CHAPTER 15

Basel I, Basel II, and Solvency II

An agreement in 1988, known as the Basel Accord, marked the start of international standards for bank regulation. Since 1988, bank regulation has been an evolutionary process. New regulations have modified previous regulations, but many of the approaches used in previous regulations have usually been preserved. In order to understand the current regulatory environment, it is therefore necessary to understand historical developments. This chapter explains the evolution of the regulatory environment prior to the 2007 credit crisis. Chapter 16 will cover developments since the crisis, and Chapter 17 will cover a planned future development.

This chapter starts by reviewing the evolution of bank regulation between the 1980s and 2000. It explains the 1988 Basel Accord (now known as Basel I), netting provisions, and the 1996 Amendment. It then moves on to discuss Basel II, which is a major overhaul of the regulations and was implemented by many banks throughout the world in about 2007. Finally, it reviews Solvency II, a new regulatory framework for insurance companies, which is broadly similar to Basel II and is expected to be implemented by the European Union in 2016.

15.1 THE REASONS FOR REGULATING BANKS

The main purpose of bank regulation is to ensure that a bank keeps enough capital for the risks it takes. It is not possible to eliminate altogether the possibility of a bank failing, but governments want to make the probability of default for any given bank very small. By doing this, they hope to create a stable economic environment where private individuals and businesses have confidence in the banking system.

It is tempting to argue: "Bank regulation is unnecessary. Even if there were no regulations, banks would manage their risks prudently and would strive to keep a level of capital that is commensurate with the risks they are taking." Unfortunately, history does not support this view. There is little doubt that regulation has played an important role in increasing bank capital and making banks more aware of the risks they are taking.

As discussed in Section 2.3, governments provide deposit insurance programs to protect depositors. Without deposit insurance, banks that took excessive risks relative to their capital base would find it difficult to attract deposits. However, the impact of deposit insurance is to create an environment where depositors are less discriminating. A bank can take large risks without losing its deposit

BUSINESS SNAPSHOT 15.1

Systemic Risk

Systemic risk is the risk that a default by one financial institution will create a "ripple effect" that leads to defaults by other financial institutions and threatens the stability of the financial system. There are huge numbers of over-the-counter transactions between banks. If Bank A fails, Bank B may take a huge loss on the transactions it has with Bank A. This in turn could lead to Bank B failing. Bank C that has many outstanding transactions with both Bank A and Bank B might then take a large loss and experience severe financial difficulties; and so on.

The financial system has survived defaults such as Drexel in 1990, Barings in 1995, and Lehman Brothers in 2008 very well, but regulators continue to be concerned. During the market turmoil of 2007 and 2008, many large financial institutions were bailed out, rather than being allowed to fail, because governments were concerned about systemic risk.

base.[1] The last thing a government wants is to create a deposit insurance program that results in banks taking more risks. It is therefore essential that deposit insurance be accompanied by regulation concerned with capital requirements.

A major concern of governments is what is known as *systemic risk*. This is the risk that a failure by a large bank will lead to failures by other large banks and a collapse of the financial system. The way this can happen is described in Business Snapshot 15.1. When a bank or other large financial institution does get into financial difficulties, governments have a difficult decision to make. If they allow the financial institution to fail, they are putting the financial system at risk. If they bail out the financial institution, they are sending the wrong signals to the market. There is a danger that large financial institutions will be less vigilant in controlling risks if they know that they are "too big to fail" and the government will always bail them out.

During the market turmoil of 2007 and 2008, the decision was taken to bail out many large financial institutions in the United States and Europe. However, Lehman Brothers was allowed to fail in September, 2008. Possibly, the United States government wanted to make it clear to the market that bailouts for large financial institutions were not automatic. However, the decision to let Lehman Brothers fail has been criticized because arguably it made the credit crisis worse.

15.2 BANK REGULATION PRE-1988

Prior to 1988, bank regulators within a country tended to regulate bank capital by setting minimum levels for the ratio of capital to total assets. However, definitions of capital and the ratios considered acceptable varied from country to country. Some

[1] As mentioned in Chapter 3, this is an example of what insurance companies term moral hazard. The existence of an insurance contract changes the behavior of the insured party.

countries enforced their regulations more diligently than other countries. Increasingly, banks were competing globally and a bank operating in a country where capital regulations were slack was considered to have a competitive edge over one operating in a country with tighter more strictly enforced capital regulations. In addition, the huge exposures created by loans from the major international banks to less developed countries such as Mexico, Brazil, and Argentina, as well as the accounting games sometimes used for those exposures (see Business Snapshot 2.3) were starting to raise questions about the adequacy of capital levels.

Another problem was that the types of transactions entered into by banks were becoming more complicated. The over-the-counter derivatives market for products such as interest rate swaps, currency swaps, and foreign exchange options was growing fast. These contracts increase the credit risks being taken by a bank. Consider, for example, an interest rate swap. If the counterparty in the interest rate swap transaction defaults when the swap has a positive value to the bank and a negative value to the counterparty, the bank is liable to lose money. The potential future exposure on derivatives was not reflected in the bank's reported assets. As a result, it had no effect on the level of assets reported by a bank and therefore no effect on the amount of capital the bank was required to keep. It became apparent to regulators that the value of total assets was no longer a good indicator of the total risks being taken. A more sophisticated approach than that of setting minimum levels for the ratio of capital to total balance-sheet assets was needed.

The Basel Committee was formed in 1974. The committee consisted of representatives from Belgium, Canada, France, Germany, Italy, Japan, Luxembourg, the Netherlands, Sweden, Switzerland, the United Kingdom, and the United States. It met regularly in Basel, Switzerland, under the patronage of the Bank for International Settlements. The first major result of these meetings was a document entitled "International Convergence of Capital Measurement and Capital Standards." This was referred to as "The 1988 BIS Accord" or just "The Accord." Later it became known as Basel I.

15.3 THE 1988 BIS ACCORD

The 1988 BIS Accord was the first attempt to set international risk-based standards for capital adequacy. It has been subject to much criticism as being too simple and somewhat arbitrary. In fact, the Accord was a huge achievement. It was signed by all 12 members of the Basel Committee and paved the way for significant increases in the resources banks devote to measuring, understanding, and managing risks. The key innovation in the 1988 Accord was the Cooke ratio.

The Cooke Ratio

The Cooke ratio[2] considers credit risk exposures that are both on-balance-sheet and off-balance-sheet. It is based on what is known as the bank's total *risk-weighted assets* (also sometimes referred to as the *risk-weighted amount*). This is a measure of the bank's total credit exposure.

[2] The ratio is named after Peter Cooke from the Bank of England.

