise, regulatory authority rests with a domestic supervisor, for example the **Securities and Exchange Commission (SEC)** in the United States.¹⁵

¹⁴ Its web site is <http://www.iosco.org>.

¹⁵ The SEC is a U.S. federal agency that has wide authority to oversee the nation's security markets. Among other responsibilities, it regulates the financial reporting practices of public corporations. To make information reporting more transparent, the SEC now requires registrants to disclose quantitative information on market risks using one of three possible alternatives: (i) a tabular presentation of expected cash flows and contract terms summarized by risk category, (ii) a sensitivity analysis expressing possible losses for hypothetical changes in market prices, and (iii) a VAR measure. Its web site is <http://www.sec.gov>.

Securities regulation is based on either the “comprehensive approach” or the “simplified approach.” The **comprehensive approach** is a system of capital charges detailed by the regulator. In contrast, the **simplified approach** uses a VAR model.

In the United States, the SEC uses the comprehensive approach with its **net-capital rule**, Rule 15c3-1 under the Securities Exchange Act of 1934. A broker-dealer must satisfy a minimum capital ratio based on the calculated ratio of capital to debt or receivables. This ratio is 6.67% of aggregate debt, or 2% of the total amount of money owed by customers. To compute net capital, only liquid assets are considered, minus **haircuts**, which provide a further margin of safety in case of default and reflect market risk, liquidity risk, and counterparty risk.

The SEC’s net capital rule, however, is widely viewed as conservative. As a result, it has become too expensive to operate derivatives activities under these rules. In January 1999, the SEC issued a ruling that created a class of OTC **derivatives dealers**, which are dealers active in OTC derivative markets. To bring their regulatory requirements in line with foreign firms and U.S. banks, the SEC created risk-based capital rules based on internal VAR models, which parallel the Basel rules.

28.5 TOOLS AND OBJECTIVES OF REGULATION

Table 28.1 provides a summary of the tools and objectives of financial regulation. Systemic risk is controlled through capital adequacy rules, asset restrictions, and disclosure standards. Consumer protection is achieved through capital standards, disclosure rules, and conflict of interest rules.

Capital adequacy and disclosure rules can help to achieve both objectives. Disclosure reduces asymmetries in capital markets, which, in turn, protects consumers. In addition, more disclosure can also stabilize capital markets. Firms that fail to reveal much information about their activities may be susceptible to market rumors, possibly resulting in loss of business or funding difficulties. Indeed, the turmoil that surrounded the near-collapse of Long-Term Capital Management

TABLE 28.1 Tools and Objectives of Financial Regulation

Tools	Objectives	
	Systemic Risk	Consumer Protection
Capital standards	✓	✓
Disclosure standards	✓	✓
Asset restrictions	✓	
Antitrust enforcement		✓
Conflict-of-interest rules		✓

Source: Herring and Litan (1995), *Financial regulation in the global economy*. Washington, DC: Brookings Institution.

illustrates the panic behavior of banks that suspect that a financial institution with large positions similar to theirs may fail.

EXAMPLE 28.1: FRM EXAM 2004—QUESTION 64

Government insurance of bank deposits provides banks with an incentive to engage in higher risk business activities. This incentive creates:

- a. An insurance arbitrage
- b. An insurance fraud
- c. A moral hazard
- d. A moral risk

EXAMPLE 28.2: INSTITUTIONS SUBJECT TO THE BASEL ACCORD

The Basel Capital Accord applies to these entities:

- a. National banks chartered in the United States
- b. All internationally active commercial banks
- c. All banks and securities firms in the G-10 countries plus Luxembourg
- d. Banks regulated by the Swiss banking regulatory authorities

EXAMPLE 28.3: INSTITUTIONS SUBJECT TO THE CAD

Which of the following financial institutions needs to comply with the provisions of CAD, the Capital Adequacy Directive? This question concerns the main home-country operations of these banks, not certain overseas subsidiaries or branches.

- a. J. P. Morgan (a U.S. bank)
- b. Credit Suisse First Boston (a Swiss bank)
- c. Deutsche Bank (a German bank)
- d. Sumitomo Bank (a Japanese bank)

EXAMPLE 28.4: FRM EXAM 2007—QUESTION 72

Which of the following statements regarding economic capital are true?

- I. Economic capital is designed to provide a cushion against unexpected losses at a specified confidence level over a set time horizon.
- II. Since regulatory capital models and economic capital models have different objectives, economic capital models cannot help regulators in setting regulatory capital requirements.
- III. Firms whose capital exceeds their required regulatory capital are firms that employ their capital inefficiently, and their shareholders would benefit if they used all of their excess capital to repurchase shares or increase dividends.
- IV. Economic capital can be used to validate a firm's regulatory capital requirement against its own assessment of the risks it is running.
 - a. I, II, and III only
 - b. III and IV only
 - c. I and IV only
 - d. I, III, and IV only

28.6 ANSWERS TO CHAPTER EXAMPLES**Example 28.1: FRM Exam 2004—Question 64**

- c. Moral hazard occurs when one has less incentive to control risk because the cost of a loss is partially borne by another party, as in the case of deposit insurance.

Example 28.2: Institutions Subject to Basel Accord

- b. The capital accord applies to commercial banks with international activities.

Example 28.3: Institutions Subject to the CAD

- c. The Capital Adequacy Directive applies to banks within the European Union. Of the four countries listed, only Germany belongs to the EU.

Example 28.4: FRM Exam 2007—Question 72

- c. Economic capital is typically constructed using a measure of extreme loss at a high confidence level, so Statement I. is correct. Some measures of economic capital are more sensitive to risk and therefore can be helpful to guide regulatory capital, so Statement II. is false. Firms may have economic capital that is much lower than regulatory capital but are still required to maintain regulatory capital, so Statement III. is false. Finally, economic capital is certainly useful to assess the efficiency of regulatory capital, so Statement IV. is true.

The Basel Accord

The Basel Capital Accord, concluded on July 15, 1988, represents a landmark financial agreement for the regulation of internationally active commercial banks. It instituted for the first time minimum levels of capital to be held by international banks against financial risks.

Initially, the capital charges were based on a set of standard, rigid rules defined by the Basel Committee on Banking Supervision (BCBS). These risk-based capital adequacy requirements evolved over time, first covering credit risk and then market risks. The latest rules by the Basel Committee, called Basel II and finalized in June 2004, represent an extensive revision of the capital charges that creates more risk-sensitive capital requirements. The new rules also add a charge against operational risks. Overall, Basel II represents a substantial improvement in capital requirements.

The Basel Accord is agreed by all members of the Committee and is endorsed by the Central Bank Governors and Heads of Banking Supervision of the G-10 countries. Although strictly speaking it only applies to internationally active bank within the G-10, these minimum capital requirements have been applied to banks in more than 100 countries as well. U.S. regulators will apply Basel II to the largest U.S. banks only. In contrast, the European Union (EU) has adopted the Basel II rules into EU law, which applies to all banks within the Union.

Section 29.1 provides a broad overview of the Basel Accord. Section 29.2 details the original Basel capital requirements, with particular emphasis on credit risk. Market risk is a complex subject in itself and will be developed in the next chapter. Section 29.3 illustrates the application of capital adequacy ratios for Citibank. Section 29.4 discusses major drawbacks of the original Basel Accord and describes the main components of the New Accord. Finally, Section 29.5 concludes with a general evaluation of capital requirements.

29.1 STEPS IN THE BASEL ACCORD

29.1.1 The Basel I Accord

The original goal of the 1988 Basel Accord, which came into force in 1992, was to minimum capital requirements for commercial banks as a buffer against financial losses. Thus its primary objective was to promote the safety and soundness of the global financial system. A secondary objective was to create a level playing

field for internationally-active banks by setting uniform minimum standards. The risk-based capital charges roughly attempted to create a greater penalty for riskier assets.

Initially, the 1988 Basel Accord only covered credit risk. The Accord set a minimum level of capital expressed as a ratio of the total risk-weighted (RW) assets, which include on-balance sheet and off-balance sheet items. Banks have to hold capital that covers at least 8% of their risk-weighted assets. The purpose of this capital is to serve as a buffer against unexpected financial losses, thereby protecting depositors and financial markets.

29.1.2 The 1996 Amendment

In 1996, the Basel Committee amended the Capital Accord to incorporate market risks. This amendment, which came into force at the end of 1997, added a capital charge for market risk. Banks are allowed to use either a standardized model or an internal models approach (IMA), based on their own risk management system.

The amendment separates the bank's assets into two categories, the trading book and banking book. The **trading book** represents the bank portfolio with financial instruments that are intentionally held for short-term resale and typically marked-to-market. The **banking book** consists of other instruments, mainly loans, that are held to maturity and typically valued on a historical cost basis.

The 1996 amendment adds a capital charge for (1) the market risk of trading books, and (2) the currency and commodity risk of the banking book. In exchange, the credit risk charge excludes debt and equity securities in the trading book and positions in commodities (apart from the specific risk charge.) As before, it still includes all OTC derivatives, whether in the trading or banking books.

29.1.3 The Basel II Accord

Capital markets have witnessed enormous changes since the initial Capital Accord of 1988. Increasingly, these credit risk charges have appeared outdated and, even worse, may be promoting unsound behavior by some banks.

In June 2004, the Basel Committee finalized a comprehensive revision to the Basel Accord. In the European Union, the new Capital Adequacy Directive implementing Basel II applies to all banks in the EU, starting in 2007, with the most advanced methods being available from 2008. U.S. regulators apply Basel II to a small number of large banks, with other banks subject to a revised version of Basel I because this is a simpler system. Basel II implementation starts in 2008, with a three-year transition period during which U.S. regulators reserve the right to change the application of rules.