TABLE 15.1 Risk Weights for On-Balance-Sheet Items

Risk Weight (%)	Asset Category
0	Cash, gold bullion, claims on OECD governments such as Treasury bonds or insured residential mortgages
20	Claims on OECD banks and OECD public sector entities such as securities issued by U.S. government agencies or claims on municipalities
50	Uninsured residential mortgage loans
100	All other claims such as corporate bonds and less-developed country debt, claims on non-OECD banks

Credit risk exposures can be divided into three categories:

1. Those arising from on-balance sheet assets (excluding derivatives)
2. Those arising for off-balance sheet items (excluding derivatives)
3. Those arising from over-the-counter derivatives

Consider the first category. Each on-balance-sheet asset is assigned a risk weight reflecting its credit risk. A sample of the risk weights specified in the Accord is shown in Table 15.1. Cash and securities issued by governments of OECD countries (members of the Organisation of Economic Co-operation and Development) are considered to have virtually zero risk and have a risk weight of zero. Loans to corporations have a risk weight of 100%. Loans to banks and government agencies in OECD countries have a risk weight of 20%. Uninsured residential mortgages have a risk weight of 50%. The total of the risk-weighted assets for N on-balance-sheet items equals

$$\sum_{i=1}^{N} w_i L_i$$

where L_i is the principal amount of the ith item and w_i is its risk weight.

EXAMPLE 15.1

The assets of a bank consist of \$100 million of corporate loans, \$10 million of OECD government bonds, and \$50 million of residential mortgages. The total of the risk-weighted assets is

$$1.0 \times 100 + 0.0 \times 10 + 0.5 \times 50 = 125$$

or \$125 million.

Consider next the second category. This includes bankers' acceptances, guarantees, and loan commitments. A credit equivalent amount is calculated by applying a conversion factor to the principal amount of the instrument. Instruments that from a credit perspective are considered to be similar to loans, such as bankers' acceptances, have a conversion factor of 100%. Others, such as note issuance facilities (where a bank agrees that a company can issue short-term paper on pre-agreed terms in the future), have lower conversion factors.

TABLE 15.2 Add-On Factors as a Percent of Principal for Derivatives

Remaining Maturity (yr)	Interest Rate	Exchange Rate and Gold	Equity	Precious Metals Except Gold	Other Commodities
< 1	0.0	1.0	6.0	7.0	10.0
1 to 5	0.5	5.0	8.0	7.0	12.0
> 5	1.5	7.5	10.0	8.0	15.0

Consider next the third category. For an over-the-counter derivative such as an interest rate swap or a forward contract the credit equivalent amount is calculated as

$$\max(V, 0) + aL \tag{15.1}$$

where V is the current value of the derivative to the bank, a is an *add-on factor*, and L is the principal amount. The first term in equation (15.1) is the current exposure. If the counterparty defaults today and V is positive, the contract is an asset to the bank and the bank is liable to lose V. If the counterparty defaults today and V is negative, the contract is an asset to the counterparty and there will be neither a gain nor a loss to the bank. The bank's exposure is therefore $\max(V, 0)$. (More details on the way in which defaults are handled in the bilaterally cleared over-the-counter derivatives market are in Chapters 18 and 20.) The add-on amount, aL, is an allowance for the possibility of the exposure increasing in the future. Examples of the add-on factor, a, are shown in Table 15.2.

EXAMPLE 15.2

A bank has entered into a \$100 million interest rate swap with a remaining life of four years. The current value of the swap is \$2.0 million. In this case, the add-on amount is 0.5% of the principal so that the credit equivalent amount is \$2.0 million plus \$0.5 million or \$2.5 million.

The credit equivalent amount arising from either the second or third category of exposures is multiplied by the risk weight for the counterparty in order to calculate the risk-weighted assets. The risk weights are similar to those in Table 15.1 except that the risk weight for a corporation is 0.5 rather than 1.0.

EXAMPLE 15.3

Consider again the bank in Example 15.2. If the interest rate swap is with a corporation, the risk-weighted assets are 2.5×0.5 or \$1.25 million. If it is with an OECD bank, the risk-weighted assets are 2.5×0.2 or \$0.5 million.

Putting all this together, the total risk-weighted assets for a bank with N on-balance-sheet items and M off-balance-sheet items is

$$\sum_{i=1}^{N} w_i L_i + \sum_{j=1}^{M} w_j^* C_j \tag{15.2}$$

Here, L_i is the principal of the ith on-balance-sheet asset and w_i is the risk weight for the asset; C_j is the credit equivalent amount for the jth derivative or other off-balance sheet item and w_j^* is the risk weight of the counterparty for this jth item.

Capital Requirement

The Accord required banks to keep capital equal to at least 8% of the risk-weighted assets. The capital had two components:

1. *Tier 1 Capital*. This consists of items such as equity and noncumulative perpetual preferred stock.[3] (Goodwill is subtracted from equity.)
2. *Tier 2 Capital*. This is sometimes referred to as Supplementary Capital. It includes instruments such as cumulative perpetual preferred stock,[4] certain types of 99-year debenture issues, and subordinated debt (i.e., debt subordinated to depositors) with an original life of more than five years.

Equity capital is the most important type of capital because it absorbs losses. If equity capital is greater than losses, a bank can continue as a going concern. If equity capital is less than losses, the bank is insolvent. In the latter case, Tier 2 capital becomes relevant. Because it is subordinate to depositors, it provides a cushion for depositors. If a bank is wound up after its Tier I capital has been used up, losses should be borne first by the Tier 2 capital and, only if that is insufficient, by depositors. (See Section 2.2.)

The Accord required at least 50% of the required capital (that is, 4% of the risk-weighted assets) to be in Tier 1. Furthermore, the Accord required 2% of risk-weighted assets to be common equity. (Note that the Basel committee has updated its definition of instruments that are eligible for Tier 1 capital and its definition of common equity in Basel III.)

The bank supervisors in some countries require banks to hold more capital than the minimum specified by the Basel Committee and some banks themselves have a target for the capital they will hold that is higher than that specified by their bank supervisors.

15.4 THE G-30 POLICY RECOMMENDATIONS

In 1993, a working group consisting of end-users, dealers, academics, accountants, and lawyers involved in derivatives published a report that contained 20 risk management recommendations for dealers and end-users of derivatives and four recommendations for legislators, regulators, and supervisors. The report was based on a

[3] Noncumulative perpetual preferred stock is preferred stock lasting forever where there is a predetermined dividend rate. Unpaid dividends do not cumulate (that is, the dividends for one year are not carried forward to the next year).