The new framework is based on three pillars, viewed as mutually reinforcing:

1. *Pillar 1: Minimum capital requirement.* These are meant to cover credit, market, and operational risk. Relative to the 1988 Accord, banks have now a wider choice of models for computing their risk charges. The BCBS, however, still tried to keep constant the total level of capital in the global banking system, at 8% of risk-weighted assets.

2. *Pillar 2: Supervisory review process.* Relative to the previous framework, supervisors are given an expanded role. Supervisors need to ensure that
 - Banks have a process in place for assessing their capital in relation to risks.
 - Banks indeed operate above the minimum regulatory capital ratios.
 - Corrective action is taken as soon as possible when problems develop.
3. *Pillar 3: Market discipline.* The New Accord emphasizes the importance of risk disclosures in financial statements. Such disclosures enable market participants to evaluate banks' risk profile and the adequacy of their capital positions. The new framework sets out disclosure requirements and recommendations. Banks that fail to meet disclosure requirements will not qualify for using internal models. As internal models generally lead to lower capital charges, this provides a strong incentive for complying with disclosure requirements. In essence, the trade-off for greater reliance on a bank's own models is greater transparency.

The New Accord provides for finer measurement of credit risk, which will generally lead to lower capital requirements. In order to maintain the overall level of bank capital, however, new capital charges are set against **operational risk**. Capital adequacy will be measured as follows:

$$\frac{\text{Total Capital}}{\text{Credit Risk} + \text{Market Risk} + \text{Operational Risk}} = \text{Bank's Capital Ratio} > 8\% \quad (29.1)$$

As before, credit risk in the denominator is measured by the sum of risk-weighted assets for credit risk. The other items are measured from the multiplication of the **market risk charge** (MRC) and **operational risk charge** (ORC) by $(1/8\%) = 12.5$. For instance, if a bank has \$875 in risk-weighted assets and MRC = \$10 and ORC = \$20, the denominator would be computed as $\$875 + [(\$10 + \$20) \times 12.5] = \$1,250$. The bank then has to hold at least $8\% \times \$1,250 = \100 in capital to satisfy the minimum requirement. This is equivalent to saying that the total charge must be at least $8\% \times \$875 + \$10 + \$20 = \$70 + \$10 + \$20 = \$100$.

Figure 29.1 summarizes the coverage of credit, market, and operational risk charges for the banking and trading books. Banks will also have access to a menu of methods to compute their risk charges. These are described in Table 29.1.

We should note that pillar 1 omits some important bank risks. In particular, **interest rate risk in the banking book** is not covered. Banks are exposed to **repricing risk**, which arises from differences in the maturity and repricing of assets and liabilities. For instance, a bank funding a long-term fixed-rate loan by short-term deposits could suffer a repricing loss if interest rates increase. Measuring this risk, however, requires modeling the complex behavior of deposits, which do not have a fixed maturity date, as well as the prepayment optionality of loans. Due to these difficulties, there is substantial heterogeneity across banks in the methods used to monitor and manage this risk. As a result, the BCBS has decided that this risk falls under pillar 2. Institutions that are perceived to have more of this risk can be subject to higher capital charges.

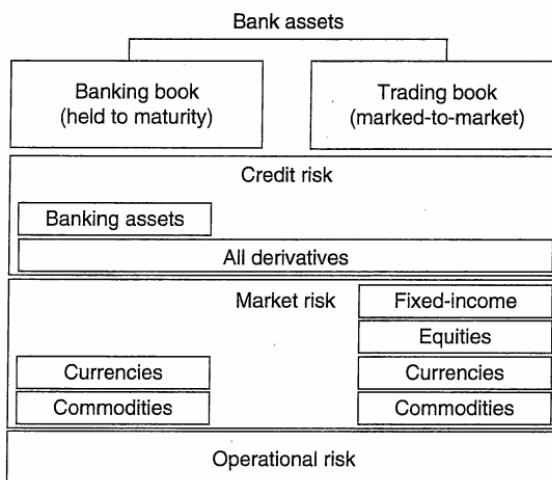


FIGURE 29.1 Summary of Basel II Risk Charges

Finally, there is no formal capital charge for **liquidity risk**, due to the difficulty of formal measurement of this risk. Yet, the Basel Committee recognizes that “liquidity is crucial to the ongoing viability of any banking organization.”

EXAMPLE 29.1: APPLICABLE MARKET RISKS

For regulatory capital calculation purposes, what market risks must be incorporated into a bank’s VAR estimate?

- Risks in the trading account relating to interest rate risk and equity risk
- Risks in the trading account relating to interest rate risk and equity risk and risks throughout the bank related to foreign exchange and commodity risks
- Risk throughout the bank related to interest rate risk, equity risk, foreign exchange risk, and commodity risk
- Interest rate risk, equity risk, foreign exchange risk, and commodity risk in the trading account only

TABLE 29.1 Menu of Approaches to Measure Risk

Risk Category	Allowed Approach
Credit	Standardized Approach (based on the 1988 Accord)
	Foundation Internal Ratings-Based Approach
	Advanced Internal Ratings-Based Approach
Market	Standardized Approach
	Internal Models Approach
Operational	Basic Indicator Approach
	Standardized Approach
	Advanced Measurement Approach

29.2 THE 1988 BASEL ACCORD

29.2.1 Risk Capital

The 1988 capital adequacy rules require any **internationally active bank** to carry capital of at least 8% of its total risk-weighted assets. This applies to commercial banks on a consolidated basis. So, for instance, holding companies that are parents of banking groups have to satisfy the capital adequacy requirements.

In the Basel Accord, “capital” has a broader interpretation than the book value of equity. The key purpose of capital is its ability to absorb losses, providing some protection to creditors and depositors. Hence, to be effective, capital must be permanent, must not impose mandatory fixed charges against earnings, and must allow for legal subordination to the rights of creditors and depositors.

The Basel Accord recognizes three forms of capital.

1 Tier 1 Capital, or “Core” Capital

Tier 1 capital includes equity capital and disclosed reserves, most notably after-tax retained earnings. Such capital is regarded as a buffer of the highest quality. Goodwill is subtracted.¹

- **Equity capital**, or shareholders’ funds. This consists of issued and fully paid common stock and nonredeemable, noncumulative preference shares (also called preferred stock).
- **Disclosed reserves** correspond to share premiums, retained profits, and general reserves.

2 Tier 2 Capital, or “Supplementary” Capital

Tier 2 capital includes components of the balance sheet that provides some protection against losses but ultimately must be redeemed or contain a mandatory charge against future income. These include:

- **Undisclosed reserves**, or hidden reserves that are allowed by the accounting standards of some countries. These are reserves that passed through the earnings statement but remain unpublished. Due to this lack of transparency, as well as the fact that many countries refuse to recognize undisclosed reserves, undisclosed reserves are not part of core capital.
- **Asset revaluation reserves**, which arise, for instance, from long-term holdings of equity securities that are valued at historical acquisition costs. Such capital could be used to absorb losses on a going-concern basis, subject to some discount to reflect market volatility and future taxes in case of sales.
- **General provisions/loan loss reserves**, which are held against future unidentified losses. These are the result of **loan loss allowances**, which are deductions taken against interest income in anticipation of probable credit losses. These deductions reduce retained profits in tier 1 capital but may qualify as tier 2 capital to the extent that they do not reflect a known deterioration in

¹This is an accounting entry which, after an acquisition, goes into book equity to represent the excess of the purchase value over book value. It is omitted because it is not a buffer against losses.

particular assets (in which case they are “specific.”)² General provisions will play a special role under Basel II.

- **Hybrid debt capital instruments**, which combine some characteristics of equity and of debt. When they are unsecured, subordinated, and fully paid-up, they are allowed into supplementary capital. These include, for instance, **cumulative preference shares**.
- **Subordinated term debt**, with a minimum original maturity of five years, and subject to a discount of 20% during the last five years. Subordinated debt would be junior in right of payment to all other debt in the event of liquidation.

3 Tier 3 Capital, for Market Risk Only

Tier 3 capital consists of short-term subordinated debt with a maturity of at least two years. This is eligible to cover market risk only.

There are additional restrictions on the relative amount of various categories. Of the 8% capital charge for credit risk, at least 50% must be covered by tier 1 capital. Next, the amount of tier 3 capital is limited to 250% of tier 1 capital allocated to support market risks (tier 2 capital can be substituted for tier 3 capital if needed). Other restrictions apply to various elements of the three tiers.

For credit risk, the eligible capital must exceed the regulatory capital, or

$$\text{Eligible Tier 1 Capital for CR} + \text{Allowed Tier 2 Capital} \geq \text{CRC} \quad (29.2)$$

A similar constraint applies to market risk capital:

$$\text{Eligible Tier 1 Capital for MR} + \text{Allowed Tier 3 (or 2) Capital} \geq \text{MRC} \quad (29.3)$$

A worked-out example later will be given later. Next, we look at the construction of risk charges.

EXAMPLE 29.2: FRM EXAM 2002—QUESTION 71

What is the best definition of tier 1 regulatory capital?

- a. Equity capital, retained earnings, disclosed reserves
- b. Subordinated debt, undisclosed reserves
- c. Equity capital, subordinated debt with a maturity greater than five years
- d. Long-term debt, revaluation reserves

² As credit losses occur, they are charged against this reserve instead of profits, which helps to smooth out earnings.

EXAMPLE 29.3: FRM EXAM 2007—QUESTION 53

Consider a bank balance sheet with (1) common stock of USD 600,000,000; (2) unrealized long-term marketable equity securities gain: USD 5,000,000; (3) allowance in anticipation of possible credit losses: USD 5,000,000; (4) goodwill: USD 30,000,000.