[4] In cumulative preferred stock, unpaid dividends cumulate. Any backlog of dividends must be paid before dividends are paid on the common stock.

detailed survey of 80 dealers and 72 end-users worldwide. The survey involved both questionnaires and in-depth interviews. The report is not a regulatory document, but it has been influential in the development of risk management practices.

A brief summary of the important recommendations is as follows:

1. A company's policies on risk management should be clearly defined and approved by senior management, ideally at the board of directors level. Managers at all levels should enforce the policies.
2. Derivatives positions should be marked to market (i.e., revalued using a model that is consistent with market prices) at least once a day.
3. Derivatives dealers should measure market risk using a consistent measure such as value at risk. Limits to the market risks that are taken should be set.
4. Derivatives dealers should carry out stress tests to determine potential losses under extreme market conditions.
5. The risk management function should be set up so that it is independent of the trading operation.
6. Credit exposures arising from derivatives trading should be assessed based on the current replacement value of existing positions and potential future replacement costs.
7. Credit exposures to a counterparty should be aggregated in a way that reflects enforceable netting agreements. (We talk about netting in the next section.)
8. The individuals responsible for setting credit limits should be independent of those involved in trading.
9. Dealers and end-users should assess carefully both the costs and benefits of credit risk mitigation techniques such as collateralization and downgrade triggers. In particular, they should assess their own capacity and that of their counterparties to meet the cash flow requirement of downgrade triggers. (Downgrade triggers are discussed in Chapter 20.)
10. Only individuals with the appropriate skills and experience should be allowed to have responsibility for trading derivatives, supervising the trading, carrying out back office functions in relation to the trading, and so on.
11. There should be adequate systems in place for data capture, processing, settlement, and management reporting.
12. Dealers and end-users should account for the derivatives transactions used to manage risks so as to achieve a consistency of income recognition treatment between those instruments and the risks being managed.

15.5 NETTING

Participants in the over-the-counter derivatives market have traditionally signed an International Swaps and Derivatives Association (ISDA) master agreement covering their derivatives trades. The word *netting* refers to a clause in the master agreement, which states that in the event of a default all transactions are considered as a single transaction. Effectively, this means that, if a company defaults on one transaction that is covered by the master agreement, it must default on all transactions covered by the master agreement.

Netting and ISDA master agreements will be discussed in Chapters 18 and 20. At this stage, we note that netting can have the effect of substantially reducing credit risk. Consider a bank that has three swap transactions outstanding with a particular counterparty. The transactions are worth +\$24 million, –\$17 million, and +\$8 million to the bank. Suppose that the counterparty experiences financial difficulties and defaults on its outstanding obligations. To the counterparty the three transactions have values of –\$24 million, +\$17 million, and –\$8 million, respectively. Without netting, the counterparty would default on the first transaction, keep the second transaction, and default on the third transaction. Assuming no recovery, the loss to the bank would be \$32 (= 24 + 8) million. With netting, the counterparty is required to default on the second transaction as well. The loss to the bank is then \$15 (= 24 – 17 + 8) million.

More generally, suppose that a financial institution has a portfolio of N derivatives outstanding with a particular counterparty and that the current value of the ith derivative is V_i. Without netting, the financial institution's exposure in the event of a default today is

$$\sum_{i=1}^{N} \max(V_i, 0)$$

With netting, it is

$$\max\left(\sum_{i=1}^{N} V_i, 0\right)$$

Without netting, the exposure is the payoff from a portfolio of options. With netting, the exposure is the payoff from an option on a portfolio.

The 1988 Basel Accord did not take netting into account in setting capital requirements. From equation (15.1) the credit equivalent amount for a portfolio of derivatives with a counterparty under the Accord was

$$\sum_{i=1}^{N} [\max(V_i, 0) + a_i L_i]$$

where a_i is the add-on factor for the ith transaction and L_i is the principal for the ith transaction.

By 1995, netting had been successfully tested in the courts in many jurisdictions. As a result, the 1988 Accord was modified to allow banks to reduce their credit equivalent totals when enforceable bilateral netting agreements were in place. The first step was to calculate the net replacement ratio, NRR. This is the ratio of the current exposure with netting to the current exposure without netting:

$$\text{NRR} = \frac{\max(\sum_{i=1}^{N} V_i, 0)}{\sum_{i=1}^{N} \max(V_i, 0)}$$

TABLE 15.3 Portfolio of Derivatives with a Particular Counterparty

Transaction	Principal, L_i	Current Value, V_i	Table 15.2 Add-On Amount, a_iL_i
3-year interest rate swap	1,000	−60	5
6-year foreign exchange forward	1,000	70	75
9-month option on a stock	500	55	30

The credit equivalent amount was modified to

$$\max\left(\sum_{i=1}^{N} V_i, 0\right) + (0.4 + 0.6 \times \text{NRR}) \sum_{i=1}^{N} a_i L_i$$

EXAMPLE 15.4

Consider the example in Table 15.3, which shows a portfolio of three derivatives that a bank has with a particular counterparty. The third column shows the current mark-to-market values of the transactions and the fourth column shows the add-on amount calculated from Table 15.2. The current exposure with netting is $-60 + 70 + 55 = 65$. The current exposure without netting is $0 + 70 + 55 = 125$. The net replacement ratio is given by

$$\text{NRR} = \frac{65}{125} = 0.52$$

The total of the add-on amounts, $\sum a_iL_i$, is $5 + 75 + 30 = 110$. The credit equivalent amount when netting agreements are in place is $65 + (0.4 + 0.6 \times 0.52) \times 110 = 143.32$. Without netting, the credit equivalent amount is $125 + 110 = 235$. Suppose that the counterparty is an OECD bank so that the risk weight is 0.2. This means that the risk-weighted assets with netting is $0.2 \times 143.32 = 28.66$. Without netting, it is $0.2 \times 235 = 47$.

15.6 1996 AMENDMENT

In 1995, the Basel Committee issued a consultative proposal to amend the 1988 Accord. This became known as the "1996 Amendment." It was implemented in 1998 and was then sometimes referred to as "BIS 98." The amendment involves keeping capital for the market risks associated with trading activities.

Marking to market is the practice of revaluing assets and liabilities daily using a model that is calibrated to current market prices. It is also known as *fair value accounting*. Banks are required to use fair value accounting for all assets and liabilities that are held for trading purposes. This includes most derivatives, marketable equity securities, foreign currencies, and commodities. These items constitute what is referred to as the bank's *trading book*. Banks are not required to use fair value

accounting for assets that are expected to be held for the whole of their life for investment purposes. These assets, which include loans and some debt securities, constitute what is referred to as the *banking book*. Unless there is reason to believe that repayment of the principal will not be made, they are held at historical cost. (See Section 2.7.)