Based solely on the above information, the Tier 1 and Tier 2 capital numbers are, respectively:

- a. USD 595,000,000 USD 45,000,000
- b. USD 570,000,000 USD 10,000,000
- c. USD 600,000,000 USD 15,000,000
- d. USD 630,000,000 USD 20,000,000

EXAMPLE 29.4: FRM EXAM 2004—QUESTION 29

Consider the following financial data for a bank, in millions of dollars: Shareholders' funds: 627.4. Retained earnings: 65.6. Undisclosed reserves: 33.5. Goodwill: 21.3. Subordinated debt: 180.0. Specific provisions: 11.7. The ratio of tier 2 to tier 1 capital is:

- a. 30.81%
- b. 31.78%
- c. 33.53%
- d. 34.03%

29.2.2 On-Balance Sheet Risk Charges

We first examine on-balance sheet assets, which consist primarily of loans for most credit institutions. Ideally, the capital charges should recognize differences in asset credit quality.

Indeed, the 1988 Basel Accord applies to the notional of each asset a risk capital weight taken from four categories, as described in Table 29.2. Each dollar of risk-weighted notional exposure must be covered by 8% capital.

These categories provide an extremely rough classification of credit risk. For instance, claims on Organization for Economic Cooperation and Development (OECD) central governments, such as holdings of U.S. Treasuries, are assigned a weight of zero since these assets have presumably no default risk.³ Cash held is also

³The OCED currently consists of 30 countries, including Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, The Netherlands, Norway, Portugal,

TABLE 29.2 Risk Capital Weights by Asset Class

Weights	Asset Type
0%	Cash held Claims on OECD central governments Claims on central governments in national currency
20%	Cash to be received Claims on OECD banks and regulated securities firms Claims on non-OECD banks below one year Claims on multilateral development banks Claims on foreign OECD public-sector entities
50%	Residential mortgage loans
100%	Claims on the private sector (corporate debt, equity, . . .) Claims on non-OECD banks above one year Real estate Plant and equipment

assigned a zero weight. At the other extreme, claims on corporations, including loans, bonds, and equities, receive a 100% weight, whatever the risk of default or maturity of the loan.

The credit risk charge (CRC) is then defined for balance sheet items (BS) as

$$\text{CRC(BS)} = 8\% \times (\text{RWA}) = 8\% \times \left(\sum_i \text{RW}_i \times \text{Notional}_i \right) \quad (29.4)$$

where RWA represents risk-weighted assets, and RW_i is the risk weight attached to asset i .

EXAMPLE 29.5: FRM EXAM 2001—QUESTION 38

A bank subject to the Basel I Accord makes a loan of \$100m to a firm with a risk weight of 50%. What is the basic on-balance sheet credit risk charge?

- a. \$8m
- b. \$4m
- c. \$2m
- d. \$1m

29.2.3 Off-Balance Sheet Risk Charges

By the late 1980s, focusing on balance sheet items only missed an important component of the credit risk of the banking system, which is the exposure to swaps.

Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, Japan, Finland, Australia, New Zealand, Mexico, Czech Republic, Hungary, South Korea, Poland, and Slovakia, in order of accession.

The first swaps were transacted in 1981. By 1990, the outstanding notional of open positions had grown to \$3,500 billion, which seems enormous. Some allowance had to be made for the credit risk of swaps. Unlike loans, however, the notional amount does not represent the maximum loss.

To account for such off-balance sheet (OBS) items, the Basel Accord computes a “credit exposure” that is equivalent to the notional for a loan, through **credit conversion factors** (CCFs). The Accord identifies five broad categories.

1. Instruments that substitute for loans (e.g. guarantees, bankers’ acceptances, and standby letters of credit serving as guarantees for loans and securities) carry the full 100% weight (or credit conversion factor). The rationale is that the exposure is not different from a loan. Take a **financial letter of credit** (LC), for instance, which provides irrevocable access to bank funds for a client. When the client approaches credit distress, it will almost assuredly draw down the letter of credit. Like a loan, the full notional is at risk. This category also includes asset sales with recourse, where the credit risk remains with the bank, and forward asset purchases.
2. Transaction-related contingencies (e.g., performance bonds or **commercial letters of credit** related to particular transactions) carry a 50% factor. The rationale is that a performance letter of credit is typically secured by some income stream and has lower risk than a general financial LC.
3. Short-term, self-liquidating trade-related liabilities (e.g., documentary credits collateralized by the underlying shipments) carry a 20% factor.
4. Commitments with maturity greater than a year (such as credit lines), as well as note issuance facilities (NIFs), carry a 50% credit conversion factor. Shorter-term commitments or revocable commitments have a zero weight. Note that this applies to the unfunded portion of commitments only, as the funded portion is an outstanding loan and appears on the balance sheet. Under Basel II, shorter-term commitments now receive a CCF of 20%.
5. Other derivatives, such as swaps, forwards and options on currency, interest rate, equity, and commodity products are given special treatment given the complexity of their exposures.

For the first four categories, the position is replaced by a credit equivalent, computed as

$$\text{Credit Equivalent} = \text{Credit Conversion Factor} \times \text{Notional} \quad (29.5)$$

For the last category (derivatives), the credit exposure is computed as the sum of the current, **net replacement value** (NRV) plus an **add-on** that is supposed to capture future or potential exposure:

$$\begin{aligned} \text{Credit Exposure} &= \text{NRV} + \text{Add-On} \\ \text{Add-On} &= \text{Notional} \times \text{Add-On Factor} \times (0.4 + 0.6 \times \text{NGR}) \end{aligned} \quad (29.6)$$

Here, the add-on factor depends on the **tenor** (maturity) and type of contract, as listed in Table 29.3 (NGR will be defined later). It roughly accounts for the maximum credit exposure which, as we have seen before, depends on the volatility of the risk factor and the maturity. As we have seen, volatility is highest for commodities, then equity, then currencies, then fixed-income instruments. This explains why the add-on factor is greater for currency, equity, and commodity swaps than for interest rate instruments, and also increases with maturity.

More precisely, the numbers have been obtained from simulation experiments (such as those in Chapter 21) that measure the 80th percentile worst loss over the life of a matched pair of swaps. The matching of pairs reflects the hedging practice of swap dealers and effectively divides the exposure in two, since only one swap can be in-the-money. Take, for instance, a currency swap with five-year initial maturity. Assuming exchange rates are normally distributed and ignoring interest rate risk, the maximum credit exposure as a fraction of the notional should be,

$$WCE = \frac{1}{2} \times 0.842 \times \sigma\sqrt{5}, \quad (29.7)$$

where the $\frac{1}{2}$ factor reflects swap matching and the 0.842 factor corresponds to a one-sided 80% confidence level. Assuming a 10% annual volatility, this gives WCE = 9.4%. This is in line with the add-on of 7.5% in Table 29.3.

Further simulations by the Bank of England and the New York Fed have shown that these numbers also roughly correspond to a 95th percentile loss over a six-month horizon. In the case of a new five-year interest-rate swap, for instance, the worst exposure over the life at the 80th% level is 1.49%; the worst exposure over six months at the 95th% level is 1.58%. This is in line with the add-on of 1.5% for this category.

Next, the NGR factor in Equation (29.6) represents the **net-to-gross ratio**, or ratio of current net market value to gross market value, which is always between 0 and 1. The purpose of this factor is to reduce the capital requirement for contracts that fall under a legally valid netting agreement. Without netting agreements in place, i.e., with NGR = 1, the multiplier ($0.4 + 0.6 \times NGR$) is equal to one. There is no reduction in the add-on.

TABLE 29.3 Add-On Factors for Potential Credit Exposure (Percent of Notional)

Residual Maturity (tenor)	Contract				
	Interest Rate	Exchange Rate, Gold	Equity	Precious Metals	Other Commodities
< 1 year	0.0	1.0	6.0	7.0	10.0
1 – 5 year	0.5	5.0	8.0	7.0	12.0
> 5 year	1.5	7.5	10.0	8.0	15.0

On the other hand, take a situation where a bank has two swaps with the same counterparty currently valued at +100 and at -60. The gross replacement value is the sum of positive values, which is 100. The net value is 40, creating a NGR ratio of 0.4. The multiplier ($0.4 + 0.6 \times \text{NGR}$) is equal to 0.64.

At the other extreme, if all contracts currently net out to zero, $\text{NGR} = 0$, and the multiplier ($0.4 + 0.6 \times \text{NGR}$) is equal to 0.4. The purpose of this minimum of 0.4 is to provide protection against *potential movements* in the NGR which, even if currently zero, could change over time.

The computation of risk-weighted assets is then obtained by applying counterparty risk weights to the credit exposure in Equation (29.6). Since most counterparties for such transactions tend to be excellent credit, the risk weights from Table 29.3 are multiplied by 50%. The credit risk charge for OBS items is defined as

$$\text{CRC(OBS)} = 8\% \times \left(\sum_i \text{RW}_i \times 50\% \times \text{Credit Exposure}_i \right) \quad (29.8)$$

Example: The Credit Charge for a Swap

Consider a \$100 million interest-rate swap with a domestic corporation. Assume a residual maturity of four years and a current market value of \$1 million. What is the credit risk charge?

Answer

Since there is no netting, the factor ($0.4 + 0.6 \times \text{NGR}$) = 1. From Table 29.3, we find an add-on factor of 0.5. The credit exposure is then $\text{CE} = \$1,000,000 + \$100,000,000 \times 0.5\% \times 1 = \$1,500,000$. This number must be multiplied by the counterparty-specific risk weight and one-half of 8% to derive the minimum level of capital needed to support the swap. This gives \$60,000.

EXAMPLE 29.6: FRM EXAM 2001—QUESTION 45

The Basel Accord computes the credit exposure of derivatives using both replacement cost and an “add-on” to cover potential future exposure. Which of the following is the correct credit risk charge for a purchased seven-year OTC equity index option of \$50m notional with a current mark to market of \$15m with no netting and a counterparty weighting of 100%?