Under the 1996 Amendment, the credit risk capital charge in the 1988 Accord continued to apply to all on-balance-sheet and off-balance-sheet items in the trading and banking book, except positions in the trading book that consisted of (a) debt and equity traded securities and (b) positions in commodities and foreign exchange. The Amendment introduced a capital charge for the market risk associated with all items in the trading book.[5]

The 1996 Amendment outlined a standardized approach for measuring the capital charge for market risk. The standardized approach assigned capital separately to each of debt securities, equity securities, foreign exchange risk, commodities risk, and options. No account was taken of correlations between different types of instruments. The more sophisticated banks with well-established risk management functions were allowed to use an "internal model-based approach" for setting market risk capital. This involved calculating a value-at-risk measure and converting it into a capital requirement using a formula specified in the 1996 Amendment. Most large banks preferred to use the internal model-based approach because it better reflected the benefits of diversification and led to lower capital requirements.

The value-at-risk measure used in the internal model-based approach was calculated with a 10-day time horizon and a 99% confidence level. It is the loss that has a 1% chance of being exceeded over a 10-day period. The capital requirement is

$$\max(\mathrm{VaR}_{t-1}, m_c \times \mathrm{VaR}_{\mathrm{avg}}) + \mathrm{SRC} \tag{15.3}$$

where m_c is a multiplicative factor, and SRC is a *specific risk charge*. The variable VaR_{t-1} is the previous day's value at risk and $\mathrm{VaR}_{\mathrm{avg}}$ is the average value at risk over the past 60 days. The minimum value for m_c is 3. Higher values may be chosen by regulators for a particular bank if tests reveal inadequacies in the bank's value-at-risk model, as will be explained shortly.

The first term in equation (15.3) covers risks relating to movements in broad market variables such as interest rates, exchange rates, stock indices, and commodity prices. The second term, SRC, covers risks related to specific companies such as those concerned with movements in a company's stock price or changes in a company's credit spread.

Consider the first term and assume $m_c = 3$. In most circumstances, the most recently calculated VaR, VaR_{t-1}, is less than three times the average VaR over the past 60 days. This gives the capital requirement for movements in broad market variables as simply

$$3 \times \mathrm{VaR}_{\mathrm{avg}}$$

[5] Certain nontrading book positions that are used to hedge positions in the trading book can be included in the calculation of the market risk capital charge.

The most popular method for calculating VaR is historical simulation, described in Chapter 13. As explained in Chapter 12, banks almost invariably calculate a one-day 99% VaR in the first instance. When formulating the 1996 amendment, regulators explicitly stated that the 10-day 99% VaR can be calculated as $\sqrt{10}$ times the one-day 99% VaR. This means that, when the capital requirement for a bank is calculated as m_c times the average 10-day 99% VaR, it is to all intents and purposes $m_c \times \sqrt{10} = 3.16m_c$ times the average one-day 99% VaR. If $m_c = 3$, it is 9.48 times the average one-day VaR.

Consider next SRC. One security that gives rise to an SRC is a corporate bond. There are two components to the risk of this security: interest rate risk and credit risk of the corporation issuing the bond. The interest rate risk is captured by the first term in equation (15.3); the credit risk is captured by the SRC.[6] The 1996 Amendment proposed standardized methods for assessing the SRC, but allowed banks to use internal models once regulatory approval for the models had been obtained.

The internal model for SRC must involve calculating a 10-day 99% value at risk for specific risks. Regulators calculate capital by applying a multiplicative factor (similar to m_c) to the value at risk. This multiplicative factor must be at least 4 and the resultant capital must be at least 50% of the capital given by the standardized approach. A method for calculating SRC will be given in Section 21.5.

The total capital a bank was required to keep after the implementation of the 1996 Amendment was the sum of (a) credit risk capital equal to 8% of the risk-weighted assets (RWA) and (b) market risk capital as explained in this section. For convenience, an RWA for market risk capital was defined as 12.5 multiplied by the amount given in equation (15.3). This means that the total capital required for credit and market risk is given by

$$\text{Total Capital} = 0.08 \times (\text{credit risk RWA} + \text{market risk RWA}) \tag{15.4}$$

A bank had more flexibility in the type of capital it used for market risk. It could use Tier 1 or Tier 2 capital. It could also use what is termed Tier 3 capital. This consists of short-term subordinated debt with an original maturity of at least two years that is unsecured and fully paid up. (Tier 3 capital was eliminated under Basel III.)

Back-Testing

The BIS Amendment requires the one-day 99% VaR that a bank calculates to be back-tested over the previous 250 days. As described in Section 12.10, this involves using the bank's current procedure for estimating VaR for each of the most recent 250 days. If the actual loss that occurred on a day is greater than the VaR level calculated for the day, an "exception" is recorded. Calculations are typically carried out (a) including changes that were made to the portfolio on the day being considered and (b) assuming that no changes were made to the portfolio on the day being considered. (Regulators pay most attention to the first set of calculations.)

[6] As mentioned earlier, the 1988 credit risk capital charge did not apply to debt securities in the trading book under the 1996 Amendment.

If the number of exceptions during the previous 250 days is less than 5, m_c is normally set equal to 3. If the number of exceptions is 5, 6, 7, 8, and 9, the value of the m_c is set equal to 3.4, 3.5, 3.65, 3.75, and 3.85, respectively. The bank supervisor has some discretion as to whether the higher multipliers are used. They will normally be applied when the reason for the exceptions is identified as a deficiency in the VaR model being used. If changes in the bank's positions during the day result in exceptions, the higher multiplier should be considered, but does not have to be used. When the only reason that is identified is bad luck, no guidance is provided for the supervisor. In circumstances where the number of exceptions is 10 or more, the Basel Amendment requires the multiplier to be set at 4. Problem 15.18 considers these guidelines in the context of the statistical tests we discussed in Section 12.10.

15.7 BASEL II

The 1988 Basel Accord improved the way capital requirements were determined, but it does have significant weaknesses. Under the Accord, all loans by a bank to a corporation have a risk weight of 100% and require the same amount of capital. A loan to a corporation with a AAA credit rating is treated in the same way as one to a corporation with a B credit rating.[7] Also, in Basel I there was no model of default correlation.

In June 1999, the Basel Committee proposed new rules that have become known as Basel II. These were revised in January 2001 and April 2003. A number of Quantitative Impact Studies (QISs) were carried out prior to the implementation of the new rules to test them by calculating the amount of capital that would be required if the rules had been in place.[8] A final set of rules agreed to by all members of the Basel Committee was published in June 2004. This was updated in November 2005. Implementation of the rules began in 2007 after a further QIS.