- a. \$1.6m
- b. \$1.2m
- c. \$150,000
- d. \$1m

EXAMPLE 29.7: FRM EXAM 2000—QUESTION 134

The capital requirement for an unfunded, short-term (under one year) credit commitment is

- a. 0%
- b. 4%
- c. 8%
- d. 100%

29.2.4 Total Risk Charge

Finally, the total risk charge is computed as the sum of the credit risk charges, both for on-balance sheet and off-balance sheet items, plus the market risk charge. Define MRC as the market risk charge, which will be detailed in the next chapter.

To translate all numbers into similar risk-adjusted assets, the MRC is transformed into a risk-adjusted asset equivalent, by dividing the MRC by 8%. For instance, if MRC is computed as \$1,832 million, the risk-adjusted asset number would be \$22.9 billion, which is taken as equivalent to the notional of loans.

We can then simply sum the risk-adjusted assets across all risk categories to find the total risk charge (TRC):

$$\text{TRC} = \text{CRC} + \text{MRC} = 8\% \times (\text{Total Risk} - \text{Adjusted Assets}) \quad (29.9)$$

subject to various restrictions on the use of different tiers. The New Accord adds an operational risk charge to this.

Table 29.4 gives an example. The total risk-adjusted assets for credit risk are 7,500. The market risk charge is 350 which translates into $350/8\% = 4,375$ in risk assets. The credit risk charge is 8% of 7,500, or 600. Of this, no more than 50% can be accounted by tier 2 capital. So, we could have 300 in tier 1 capital plus 300

TABLE 29.4 Computation of Capital Requirements

Category	Risk Assets	Capital Charge (8%)	Minimum Capital, Required	Available Capital	Minimum Capital, Actual	Eligible Capital
Credit risk	7,500	600	Tier 1: 300 Tier 2: 300		Tier 1: 500 Tier 2: 100	
Market risk	4,375	350	Tier 1: 100 Tier 3: 250		Tier 1: 100 Tier 3: 250	
Tier 1				700		700
Tier 2				100		100
Tier 3				600		250
Total Capital ratio	11,875	950		1,400	950	1,050
						8.8%

in tier 2 capital covering credit risk. For market risk, we know the maximum ratio of tier 3 to tier 1 capital is 250 to 100. Hence, with a 350 market risk charge, we can have a maximum allocation of 250 for tier 3 for every 100 of tier 1.

The next step is to match these numbers with the available capital. Assume the bank has capital available of 700, 100, and 600 in tiers 1, 2, and 3, respectively. For credit risk, we only have 100 in tier 2 capital, so that the remaining 500 must be in the form of tier 1 capital. For market risk, we apply the maximum of 250 in tier 3 capital, so that the remainder of 100 comes from tier 1 capital.

This leaves a buffer of excess capital. We can compute the capital ratio using all eligible capital. All of tier 1 capital is eligible, plus 100 in tier 2, plus 250 in tier 3. This sums to a total of 1,050, which translates into an “eligible” capital ratio of $1,050/11,875 = 8.8\%$. The bank has also $600 - 250 = 350$ in unused tier 3 capital.

29.3 ILLUSTRATION

As an illustration, let us examine the capital adequacy requirements for Citibank, which was once the biggest global commercial bank.

Table 29.5 summarizes on-balance sheet and off-balance sheet items as of December 2007. The bank has total assets of \$1,252 billion, consisting of cash

TABLE 29.5 Citibank's Credit Risk-Weighted Assets

On-Balance Sheet Assets (\$ Billion)						
Item	Notional	Not Cov'd	Risk Weight Category			
			0%	20%	50%	100%
Cash and due	86.2	0.0	38.1	43.9	0.0	4.1
Securities	166.2	(1.9)	73.3	85.8	2.3	6.7
Loans and leases	677.1	(10.7)	15.3	96.2	154.0	422.3
Trading assets	215.4	215.4	0.0	0.0	0.0	0.0
All other assets	106.7	21.6	3.9	14.4	1.1	65.7
Total on-BS	1251.7	224.6	130.6	240.2	157.3	498.9
Off-Balance Sheet Items (\$ Billion)						
Item	Notional	Conv. Factor	Credit Equiv.	Risk Weight Category		
				0%	20%	50%
Financial standby LC	84.5	1.00	84.5	11.4	32.9	3.3
Performance standby LC	17.1	0.50	8.6	2.0	1.3	0.0
Commercial LC	9.0	0.20	1.8	0.1	0.4	0.0
Securities lent	152.8	1.00	152.8	152.5	0.2	0.0
Other credit substitutes	0.3	—	2.6	0.0	0.0	0.0
Other off-balance sheet	2.5	1.00	2.5	0.0	0.0	0.8
Unused commitmt. > 1 yr	187.1	0.50	93.6	2.5	36.0	5.0
Derivative contracts	27,235		271.1	11.7	124.9	134.6
Total off-BS			617.4	180.3	195.7	143.8
						97.7

TABLE 29.6 Citibank's Risk-Weighted Assets

Item	Risk-Weighted Assets (\$ Billion)				
	Risk Weight Category				
	0%	20%	50%	100%	Total
On-BS and off-BS items	310.9	435.9	301.1	596.6	
Credit RW assets	0.0	87.2	150.5	596.6	834.3
Market RW assets					78.3
Others					0.0
Total RW assets					912.6

equivalents, securities, loans, trading assets, and other assets. The notional for each asset is assigned to one of the four risk weighted categories, ranging from 0% to 100%. For example, out of the \$166 billion in securities, \$73 billion have a zero risk weight because these represent, for instance, positions in OECD government bonds. Of the remainder, \$86 billion has a 20% weight, \$2 billion has a 50% weight, and \$7 billion has a 100% weight. Most of the loans carry a risk weight of 100%. Trading assets are excluded from this computation because they carry a market risk charge only.

The second panel of the table displays off-balance sheet information. The second column displays the notional, the third the conversion factor, and the fourth the credit equivalent, which is the product of the previous two. As described in the previous section, the conversion factors are 1.00 for financial LCs and securities lent, 0.50 for performance LCs and unused commitments greater than one year, and 0.20 for commercial LCs.⁴

Finally, note the huge size of the notional derivatives position. At \$27,235 billion, it is several times the size of Citibank's total assets of \$1,252 billion and dwarfs its equity of \$99 billion. The notional amounts, however, give no indication of the risk. The credit equivalent amount, which consists of the net replacement value plus the add-on, is \$271 billion, a much lower number.

From this information, we can compute the total risk-weighted assets and capital adequacy ratios. This is shown in Tables 29.6 and 29.7. The first line adds up on-balance sheet and off-balance sheet items for each category. Multiplication by the risk weights gives the second line. The total RW assets for credit risk are \$834 billion, which consists of \$625 billion for on-BS items and \$209 billion for off-BS items. To this, we add the RW assets for market risk, or \$78 billion. Thus, most of Citibank's regulatory risk capital covers credit risk. Market risk represents less than 10% of the total.

The total RW assets add up to \$913 billion. Applying the 8% ratio, we find a minimum regulatory capital of \$73 billion. In fact, the available risk capital

⁴The category "credit substitutes" represent residual interests, such as the equity tranche from securitizations of assets, which are subject to a dollar-for-dollar capital requirement. This implies a credit conversion factor of $(1/8\%) = 12.50$. U.S. regulators have imposed this high capital requirement to reflect the higher risk of such residual interests, whose value can be wiped out easily in case of losses on the underlying assets.

TABLE 29.7 Citibank's Capital Requirements

Capital	Amount (\$ Billion)	Ratio (Percent)
Equity	99.3	
Goodwill	-21.2	
Others	3.9	
Tier 1	82.0	9.0%
Sub.debt	28.2	
LL. Allowance	11.4	
Others	0.1	
Tier 2	39.7	4.3%
Total	121.6	13.3%
Tier 1 Leverage		6.7%

adds up to \$122 billion, which represents a 13.3% ratio, comfortably above the regulatory minimum. The ratio for a well capitalized bank would be 10%. Apparently, the regulatory constraint is not binding.⁵

As long as the regulatory capital ratio is not binding, the bank could decide on a target optimal capital ratio, based on a careful consideration of the trade-off between increasing expected returns and increasing risks. In other words, this requires a measure of **economic capital**. If the current capital ratio is viewed as too high relative to this target, the bank could shrink its capital base through dividend payments or share repurchases. Like other major banks, Citibank has decided to hold more capital than the minimum regulatory standard of 8%. Conversely, if the bank thinks it requires more capital, it could issue new shares.

Table 29.8 summarizes the financial statements for Citigroup starting in 2003 and ending in the third quarter of 2008. Citigroup is a bank holding company that wholly owns Citibank, which is the commercial bank. From 2003 to 2006, the company has expanded aggressively, as indicated by the growth in assets, but has maintained a capital ratio in a narrow range. This was managed in part by dividend payments and share repurchases.

Starting in 2007, however, the company's situation deteriorated quickly, with a sharp downturn in net income and fall in capital ratio. As a result, the company stopped repurchasing shares and instead issued a large amount of tier 1 capital in order to maintain its capital ratio. In January 2008, Standard & Poor's lowered Citigroup's credit rating from AA to AA-.

On October 28, 2008, the company raised \$25 billion through the U.S. Treasury Troubled Asset Relief Program (TARP), which was in essence a government bailout. The company also decreased its quarterly dividend from \$0.54 per share in 2007 to \$0.32 during the first three quarters of 2008 and to \$0.16 in October. The credit rating was further lowered by two notches to A in December 2008. Over the year, Citi's stock price went from \$29.4 to \$6.7.

⁵In addition, based on total assets, tier 1 leverage is 6.7%, which is above the minimum ratio set by the Federal Reserve board, as described in the previous chapter.

TABLE 29.8 Citigroup's Summary Financials (\$ Billion)

	2003	2004	2005	2006	2007	2008Q3
Assets	1,264	1,484	1,494	1,884	2,188	2,050
Risk-weighted assets	750	852	885	1,058	1,253	1,176
Equity	98	109	113	120	114	126
Capital ratio	12.0%	11.9%	12.0%	11.7%	10.7%	11.7%
Net income	17.8	17.0	24.6	21.5	3.6	-11.0
Dividends	5.8	8.4	9.2	9.8	10.8	6.0
Tier 1 issuance	2.3	0.9	1.4	1.8	12.9	37.3
Share repurchase	2.4	1.8	12.8	7.0	0.7	0.0

29.4 THE NEW BASEL ACCORD

The Basel Accord has been widely viewed as successful in raising banking capital ratios. As a result of the Accord, the aggregate tier 1 ratio increased from \$840 to \$1,500 billion from 1990 to 1998 for the 1,000 largest banks.

29.4.1 Issues with the 1988 Basel Accord

Over time, however, these regulations have shown their age. The system has led to **regulatory arbitrage**, which can be broadly defined as bank activities aimed at getting around these regulations. Lending patterns have been transformed, generally in the direction of taking on more credit risk to drive the economic capital up to the level of regulatory capital.

To illustrate, consider a situation where a bank can make a loan of \$100 million to an investment-grade company rated AAA or to a speculative-grade company rated CCC. Irrespective of the credit quality, the bank is forced to hold regulatory capital of \$8 million, so it has to borrow \$92 million. Suppose the rate of return on the AAA loan is 6%, after expenses. The cost of borrowing is close, at 5.7%. The dollar return to shareholders is then $\$100,000,000 \times 6\% - \$92,000,000 \times 5.7\% = \$756,000$. Compared to a capital base of \$8 million, this represents a rate of return of 9.5% only, which may be insufficient for shareholders. The bank could support this loan with a much smaller capital base. For instance, a capital base of \$2 million would require borrowing \$98 million and would yield a return of $\$100,000,000 \times 6\% - \$98,000,000 \times 5.7\% = \$414,000$, assuming the cost of debt remains the same. This translates into a rate of return of 20.7%, which is much more acceptable. The bank, however, is unable to lower its capital due to the binding regulatory requirement.

Suppose now the rate of return on the CCC loan is 7%, after expenses and expected credit losses. The dollar return to shareholders is now \$1.756 million, which represents a 22.0% rate of return. In this situation, the bank has an incentive to increase the risk of its loan in order to bring the economic capital more in line with its regulatory capital. This simple example has shown that regulation may perversely induce banks to shift lending to lower-rated borrowers.

In addition to inadequate differentiation of credit risk, the 1988 Accord did not recognize credit mitigation techniques, nor diversification effects for credit risk. Some of these drawbacks have been corrected with Basel II.

EXAMPLE 29.8: RETURN ON BANK EQUITY

A bank that funds itself at LIBOR – 5bp purchases an A+ rated corporate floating coupon loan paying LIBOR + 15bp. Based on the Basel I minimum capital requirements, what is the annualized return on regulatory capital for this loan?

- a. 2.5%
- b. 5.0%
- c. 11%
- d. None of the above

29.4.2 Definition of Capital

The new Basel Accord, dubbed **Basel II**, was finalized in June 2004. It gives banks a choice between a standardized approach, which is a simple extension of the Basel I rules, and a more complex internal ratings-based (IRB) approach.

For the former, capital is still defined as before. However, **general provisions** or **loan loss reserves** can be included in tier 2 only subject to a limit of 1.25% of risk-weighted assets.

For the IRB approach, in contrast, the new Accord distinguishes between Expected Loss (EL) and Unexpected Loss (UL). Capital is supposed to absorb unexpected losses, which means that it cannot support expected losses as well. Banks typically fund accounts called general provisions, or loan loss reserves to absorb expected credit losses. Hence, Basel II withdraws general provisions from tier 2 capital.⁶

29.4.3 The Credit Risk Charge

As before, the credit risk charge is computed as the sum of individual credit charges:

$$\text{CRC} = 8\% \times \left(\sum_i \text{RW}_i \times N_i \right) \quad (29.10)$$

⁶If total expected losses are less than eligible provisions, however, the difference may be recognized in tier 2 capital, up to a maximum of 0.6% of risk-weighted assets. On the other hand, if total expected losses exceed eligible provisions, the bank must deduct the difference from capital (50% from tier 1 and 50% from tier 2).

In general, the capital charges are calibrated to correspond to the amount of capital required to support a 99.9% confidence level over a one-year horizon.

A notable feature of this approach is that it is *additive*. The main reason for this specification is that it should be robust. However, it is not clear why the addition of individual capital charges should lead to a capital charge that reflects a 99.9% VAR measure for the entire portfolio. After all, summing individual VARs certainly does not add up to the portfolio VAR. It turns out, however, that when default correlations are generated by a single factor, this decomposition adds up to a good approximation of the portfolio risk. The capital charges have been chosen by the Basel Committee to represent bank portfolios of typical sizes with typical default correlations. This analysis is similar to the **component VAR** decomposition presented in Chapter 16.

Banks have now a choice of three approaches for the risk weights.

(1) Standardized Approach

This is an extension of the 1988 Accord, but with finer classification of categories for credit risk, based on external credit ratings, provided by **external credit assessment institutions**. Table 29.9 describes the new weights, which now fall into five categories for banks and sovereigns, and four categories for corporates. For sovereigns, OECD membership is no longer given preferential status. For banks, two options are available. The first assigns a risk weight one notch below that of the sovereign—the other uses an external credit assessment. The new Accord also removes the 50% risk weight cap on derivatives.

(2) Foundation Internal Ratings-Based Approach (FIRB Approach)

Under the **internal ratings-based approach (IRB)**, banks are allowed to use their internal estimate of creditworthiness, subject to regulatory standards. Under the foundation approach, banks estimate the **probability of default (PD)** and supervisors supply other inputs, which carry over from the standardized approach.

TABLE 29.9 Risk Weights: Standardized Approach

Claim	Credit Rating					
	AAA/ AA-	A+/ A-	BBB+/ BBB-	BB+/ B-	Below B-	Unrated
Sovereign	0%	20%	50%	100%	150%	100%
Banks-option 1	20%	50%	100%	100%	150%	100%
Banks-option 2	20%	50%	50%	100%	150%	50%
Short-term	20%	20%	20%	50%	150%	20%
Claim	AAA/ AA-	A+/ A-	BBB+/ BB-		Below BB-	Unrated
Corporates	20%	50%	100%		150%	100%

Note: Under option 1, the bank rating is based on the sovereign country in which it is incorporated. Under option 2, the bank rating is based on an external credit assessment. Short-term claims are defined as having an original maturity less than three months.

TABLE 29.10 IRB Risk Weights

Probability of Default	Corporate	Residential Mortgage	Other Retail
0.03%	14.44%	4.15%	4.45%
0.10%	29.65%	10.69%	11.16%
0.25%	49.47%	21.30%	21.15%
0.50%	69.61%	35.08%	32.36%
0.75%	82.78%	46.46%	40.10%
1.00%	92.32%	56.40%	45.77%
2.00%	114.86%	87.94%	57.99%
3.00%	128.44%	111.99%	62.79%
4.00%	139.58%	131.63%	65.01%
5.00%	149.86%	148.22%	66.42%
0.00%	193.09%	204.41%	75.54%
20.00%	238.23%	253.12%	100.28%
50.00%	217.87%	226.62%	105.94%

Note: Illustrative weights for LGD = 45%, maturity of 2.5 years, and large corporate exposures (firms with turnover greater than 50 million euros).

Table 29.10 illustrates the link between PD and the risk weights for various asset classes. For instance, a corporate loan with a 1.00% probability of default would be assigned a risk weight of 92.32%, which is close to the standard risk weight of 100% from Basel I. Note that retail loans have much lower risk weights than the other categories, reflecting their greater diversification.⁷

(3) Advanced Internal Ratings-Based Approach (AIRB Approach)

Under the advanced approach, banks can supply other inputs as well. These include loss given default (LGD) and exposure at default (EAD). The combination of PDs and LGDs for all applicable exposures are then mapped into regulatory risk weights. The capital charge is obtained by multiplying the risk weight by EAD by 8%. The advanced IRB approach applies only to sovereign, banks and corporate exposures and not to retail portfolios.

Adoption of Approach Banks with simple portfolios can follow the standardized approach. More advanced banks are expected to adopt an IRB approach. To be eligible for the IRB approach, a bank must demonstrate to its supervisor that it meets a set of minimum requirements. Most importantly, the internal rating system must be consistent and reliable. Also, banks cannot allocate borrowers across rating systems, or cherry-pick ratings to minimize capital requirements. In addition, the bank-developed rating system must be approved at the highest level and subject to independent oversight.

⁷ Also, these weights cover unexpected losses; as the PD increases to very high levels, the weights start to decrease because most of the losses are expected and hence should be covered by general provisions.

Once a bank adopts an IRB approach, it is expected to extend it eventually across all asset classes and across the entire banking group. Banks adopting the IRB approach are expected to continue to employ it; a voluntary return to the standardized approach is only permitted in special cases, as approved by the supervisor.

Credit Risk Mitigation The New Accord also recognizes credit risk mitigation (CRM) techniques, such as collateralization, third-party guarantees, credit derivatives, and netting. **Collateralized credit exposures** are those where the borrower has posted assets as collateral. Recognition is only given to cash, gold, listed equities, investment-grade debt, sovereign securities rated BB– or better, or mutual funds investing in the same assets.

Under the Standardized Approach, two treatments are possible. In the simple approach, the risk of the collateral is simply substituted for that of the counterparty, generally subject to a 20% floor. In contrast, the comprehensive approach is more accurate and will lead to lower capital charges.