The Basel II capital requirements applied to "internationally active" banks. In the United States, there are many small regional banks and the U.S. regulatory authorities decided that Basel II would not apply to them. (These banks are regulated under what is termed Basel IA, which is similar to Basel I.) In Europe, all banks, large or small, were regulated under Basel II. Furthermore, the European Union required the Basel II rules to be applied to securities companies as well as banks.

The Basel II is based on three "pillars":

1. Minimum Capital Requirements
2. Supervisory Review
3. Market Discipline

[7] Credit ratings are discussed in Section 1.7.

[8] One point to note about the QISs is that they do not take account of changes banks may choose to make to their portfolios to minimize their capital requirements once the new rules have been implemented.

In Pillar 1, the minimum capital requirement for credit risk in the banking book is calculated in a new way that reflects the credit risk of counterparties. The capital requirement for market risk remains unchanged from the 1996 Amendment and there is a new capital charge for operational risk. The general requirement in Basel I that banks hold a total capital equal to 8% of risk-weighted assets (RWA) remains unchanged. When the capital requirement for a particular risk is calculated directly rather than in a way involving RWAs, it is multiplied by 12.5 to convert it into an RWA-equivalent. As a result it is always the case that

$$\text{Total Capital} = 0.08 \times (\text{credit risk RWA} + \text{market risk RWA} + \text{operational risk RWA}) \tag{15.5}$$

Pillar 2 is concerned with the supervisory review process. It covers both quantitative and qualitative aspects of the ways risk is managed within a bank. Supervisors are required to ensure that a bank has a process in place for ensuring that capital levels are maintained. Banks are expected to keep more than the minimum regulatory capital to allow for fluctuations in capital requirements and possible difficulties in raising capital at short notice. Regulators in different countries are allowed some discretion in how rules are applied (so that they can take account of local conditions), but overall consistency in the application of the rules is required. Pillar 2 places more emphasis on early intervention when problems arise. Supervisors are required to do far more than just ensuring that the minimum capital required under Basel II is held. Part of their role is to encourage banks to develop and use better risk management techniques and to evaluate these techniques. They should evaluate risks that are not covered by Pillar 1 (e.g., concentration risks) and enter into an active dialogue with banks when deficiencies are identified.

The third pillar, market discipline, requires banks to disclose more information about the way they allocate capital and the risks they take. The idea here is that banks will be subjected to added pressure to make sound risk management decisions if shareholders and potential shareholders have more information about those decisions.

15.8 CREDIT RISK CAPITAL UNDER BASEL II

For credit risk, Basel II specified three approaches:

1. The Standardized Approach
2. The Foundation Internal Ratings Based (IRB) Approach
3. The Advanced IRB Approach

However, the United States (which, as mentioned earlier, chose to apply Basel II only to large banks) decided that only the IRB approach can be used.

TABLE 15.4 Risk Weights as a Percent of Principal for Exposures to Countries, Banks, and Corporations Under Basel II's Standardized Approach

	AAA to AA–	A+ to A–	BBB+ to BBB–	BB+ to BB–	B+ to B–	Below B–	Unrated
Country*	0	20	50	100	100	150	100
Banks**	20	50	50	100	100	150	50
Corporations	20	50	100	100	150	150	100

*Includes exposures to the country's central bank.
**National supervisors have options as outlined in the text.

The Standardized Approach

The standardized approach is used by banks that are not sufficiently sophisticated (in the eyes of the regulators) to use the internal ratings approaches. The standardized approach is similar to Basel I except for the calculation of risk weights.[9] Some of the new rules here are summarized in Table 15.4. Comparing Table 15.4 with Table 15.1, we see that the OECD status of a bank or a country is no longer considered important under Basel II. The risk weight for a country (sovereign) exposure ranges from 0% to 150% and the risk weight for an exposure to another bank or a corporation ranges from 20% to 150%. In Table 15.1, OECD banks were implicitly assumed to be lesser credit risks than corporations. An OECD bank attracted a risk weight of 20% while a corporation attracted a risk weight of 100%. Table 15.4 treats banks and corporations much more equitably. An interesting observation from Table 15.4 for a country, corporation, or bank that wants to borrow money is that it may be better to have no credit rating at all than a very poor credit rating. Supervisors are allowed to apply lower risk weights (20% rather than 50%, 50% rather than 100%, and 100% rather than 150%) when exposures are to the country in which the bank is incorporated or to that country's central bank.

For claims on banks, the rules are somewhat complicated. Instead of using the risk weights in Table 15.4, national supervisors can choose to base capital requirements on the rating of the country in which the bank is incorporated. The risk weight assigned to the bank will be 20% if the country of incorporation has a rating between AAA and AA–, 50% if it is between A+ and A–, 100% if it is between BBB+ and B–, 150% if it is below B–, and 100% if it is unrated. Another complication is that, if national supervisors elect to use the rules in Table 15.4, they can choose to treat claims with a maturity less than three months more favorably so that the risk weights are 20% if the rating is between AAA+ and BBB–, 50% if it is between BB+ and B–, 150% if it is below B–, and 20% if it is unrated.

The standard rule for retail lending is that a risk weight of 75% be applied. (This compares to 100% in the 1988 Accord.) When claims are secured by a residential mortgage, the risk weight is 35%. (This compares with 50% in the 1988 Accord.) Because of poor historical loss experience, the risk weight for claims secured by commercial real estate is 100%.

[9] Ratios calculated using the new weights are sometimes referred to as McDonough ratios after William McDonough, the head of the Basel Committee.

EXAMPLE 15.5

Suppose that the assets of a bank consist of \$100 million of loans to corporations rated A, \$10 million of government bonds rated AAA, and \$50 million of residential mortgages. Under the Basel II standardized approach, the total of the risk-weighted assets is

$$0.5 \times 100 + 0.0 \times 10 + 0.35 \times 50 = 67.5$$

or \$67.5 million. This compares with \$125 million under Basel I (See Example 15.1.)

Adjustments for Collateral

There are two ways banks can adjust risk weights for collateral. The first is termed the *simple approach* and is similar to an approach used in Basel I. The second is termed the *comprehensive approach*. Banks have a choice as to which approach is used in the banking book, but must use the comprehensive approach to calculate capital for counterparty credit risk in the trading book.

Under the simple approach, the risk weight of the counterparty is replaced by the risk weight of the collateral for the part of the exposure covered by the collateral. (The exposure is calculated after netting.) For any exposure not covered by the collateral, the risk weight of the counterparty is used. The minimum level for the risk weight applied to the collateral is 20%.[10] A requirement is that the collateral must be revalued at least every six months and must be pledged for at least the life of the exposure.

Under the comprehensive approach, banks adjust the size of their exposure upward to allow for possible increases in the exposure and adjust the value of the collateral downward to allow for possible decreases in the value of the collateral.[11] (The adjustments depend on the volatility of the exposure and the collateral.) A new exposure equal to the excess of the adjusted exposure over the adjusted value of the collateral is calculated and the counterparty's risk weight is applied to this exposure. The adjustments applied to the exposure and the collateral can be calculated using rules specified in Basel II or, with regulatory approval, using a bank's internal models. Where netting arrangements apply, exposures and collateral are separately netted and the adjustments made are weighted averages.

EXAMPLE 15.6

Suppose that an \$80 million exposure to a particular counterparty is secured by collateral worth \$70 million. The collateral consists of bonds issued by an A-rated company. The counterparty has a rating of B+. The risk weight for the counterparty

[10] An exception is when the collateral consists of cash or government securities with the currency of the collateral being the same as the currency of the exposure.

[11] An adjustment to the exposure is not likely to be necessary on a loan, but is likely to be necessary on an over-the-counter derivative. The adjustment is in addition to the add-on factor.

is 150% and the risk weight for the collateral is 50%. The risk-weighted assets applicable to the exposure using the simple approach is

$$0.5 \times 70 + 1.50 \times 10 = 50$$

or \$50 million.

Consider next the comprehensive approach. Assume that the adjustment to exposure to allow for possible future increases in the exposure is +10% and the adjustment to the collateral to allow for possible future decreases in its value is –15%. The new exposure is

$$1.1 \times 80 - 0.85 \times 70 = 28.5$$

or \$28.5 million and a risk weight of 150% is applied to this exposure to give risk adjusted assets equal to \$42.75 million.

The IRB Approach

The model underlying the IRB approach is shown in Figure 15.1. Regulators base the capital requirement on the value at risk calculated using a one-year time horizon and a 99.9% confidence level. They recognize that expected losses are usually covered by the way a financial institution prices its products. (For example, the interest charged by a bank on a loan is designed to recover expected loan losses.) The capital required is therefore the value at risk minus the expected loss.

The value at risk is calculated using the one-factor Gaussian copula model of time to default that we discussed in Section 11.5. Assume that a bank has a very large number of obligors and the ith obligor has a one-year probability of default equal to

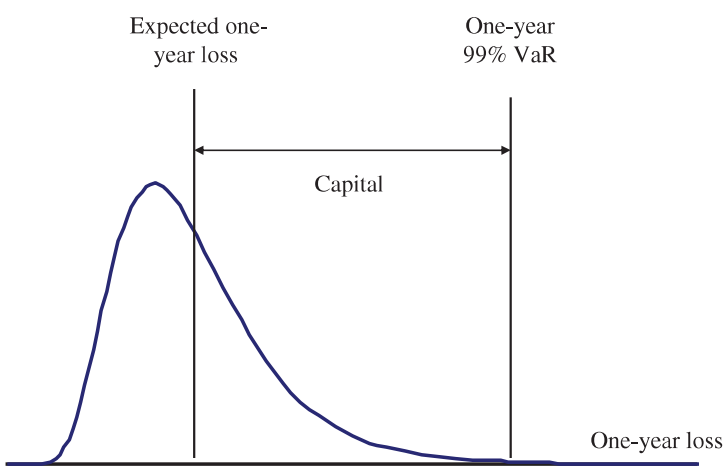

FIGURE 15.1 The Loss Probability Density Function and the Capital Required by a Financial Institution

PD_i. The copula correlation between each pair of obligors is ρ.[12] As in Section 11.5, we define

$$\mathrm{WCDR}_i = N\left[\frac{N^{-1}(\mathrm{PD}_i) + \sqrt{\rho}N^{-1}(0.999)}{\sqrt{1-\rho}}\right] \tag{15.6}$$

where WCDR_i denotes the "worst-case default rate" defined so that the bank is 99.9% certain it will not be exceeded next year for the *i*th counterparty. Gordy's (2003) research (see Section 11.5) shows that for a large portfolio of instruments (loans, loan commitments, derivatives, and so on) that have the same ρ, in a one-factor model the one-year 99.9% VaR is approximately[13]

$$\sum_i \mathrm{EAD}_i \times \mathrm{LGD}_i \times \mathrm{WCDR}_i$$

where EAD_i is the exposure at default of the *i*th counterparty and LGD_i is the loss given default for the *i*th counterparty. The variable EAD_i is the dollar amount that is expected to be owed by the *i*th counterparty at the time of default during the next year.

The variable LGD_i is the proportion of EAD_i that is expected to be lost in the event of default. For example, if a bank expects to recover 30% of the amount owed in the event of default, $\mathrm{LGD}_i = 0.7$.

The expected loss from defaults is

$$\sum_i \mathrm{EAD}_i \times \mathrm{LGD}_i \times \mathrm{PD}_i$$

The capital required in Figure 15.1 is the excess of the 99.9% worst-case loss over the expected loss. It is therefore

$$\sum_i \mathrm{EAD}_i \times \mathrm{LGD}_i \times (\mathrm{WCDR}_i - \mathrm{PD}_i) \tag{15.7}$$

We now drop the subscripts and define for a counterparty:

PD: The probability that the counterparty will default within one year (expressed as a decimal)

EAD: The exposure at default (in dollars)

LGD: The loss given default or the proportion of the exposure that is lost if there is a default (expressed as a decimal)

[12] Note that the Basel Committee publications use *R*, not ρ, to denote the copula correlation.
[13] See M. B. Gordy, "A Risk-Factor Model Foundation for Ratings-Based Bank Capital Ratios," *Journal of Financial Intermediation* 12 (2003): 199–232.

TABLE 15.5 Dependence of One-Year 99.9% WCDR on PD and ρ

	PD = 0.1%	PD = 0.5%	PD = 1%	PD = 1.5%	PD = 2.0%
ρ = 0.0	0.1%	0.5%	1.0%	1.5%	2.0%
ρ = 0.2	2.8%	9.1%	14.6%	18.9%	22.6%
ρ = 0.4	7.1%	21.1%	31.6%	39.0%	44.9%
ρ = 0.6	13.5%	38.7%	54.2%	63.8%	70.5%
ρ = 0.8	23.3%	66.3%	83.6%	90.8%	94.4%

Table 15.5 shows how WCDR depends on PD and ρ in the Gaussian copula model. When the correlation ρ is zero, WCDR = PD because in that case there is no default correlation and the percentage of loans defaulting can be expected to be the same in all years. As ρ increases, WCDR increases.