Even if the exposure is exactly matched by the collateral, there is some credit risk due to the volatility of values during a default. In the worst case, the value of the exposure could go up and that of the collateralized assets could go down. This volatility effect is measured by a **haircut** parameter (H) that is instrument-specific and approximates the 99% VAR over a ten-day period. For equities, for example, $H = 25\%$. For cash, this is zero.

The exposure after risk mitigation is then

$$E^* = E \times (1 + H_e) - C \times (1 - H_c - H_{fx}) \quad (29.11)$$

if positive, where E is the value of the uncollateralized exposure, C is the current market value of the collateral held, H_e is the haircut appropriate to the exposure, H_c is the haircut appropriate to the collateral, and H_{fx} is the haircut appropriate for a currency mismatch between the two.

Under the Foundation Approach, only the comprehensive approach is allowed. The effective loss given default (LGD*) is derived from the usual LGD and the current value of the exposure E and the exposure after risk mitigation E^*

$$\text{LGD}^* = \text{LGD} \times (E^*/E) \quad (29.12)$$

Other forms of CRM are **guarantees** and **credit derivatives**, which are a form of protection against obligor default provided by a third party, called the guarantor. Capital relief, however, is only granted if there is no uncertainty as to the quality of the guarantee. Protection must be direct, explicit, irrevocable, and unconditional. In such a situation, one can apply the principle of **substitution**. In other words, if bank A buys credit protection against a default of company B from bank C, it may substitute C's credit risk for B's risk. It will do so if the credit rating of bank C is better than that of B.

TABLE 29.11 Risk Weights for Securitizations:
Standardized Approach

	AAA/ AA-	A+/ A-	BBB+/ BBB-	BB+/ BB-	B+ and below or unrated
Tranche	20%	50%	100%	350%	1,250% (deduction)

An allowance can be made, however, for the low probability of **double default**. In order for bank A to incur a credit loss, both B and C must default. The likelihood of such a double default occurrence is generally very low. For instance, if defaults are independent, the probability of a credit loss is given by the *product* of the two default probabilities. In July 2005, the BCBS adopted new capital requirements that account for double default effects

$$RW_{DD} = RW_0(0.15 + 160 \times PD_g) \quad (29.13)$$

where RW_0 is the original capital requirement and PD_g is the probability of default of the guarantor, bank C in this case.

Securitization Finally, the New Accord also deals explicitly with **securitization**, which involves the economic or legal transfer of assets to a third party, typically called **special purpose vehicle** (SPV). Examples are asset-backed securities such as collateralized loan obligations, where the underlying asset is a pool of bank loans. Because of the high regulatory cost of keeping loans on their balance sheets, banks are now routinely transforming loans into tradeable securities. The securitization process is explained in Chapter 7.

A bank can remove these assets from its balance sheet only after a **true sale**, which is defined using **clean break** criteria. These are satisfied if a number of conditions are all met: (1) significant credit risk must be transferred to third parties, (2) the seller does not maintain effective or indirect control over the assets,⁸ (3) the securities are not an obligation of the seller, and (4) the holders of the SPV have the right to pledge or exchange those interests. Two other technical conditions are also involved.

If these conditions are all met, then the bank can remove the assets from its balance sheet and becomes subject to new risk weights for securitization tranches. These are described in Table 29.11 under the Standardized Approach. For example, the risk weight for a BBB-rated tranche is 100%. For the lowest-rated tranches, the bank must hold capital equal to the notional amount, which implies a risk weight of $(1/8\%) = 1250\%$.

⁸In particular, the transferred assets must be legally separated from the seller so that it does not have additional obligations in case the SPV goes bankrupt. Also, the seller cannot maintain effective control either by being able to repurchase the assets at a profit or by being obligated to retain the risk of the transferred assets.

EXAMPLE 29.9: FRM EXAM 2004—QUESTION 67

Which of the following statements about the Basel II capital requirements is *false*?

- a. It increases the risk sensitivity of minimum capital requirements for internationally active banks.
- b. It only addresses credit risk and market risk.
- c. United States insurance companies are not required to comply with Basel II capital requirements.
- d. Banks are not allowed to use their internal models for credit risk in determining the capital requirements for credit risk.

EXAMPLE 29.10: FRM EXAM 2006—QUESTION 79

Which of the following is *not* allowed by the Basel II Accord for measuring credit risk?

- a. Banks may measure credit risk in a standardized manner supported by external credit assessments.
- b. Banks may measure credit risk using a bank's internal credit rating systems, subject to the explicit approval of the bank's supervisor.
- c. Using external ratings for certain assets and internal ratings for the remaining assets.
- d. Banks may measure credit risk using their own internal estimates of the probability of default, loss given default, the exposure at default, and effective maturity, subject to certain minimum conditions, disclosure requirements, and supervisory approval.

EXAMPLE 29.11: FRM EXAM 2006—QUESTION 108

Which of the following statements is *not* correct about the Foundation IRB and the Advanced IRB approaches for credit risk capital charges in Basel II?

- a. Under the Advanced IRB approach, banks are allowed to use their own estimates of PD, LGD, EAD, and correlation coefficient but must use the risk-weighted functions provided by the supervisors.
- b. Under the Foundation IRB approach, banks provide their own estimates of PD and rely on supervisory estimates for other risk components.
- c. Banks adopting the Advanced IRB approach are expected to continue to employ this approach. A voluntary return to the standardized approach is only permitted in extraordinary circumstances.
- d. Under both Foundation IRB and Advanced IRB approaches, the expected loss is not included in the credit risk capital charge.

EXAMPLE 29.12: FRM EXAM 2006—QUESTION 90

Under the comprehensive approach for the Foundation Internal Ratings Based approach under Basel II, which of the following methods is used for calculating the effective loss given default (LGD*) where:

LGD* is the effective loss given default (considering risk mitigation measures). LGD is that of the senior unsecured exposure before recognition of collateral. E is the current value of the exposure (i.e., cash lent or securities lent or posted). E^* is the exposure value after risk mitigation.

- a. $\text{LGD}^* = \text{LGD} \times (E^*/E)$
- b. $\text{LGD}^* = \text{LGD} \times (E^*) * (E)$
- c. $\text{LGD}^* = \text{LGD} \times (E^* + E)$
- d. $\text{LGD}^* = \text{LGD} \times (E^* - E)$

29.4.4 The Operational Risk Charge

One of the most significant, and controversial, additions to the New Accord is the operational risk charge (ORC). The Basel Committee expects that the ORC will represent on average 12% of the total capital charge.

The new rules give three alternatives methods. The simplest is called the **basic indicator approach**. This is based on an aggregate measure of business activity. The capital charge equals a fixed percentage, called **alpha factor**, of the exposure indicator defined as gross income (GI):⁹

$$\text{ORC}^{BIA} = \alpha \times \text{GI} \quad (29.14)$$

where α has been set at 15%. The advantage of this method is that it is simple, transparent, and uses readily available data. The problem is that it does not account for the quality of controls. As a result, this approach is expected to be mainly used by non-sophisticated banks.

The second method is the **standardized approach**. Here, bank's activities are divided into eight **business lines**. Within each business line, gross income is taken as an indicator of the scale of activity. The capital charge is then obtained by multiplying gross income by a fixed percentage, called **beta factor**, and summing across business lines:

$$\text{ORC}^{SA} = \sum_{i=1}^8 \beta_i \times \text{GI}_i \quad (29.15)$$

⁹This is taken as the average of positive gross income numbers over the last three years. Negative values are excluded.

The β factors are described in Table 29.12. This approach is still simple but better reflects varying risks across business lines.¹⁰ Trading and sales, for example, carries a higher weight to reflect the possibility of high severity losses due to trader fraud.

The third class of method is the **advanced measurement approach (AMA)**. This allows banks to use their own internal models in the estimation of required capital using quantitative and qualitative criteria set by the Accord. It can only be used if the bank demonstrates effective management and control of operational risk.

The qualitative criteria are similar to those for the use of internal market VAR systems.¹¹ Once these are satisfied, the risk charge is obtained from the unexpected loss (UL), or VAR at the 99.9% confidence level over a one-year horizon:

$$\text{ORC}^{\text{AMA}} = \text{UL}(1 - \text{year}, 99.9\% \text{ confidence}) \quad (29.16)$$

Normally, the expected loss (EL) must be included in the capital charge, unless the bank can demonstrate that it adequately captures EL in its internal business practices.

Other quantitative criteria are as follows: (1) Banks must track internal loss data measured over a minimum period of five years; (2) banks must use external data; (3) banks must use scenario analysis to evaluate its exposure to high-severity events; and (4) banks must take into account the business environment and internal control factors. Finally, insurance can be used to offset up to 20% of the operational risk charge.

This approach offers the most refined measurement of operational risk and is expected to be used by more sophisticated institutions.

TABLE 29.12 Beta Factors

Business Line	Beta Factor
Corporate finance	18%
Trading and sales	18%
Retail banking	12%
Commercial banking	15%
Payment, settlement	18%
Agency services	15%
Asset management	12%
Retail brokerage	12%

¹⁰ The formula is actually more complex and allows offsets for some negative GI numbers in a year with positive numbers in other business lines, up to a limit of zero. The exact formula is $\text{ORC}^{\text{SA}} = \{\sum_{t=1}^3 \text{Max}[\sum_{i=1}^8 (\beta_i \times \text{GI}_i), 0]\}/3$.

¹¹ Specifically, (1) the bank must have an independent operational risk function, (2) the system must be integrated in day-to-day management, (3) there must be regular reporting, (4) documentation must exist, (5) auditors must perform regular reviews, and (6) there must be external validation.

EXAMPLE 29.13: FRM EXAM 2007—QUESTION 117

Which of the following approaches for calculating operational risk capital charges leads to a higher capital charge for a given accounting income as risk increases?

- a. The basic indicator approach
- b. The standardized approach
- c. The advanced measurement approach
- d. All of the above

EXAMPLE 29.14: FRM EXAM 2004—QUESTION 53

Which of the following statements about its methodology for calculating an operational risk capital charge in Basel II is *correct*?

- a. Basic indicator approach is suitable for institutions with sophisticated operational risk profile.
- b. Under the standardized approach, capital requirement is measured for each of the business line.
- c. Advanced measurement approaches will not allow an institution to adopt its own method of assessment of operational risk.
- d. AMA is less risk-sensitive than the standardized approach.

EXAMPLE 29.15: FRM EXAM 2004—QUESTION 42

According to the Basel Accord's advanced measurement approach, how are operational capital requirements calculated?

- a. As in credit risk, there are formulae specified in the Accord so that only the inputs have to be estimated.
- b. Capital requirements have to be estimated using historical data bases but the Accord does not specify which statistical distribution has to be used.
- c. The formulae are the same as those used for credit risk capital requirements.
- d. Each national supervisor must specify the formulae that the banks have to use.

EXAMPLE 29.16: FRM EXAM 2007—QUESTION 6

Which of the following statements regarding Basel II non-advanced approaches is *incorrect*?

- The standardized approach makes it advantageous for a bank to book losses early if doing so reduces this year's gross income sufficiently to make it negative.
- Corporate finance, trading and sales, and payment and settlement are the business lines with the highest regulatory capital requirements.
- The standardized approach divides the bank into business lines and uses data from the last three years of a business line's gross income and a beta factor to obtain the regulatory capital for that business line.
- The standardized approach uses data from the last three years of gross income to obtain a bank's operational risk capital charge.

29.4.5 Evaluation

The BCBS has organized a large-scale analysis of the effect of the new capital requirements on the banking system. Table 29.13 reports the results for 228 banks in the G-10 countries. The table shows that the new capital charge will affect banks differentially. Smaller banks, with more retail exposures, will have lower capital requirements than before. Retail risks are indeed more diversified than other types.

Larger banks are more likely to adopt the AIRB approach because it leads to lower capital requirements than the standardized approach. The table lists the

TABLE 29.13 Percentage Changes in Capital Requirements
(Banks in G-10 Countries)

Portfolio	Larger Banks		Smaller Banks	
	Method Standardized	IRB	Method Standardized	IRB
Corporate	0.9%	-5.0%	-1.0%	-4.5%
Bank	1.5%	0.4%	0.2%	0.1%
Sovereign	0.2%	1.3%	-0.1%	0.6%
SME	-0.2%	-1.3%	-0.1%	-2.2%
Mortgage	-6.3%	-7.6%	-6.2%	-12.6%
Retail	-0.7%	-0.9%	-2.5%	-4.5%
Other	0.8%	2.6%	0.0%	1.5%
Overall credit risk	-3.8%	-10.5%	-9.7%	-21.6%
Operational risk	5.6%	6.1%	8.3%	7.5%
Overall change	1.8%	-4.4%	-1.4%	-14.1%

Source: QIS5 study conducted by the BCBS (2006).

results for the standardized and most likely IRB approach. For instance, large banks will suffer a slightly higher capital charge (by 1.8%) under the standardized approach, which is primarily due to the addition of the operational risk charge. Under the AIRB approach, however, the credit risk charge drops by 10.5%, which leads to a net decrease in capital requirements of -4.4%.

Because the Basel Committee wants to keep the total level of global banking capital unchanged, the new framework introduces a **scaling factor**, which applies to the credit capital requirements under the IRB approach. This factor, which is incorporated in the table, is currently set at 1.06.

29.5 CONCLUSIONS

The Basel II Accord represents a major step forward for the measurement and management of banking risks. It creates more risk-sensitive capital charges for credit risk and, for the first time, attempts to account for operational risk.

Among winners will be banks that invest in risk management systems, banks with large retail portfolios and with high-grade corporate credits. Indeed, all of these should have lower credit risk than the rest of the industry.

This new framework is certainly not perfect, however. The standardized approach has been criticized for the greater role given to credit rating agencies. The internal approach is viewed as giving too much discretion to banks. These features, however, are certainly much better than the Basel I alternative and are the inevitable result of the move toward risk-sensitive capital charges.

Like any set of formal rules, the Basel II rules leave open some possibilities of regulatory arbitrage, due to discrepancies between economic and regulatory capital for some assets. The framework incorporates "typical" correlations in the construction of the credit risk charge. Institutions that have greater diversification than typical banks cannot enjoy lower capital charges. In theory, this could be corrected by using internal **portfolio credit risk models**, developed by the banks themselves. In practice, these models are not allowed for setting credit risk charges because they are not viewed as robust enough. Indeed, the losses suffered during the credit crisis that started in 2007 have highlighted major weaknesses in credit risk management.

More importantly, the system of capital charges has missed an important element of banking risk, which is liquidity risk. The need to recapitalize major banks by governments proves that capital levels were not adequate to protect against a major financial crisis. In addition, more risk-sensitive capital charges could have a **procyclical effect**. In a recession, defaults increase, leading to greater credit risk and greater capital charges. At the same time, the banking system suffers credit losses that erode its actual capital. Caught between lower actual capital and greater regulatory capital requirements, the banking system could respond by reducing its lending activities, thereby aggravating the extent of the recession. The Basel Committee will surely re-examine the adequacy of its capital standards.

EXAMPLE 29.17: FRM EXAM 2002—QUESTION 72

Under the new Basel Accord, which of the following best defines the overall minimum capital ratio?

- a. (Total Capital) / (Credit Risk + Market Risk + Operational Risk) = Capital Ratio > 8%
- b. (Total Capital) / (Credit Risk + Market Risk + Operational Risk) = Capital Ratio < 8%
- c. (Total Capital) / (Credit Risk + Market Risk) = 8%
- d. (Tier 1 Capital) / (Market Risk + Operational Risk) = 8%

EXAMPLE 29.18: FRM EXAM 2007—QUESTION 19

Your bank is implementing the AIRB approach for credit risk, the AMA for operational risk, and the internal model approach for market risk. The Chief Risk Officer (CRO) wants to estimate the bank's total risk by adding up the regulatory capital for market risk, credit risk, and operational risk. The CRO asks you to identify the problems with using this approach to estimate the bank's total risk. Which of the following statements about this approach is *incorrect*?

- a. It assumes market, credit, and operational risks have zero correlation.
- b. It uses a 10-day horizon for market risk.
- c. It ignores strategic risks.
- d. It ignores the interest risk associated with the bank's loans.

29.6 IMPORTANT FORMULAS

Basel I credit risk charge:

$$\text{CRC} = 8\% \times \text{RWA} = 8\% \times (\sum_i \text{RW}_i \times N_i)$$

Basel I derivatives credit exposure: Credit Exposure = NRV + Add-On
 Add-On = Notional × Add-On Factor × (0.4 + 0.6 × NGR)

Basel I total risk charge: TRC = CRC + MRC

Basel II total risk charge: TRC = CRC + MRC + ORC

Basel II credit risk charge: CRC = 8% × (\sum_i RW_i × N_i)

Standardized approach: RW = f (credit rating)

FIRB: RW = f (PD)

AIRB: RW = f (PD, LGD)

Basel II RW including double default effects: $RW_{DD} = RW_0(0.15 + 160 \times PD_g)$

Basel II operational risk charge:

Basic indicator approach: $ORC^{BIA} = \alpha \times GI$

Standardized approach: $ORC^{SA} = \sum_{i=1}^8 \beta_i \times GI_i$

AMA: $ORC^{AMA} = UL(1 - \text{year}, 99.9\% \text{ confidence}) + EL$

29.7 ANSWERS TO CHAPTER EXAMPLES

Example 29.1: Applicable Market Risks

- b. In addition to all the risks in the trading book (interest rate, equity, forex, commodity), the market capital charges also include forex and commodity risks in the bank book.

Example 29.2: FRM Exam 2002—Question 71

- a. Tier 1 capital includes equity capital, disclosed reserves, and retained earnings. Tier 2 includes undisclosed reserves, hybrid debt, and subordinated debt.

Example 29.3: FRM Exam 2007—Question 53

- b. Tier 1 capital consists of equity minus goodwill, or USD 570m. Tier 2 capital includes asset revaluation reserves of \$5m and loan loss reserves of \$5m. For this question, it is sufficient to find the correct number for tier 1 capital.

Example 29.4: FRM Exam 2004—Question 29

- b. Tier 1 capital consists of shareholders' funds plus retained earnings, minus goodwill, which is 671.7. Tier 2 capital consists of subordinated debt plus undisclosed reserves, or 213.5. The ratio is 31.78%. Specific provisions cannot be included in risk capital, because they are likely to be absorbed by specific bad loans.

Example 29.5: FRM Exam 2001—Question 38

- b. Under the Basel I rules, the charge is $\$100 \times 50\% \times 8\% = \4 million .

Example 29.6: FRM Exam 2001—Question 45

- a. From Table 29.3, the add-on factor is 10%. This gives a credit exposure of $\$15 + \$50 \times 10\% = \$20 \text{ million}$, and a credit risk charge of $\$20 \times 8\% = \1.6 million .

Example 29.7: FRM Exam 2000—Question 134

- a. Unfunded commitments are off-balance sheet items (unlike funded commitments, which are loans). Below a year, the credit conversion factor is zero, which means zero Basel weight.

Example 29.8: Return on Bank Equity

- a. An 8% capital charge applies to this bond. We buy \$100 worth of the bond, which is funded at the bank rate, for a net dollar return of $\$100[(L + 0.15\%) - (L - 0.05\%)] = \0.20 . We need to keep \$8 in capital, which we assume is not invested. The rate of return is then $\$0.20/\$8 = 2.5\%$.

Example 29.9: FRM Exam 2004—Question 67

- b. This is because Basel II also covers operational risk. Banks can provide inputs but cannot use their internal models for credit risk, so answer d. is false.