Corporate, Sovereign, and Bank Exposures

In the case of corporate, sovereign, and bank exposures, Basel II assumes a relationship between the correlation parameter, ρ, and the probability of default, PD, based on empirical research.[14] The formula is

$$\rho = 0.12\frac{1-\exp(-50\times \mathrm{PD})}{1-\exp(-50)} + 0.24\left[1-\frac{1-\exp(-50\times \mathrm{PD})}{1-\exp(-50)}\right]$$

Because exp(−50) is a very small number, this formula is to all intents and purposes

$$\rho = 0.12\left(1+e^{-50\times \mathrm{PD}}\right) \tag{15.8}$$

As PD increases, ρ decreases. The reason usually given for this inverse relationship is as follows. As a company becomes less creditworthy, its PD increases and its probability of default becomes more idiosyncratic and less affected by overall market conditions.

Combining equation (15.8) with equation (15.6), we obtain the relationship between WCDR and PD in Table 15.6. WCDR is, as one would expect, an increasing function of PD. However it does not increase as fast as it would if ρ were assumed to be independent of PD.

The formula for the capital required for the counterparty is

$$\mathrm{EAD}\times \mathrm{LGD}\times(\mathrm{WCDR}-\mathrm{PD})\times \mathrm{MA} \tag{15.9}$$

[14] See J. Lopez, "The Empirical Relationship between Average Asset Correlation, Firm Probability of Default, and Asset Size," *Journal of Financial Intermediation* 13, no. 2 (2004): 265–283.

TABLE 15.6 Relationship between One-Year 99.9% WCDR and PD for Corporate, Sovereign, and Bank Exposures

PD	0.1%	0.5%	1%	1.5%	2.0%
WCDR	3.4%	9.8%	14.0%	16.9%	19.0%

The meaning of the first three terms in this expression should be clear from our earlier discussion leading to equation (15.7). The variable MA is the maturity adjustment and is defined as

$$\mathrm{MA} = \frac{1 + (\mathrm{M} - 2.5) \times b}{1 - 1.5 \times b} \tag{15.10}$$

where

$$b = [0.11852 - 0.05478 \times \ln(\mathrm{PD})]^2$$

and M is the maturity of the exposure. The maturity adjustment is designed to allow for the fact that, if an instrument lasts longer than one year, there is a one-year credit exposure arising from a possible decline in the creditworthiness of the counterparty as well as from a possible default by the counterparty. (Note that, when M = 1, MA is 1.0 and has no effect.) As mentioned in Section 15.7 (see Equation (15.5)), the risk-weighted assets (RWA) are calculated as 12.5 times the capital required

$$\mathrm{RWA} = 12.5 \times \mathrm{EAD} \times \mathrm{LGD} \times (\mathrm{WCDR} - \mathrm{PD}) \times \mathrm{MA}$$

so that the capital is 8% of RWA, 4% of which must be Tier 1.

Under the Foundation IRB approach, banks supply PD while LGD, EAD, and M are supervisory values set by the Basel Committee. PD is subject to a floor of 0.03% for bank and corporate exposures. LGD is set at 45% for senior claims and 75% for subordinated claims. When there is eligible collateral, in order to correspond to the comprehensive approach that we described earlier, LGD is reduced by the ratio of the adjusted value of the collateral to the adjusted value of the exposure, both calculated using the comprehensive approach. For derivatives, the EAD is calculated in a manner similar to the "current exposure plus add-on" approach of Basel I and includes the impact of netting. M is set at 2.5 in most circumstances.

Under the advanced IRB approach, banks supply their own estimates of the PD, LGD, EAD, and M for corporate, sovereign, and bank exposures. The PD can be reduced by credit mitigants such as credit triggers. (As in the case of the Foundation IRB approach, it is subject to a floor of 0.03% for bank and corporate exposures.) The two main factors influencing the LGD are the seniority of the debt and the collateral. In calculating EAD, banks can with regulatory approval use their own models. In the case of derivatives, the model is likely to involve a Monte Carlo simulation to determine how expected exposure (after netting and collateral) will vary over the next year.

The capital given by equation (15.9) is intended to be sufficient to cover unexpected losses over a one-year period that we are 99.9% certain will not be exceeded. (As discussed earlier, the expected losses should be covered by a bank in the way it

prices its products.) The WCDR is the default rate that (theoretically) happens once every thousand years. The Basel committee reserved the right to apply a scaling factor (less than or greater than 1.0) to the result of the calculations in equation (15.9) if it finds that the aggregate capital requirements are too high or low. A typical scaling factor is 1.06.

EXAMPLE 15.7

Suppose that the assets of a bank consist of \$100 million of loans to A-rated corporations. The PD for the corporations is estimated as 0.1% and the LGD is 60%. The average maturity is 2.5 years for the corporate loans. This means that

$$b = [0.11852 - 0.05478 \times \ln(0.001)]^2 = 0.247$$

so that

$$\text{MA} = \frac{1}{1 - 1.5 \times 0.247} = 1.59$$

From Table 15.6, the WCDR is 3.4%. Under the Basel II IRB approach, the risk-weighted assets for the corporate loans are

$$12.5 \times 100 \times 0.6 \times (0.034 - 0.001) \times 1.59 = 39.3$$

or \$39.3 million. This compares with \$100 million under Basel I and \$50 million under the standardized approach of Basel II. (See Examples 15.1 and 15.5 where a \$100 million corporate loan is part of the portfolio.)

Retail Exposures

The model underlying the calculation of capital for retail exposures is similar to that underlying the calculation of corporate, sovereign, and banking exposures. However, the Foundation IRB and Advanced IRB approaches are merged and all banks using the IRB approach provide their own estimates of PD, EAD, and LGD. There is no maturity adjustment, MA. The capital requirement is therefore

$$\text{EAD} \times \text{LGD} \times (\text{WCDR} - \text{PD})$$

and the risk-weighted assets are

$$12.5 \times \text{EAD} \times \text{LGD} \times (\text{WCDR} - \text{PD})$$

WCDR is calculated as in equation (15.6). For residential mortgages, ρ is set equal to 0.15 in this equation.[15] For qualifying revolving exposures, ρ is set equal to 0.04. For all other retail exposures, a relationship between ρ and PD is specified for the calculation of WCDR. This is

$$\rho = 0.03\frac{1 - \exp(-35 \times \text{PD})}{1 - \exp(-35)} + 0.16\left[1 - \frac{1 - \exp(-35 \times \text{PD})}{1 - \exp(-35)}\right]$$

[15] In the light of experience during the crisis, this is probably too low.