Example 29.10: FRM Exam 2006—Question 79

- c. The Basel II rules do not allow cherry-picking.

Example 29.11: FRM Exam 2006—Question 108

- a. Banks are never allowed to use their own correlations.

Example 29.12: FRM Exam 2006—Question 90

- a. See Equation (29.12). Also, this answer is the only one that makes sense taking units into account because LGD is a unitless ratio.

Example 29.13: FRM Exam 2007—Question 117

- c. The basic indicator approach uses a factor of $\alpha = 15\%$. The standardized approach uses a factor ranging from 12% to 18%. For the same level of income, if risk increases for instance by having more exposure to trading, the second approach will correctly pick up an increase in risk. Similarly for the AMA, which is even more risk-sensitive.

Example 29.14: FRM Exam 2004—Question 53

- b. The BI approach is suitable for banks with basic risk profiles, so answer a. is incorrect. The AMA approach is an internal model, so answer c. is incorrect. AMA is more risk-sensitive than the SI approach, so answer d. is incorrect.

Example 29.15: FRM Exam 2004—Question 42

- c. The AMA approach is an internal models approach, which does not specify a particular loss distribution.

Example 29.16: FRM Exam 2007—Question 6

- a. Statement b. is correct, given Table 29.12. Statement a. is incorrect, as only positive income is considered.

Example 29.17: FRM Exam 2002—Question 72

- a. The ratio of capital to total risk must be greater than 8%.

Example 29.18: FRM Exam 2007—Question 19

- a. The market risk charges uses a 10-day horizon, so statement b. is correct. The Basel capital charges do ignore strategic risk and interest rate in the banking book. Adding up the capital charges assumes perfect correlations (or at least high correlations, implying extreme shocks happen at the same time), not zero correlations.

The Basel Market Risk Charge

After the credit risk charges were instituted in 1988, the Basel Committee turned its attention to market risk in response to the increased proprietary trading activities of commercial banks. The Capital Accord was amended in 1996 to include a capital charge for market risk, which was implemented by January 1998.

The capital charge can be computed using two methods. The first is based on a “standardized” method, similar to the credit risk system with add-ons determined by the Basel rules. Because diversification effects are not fully recognized, this method generates a high market risk charge. The second method is called the **internal models approach (IMA)** and is based on the banks’ own risk management systems, which are more adaptable than the rigid set of standardized rules. This approach must be viewed as a breakthrough in financial regulation. For the first time, regulators relied on the banks’ own VAR systems to determine the capital charge. Since banks may have an incentive to underestimate their market risk, however, the internal models approach also includes a strong system of verification, based on backtesting.

The market risk framework was updated and fully incorporated in Basel II. During the events of 2007 and 2008, however, a number of banks suffered very large losses not captured by the usual VAR numbers. As a result, the Basel Committee has proposed a number of changes to the market risk framework.¹

This chapter discusses the implementation of capital charges for market risk. Section 30.1 summarizes the standardized method. The application of the internal model approach is described in Section 30.2. Section 30.3 then turns to stress testing. Finally, the framework for backtesting is presented in Section 30.4.

30.1 THE STANDARDIZED METHOD

The objective of the market risk amendment was “to provide an explicit capital cushion for the price risk to which banks are exposed.” This was viewed as important in further strengthening the soundness and stability of the international banking system and of financial markets. The original proposal was issued in

¹ Basel Committee on Banking Supervision (2008), *Proposed Revisions to the Basel II Market Risk Framework*, Basel: BIS.

April 1993 and was based on a prespecified **building block approach**. Essentially, this consists of attaching add-ons to all positions, which are added up across the portfolio.

The bank's market risk is first computed for portfolios exposed to interest-rate risk (IR), equity risk (EQ), foreign currency risk (FX), commodity risk (CO), and option risk (OP), using specific guidelines. The bank's total risk is then obtained from the summation of risks across the four categories. Because the construction of the risk charge follows a prespecified process, this approach is sometimes called the **standardized method**.²

The bank's total risk is obtained from the summation of risks across different types of risks, j , on each day, t :

$$\text{MRC}_t^{\text{STD}} = \sum_{j=1}^5 \text{MRC}_t^j = \text{MRC}_t^{\text{IR}} + \text{MRC}_t^{\text{EQ}} + \text{MRC}_t^{\text{FX}} + \text{MRC}_t^{\text{CO}} + \text{MRC}_t^{\text{OP}}$$
(30.1)

The interest rate risk charge is the sum of a general market risk charge, which typically increases for longer duration instruments, and a specific risk charge, which covers against issuer-specific risk. For instance, the weight for long-term investment-grade credits is 1.60%. For equity risk, the general market risk charge is 8% of the net positions; the specific risk charge is 8% of the gross positions, unless the portfolio is both liquid and well-diversified, in which case the weight is reduced to 4%. For currency risk, the market risk charge is 8% of the higher of either the net long currency positions or the net short currency positions. For commodity risk, several approaches are possible. In the simplified approach, the risk charge is 15% of the net position in each commodity. Finally, for option risk, several approaches are also possible. In the simplified approach, which applies when banks handle a limited range of purchased options, the capital charge is the lesser of the market risk charge for the underlying security and the option premium.

Thus, the standardized model is relatively straightforward to implement. It is also robust to model misspecification. The building-block approach, however, has been criticized on several grounds. First, the risk classification is arbitrary. For instance, a capital charge of 8% is applied uniformly to equities and currencies without regard for their actual return volatilities. Different currencies have different volatilities relative to the dollar that also can change over time.

Second, the approach leads to high capital requirements because risk charges are systematically added up across different sources of risk, which ignores diversification. For instance, fixed-income charges are computed for each currency separately, then added up across markets. Implicitly, this approach is a worst-case scenario that assumes that the worst loss will occur at the same time across all sources of risk. In practice, these markets are not perfectly correlated, which means that the worst loss will be less than the sum of individual worst losses. Thus, the standardized model fails to recognize the benefits of diversification, which gives

² See BCBS (1996), *Amendment to the Basel Capital Accord to Incorporate Market Risk*, Basel: BIS.

no incentive for banks to diversify prudently. Recognition of these problems has led to another, more flexible approach based on internal models.

EXAMPLE 30.1: FRM EXAM 2007—QUESTION 63

You are an analyst at Bank Alpha. You were given the task to determine whether under Basel II your bank can use the simplified approach to report option exposure instead of the intermediate approach. Which of the following criteria would your bank have to satisfy in order for it to use the simplified approach?

- a. The bank writes options, but its options trading is insignificant in relation to its overall business activities.
- b. The bank purchases and writes options and has significant options trading.
- c. The bank solely purchases options, and its options trading is insignificant in relation to its overall business activities.
- d. The bank purchases and writes options, but its options trading is insignificant.

30.2 THE INTERNAL MODELS APPROACH

In contrast to the simplistic standardized approach, the **internal models approach** (IMA) relies on internal risk management systems developed by banks themselves as the basis for the market risk charge.

This approach must be considered as a watershed in financial regulation. For the first time, regulators implicitly recognized that banks had developed sophisticated risk management systems, which should be more precise than simple standardized rules. Indeed, the complexity and speed of development of financial innovations is such that rigid rules can be avoided with new products. Another motivation for the IMA was to provide incentives for banks to develop risk management systems. This is because the IMA approach leads to lower capital charges than the standardized approach.

Regulators, however, have not totally given up their authority. A bank can use internal models only after it has been explicitly approved by the supervisory authority. The bank must satisfy qualitative requirements first. Second, the output is subject to a rigorous backtesting process.

30.2.1 Qualitative Requirements

Not all banks can use internal models, though. Regulators first must have some general reassurance that the bank's risk management system is sound. As a result,

banks first have to satisfy various qualitative standards:

- *Independent risk control unit.* The bank must have a risk control unit that is independent of trading and reports to senior management. This structure minimizes potential conflicts of interest.
- *Backtesting.* The bank must conduct a regular backtesting program, which provides essential feedback on the accuracy of internal VAR models.
- *Involvement.* Senior management and the board need to be involved in the risk control process and devote sufficient resources to risk management.
- *Integration.* The bank's internal risk model must be integrated with day-to-day management. This avoids situations where a bank could compute its VAR simply for regulatory purposes and otherwise ignore it.
- *Use of limits.* The bank should use its risk measurement systems to set internal trading and exposure limits.
- *Stress testing.* The bank should conduct stress tests on a regular basis. Stress tests results should be reviewed by senior management and be reflected in policies and limits set by management and the board of directors.
- *Compliance.* The bank should be compliant with a documented set of policies.
- *Independent review.* An independent review of the trading units and of the risk control unit should be performed regularly, at least once a year. This includes verification with backtesting.

30.2.2 The Market Risk Charge

In addition to these requirements, the bank's risk model must contain a sufficient number of risk factors, where the definition of *sufficient* depends on the extent and complexity of trading activities.³

For material exposures to interest rates, there should be at least six factors for yield curve risk plus separate factors to model spread risk. For equity risk, the model should at least consist of beta mapping on an index; a more detailed approach would have industry and even individual risk factor modeling. For active trading in commodities, the risk model should account for movements in spot rates plus convenience yields. Banks should also capture the nonlinear price characteristics of option positions, including vega risk. Correlations *within* broad risk categories are recognized explicitly. Regulators can also recognize correlations *across* risk categories provided the model is sound.

Once these requirements are satisfied, the market risk charge is computed according to these rules:

- *Quantitative parameters.* The computation of daily VAR shall be based on a set of uniform quantitative inputs:
 - A horizon of 10 trading days, or two calendar weeks; banks can, however, scale their daily VAR by the square root of time
 - A 99 percent confidence interval

³The 2008 proposed revisions would require a bank to justify any factor used in pricing which are left out in the VAR computation.