TABLE 15.7 Relationship between One-Year 99.9% WCDR and PD for Retail Exposures

PD	0.1%	0.5%	1.0%	1.5%	2.0%
WCDR	2.1%	6.3%	9.1%	11.0%	12.3%

Because exp(−35) is a very small number, this formula is to all intents and purposes

$$\rho = 0.03 + 0.13e^{-35\times \mathrm{PD}} \tag{15.11}$$

Comparing equation (15.11) with equation (15.8), we see that correlations are assumed to be much lower for retail exposures than for corporate exposures. Table 15.7 is the table corresponding to Table 15.6 for retail exposures.

EXAMPLE 15.8

Suppose that the assets of a bank consist of \$50 million of residential mortgages where the PD is 0.005 and the LGD is 20%. In this case, $\rho = 0.15$ and

$$\mathrm{WCDR} = N\left[\frac{N^{-1}(0.005) + \sqrt{0.15}N^{-1}(0.999)}{\sqrt{1-0.15}}\right] = 0.067$$

The risk-weighted assets are

$$12.5 \times 50 \times 0.2 \times (0.067 - 0.005) = 7.8$$

or \$7.8 million. This compares with \$25 million under Basel I and \$17.5 million under the Standardized Approach of Basel II. (See Examples 15.1 and 15.5 where \$50 million of residential mortgages is part of the portfolio.)

Guarantees and Credit Derivatives

The approach traditionally taken by the Basel Committee for handling guarantees and credit derivatives such as credit default swaps is the credit substitution approach. Suppose that a AA-rated company guarantees a loan to a BBB-rated company. For the purposes of calculating capital, the credit rating of the guarantor is substituted for the credit rating of the borrower so that capital is calculated as though the loan had been made to the AA-rated company. This overstates the credit risk because, for the lender to lose money, both the guarantor and the borrower must default (with the guarantor defaulting before the borrower).[16] The Basel Committee has addressed this issue. In July 2005, it published a document concerned with the treatment of double defaults under Basel II.[17] As an alternative to using the credit substitution

[16] Credit default swaps, which we discuss in Chapter 19, provide a type of insurance against default and are handled similarly to guarantees for regulatory purposes.

[17] See Bank for International Settlements, "The Application of Basel II to Trading Activities and the Treatment of Double Defaults," July 2005, available on www.bis.org.

approach, the capital requirement can be calculated as the capital that would be required without the guarantee multiplied by $0.15 + 160 \times \mathrm{PD}_g$ where PD_g is the one-year probability of default of the guarantor.

15.9 OPERATIONAL RISK CAPITAL UNDER BASEL II

In addition to changing the way banks calculate credit risk capital, Basel II requires banks to keep capital for operational risk. This is the risk of losses from situations where the bank's procedures fail to work as they are supposed to or where there is an adverse external event such as a fire in a key facility.

There are three approaches to calculating capital for operational risk:

1. The Basic Indicator Approach
2. The Standardized Approach
3. The Advanced Measurement Approach

Which of these is used depends on the sophistication of the bank. The simplest approach is the Basic Indicator Approach. This sets the operational risk capital equal to the bank's average annual gross income over the last three years multiplied by 0.15.[18] The Standardized Approach is similar to the basic indicator approach except that a different factor is applied to the gross income from different business lines. In the Advanced Measurement Approach, the bank uses its own internal models to calculate the operational risk loss that it is 99.9% certain will not be exceeded in one year. Similarly to the way credit risk capital is calculated in the IRB approach, operational risk capital is set equal to this loss minus the expected loss. One advantage of the advanced measurement approach is that it allows banks to recognize the risk mitigating impact of insurance contracts subject to certain conditions. The calculation of operational risk is discussed further in Chapter 23.

15.10 PILLAR 2: SUPERVISORY REVIEW

Pillar 2 of Basel II is concerned with the supervisory review process. Four key principles of supervisory review are specified:

1. Banks should have a process for assessing their overall capital adequacy in relation to their risk profile and a strategy for maintaining their capital levels.
2. Supervisors should review and evaluate banks' internal capital adequacy assessments and strategies, as well as their ability to monitor and ensure compliance with regulatory capital ratios. Supervisors should take appropriate supervisory action if they are not satisfied with the result of this process.

[18] Gross income defined as net interest income plus non-interest income. Net interest income is the excess of income earned on loans over interest paid on deposits and other instruments that are used to fund the loans. Years where gross income is negative are not included in the calculations.

3. Supervisors should expect banks to operate above the minimum regulatory capital and should have the ability to require banks to hold capital in excess of this minimum.
4. Supervisors should seek to intervene at an early stage to prevent capital from falling below the minimum levels required to support the risk characteristics of a particular bank and should require rapid remedial action if capital is not maintained or restored.

The Basel Committee suggests that regulators pay particular attention to interest rate risk in the banking book, credit risk, and operational risk. Key issues in credit risk are stress tests used, default definitions used, credit risk concentration, and the risks associated with the use of collateral, guarantees, and credit derivatives.

The Basel Committee also stresses that there should be transparency and accountability in the procedures used by bank supervisors. This is particularly important when a supervisor exercises discretion in the procedures used or sets capital requirements above the minimum specified in Basel II.

15.11 PILLAR 3: MARKET DISCIPLINE

Pillar 3 of Basel II is concerned with increasing the disclosure by a bank of its risk assessment procedures and capital adequacy. The extent to which regulators can force banks to increase their disclosure varies from jurisdiction to jurisdiction. However, banks are unlikely to ignore directives on this from their supervisors, given the potential of supervisors to make their life difficult. Also, in some instances, banks have to increase their disclosure in order to be allowed to use particular methodologies for calculating capital.

Regulatory disclosures are likely to be different in form from accounting disclosures and need not be made in annual reports. It is largely left to the bank to choose disclosures that are material and relevant. Among the items that banks should disclose are:

1. The entities in the banking group to which Basel II is applied and adjustments made for entities to which it is not applied
2. The terms and conditions of the main features of all capital instruments
3. A list of the instruments constituting Tier 1 capital and the amount of capital provided by each item
4. The total amount of Tier 2 capital.
5. Capital requirements for credit, market, and operational risk
6. Other general information on the risks to which a bank is exposed and the assessment methods used by the bank for different categories of risk.
7. The structure of the risk management function and how it operates.

15.12 SOLVENCY II

As discussed in Section 3.11, there are no international standards for the regulation of insurance companies. In the United States, insurance companies are regulated at

the state level with some input from the Federal Insurance Office and the National Association of Insurance Commissioners. In Europe, the regulation of insurance companies is handled by the European Union. The long-standing regulatory framework in the European Union, known as Solvency I, is in the process of being replaced by Solvency II. Quantitative Impact Studies are being carried out and it is expected that Solvency II will be implemented in all 27 countries of the European Union (including the United Kingdom)in 2016. Whereas Solvency I calculates capital only for underwriting risks, Solvency II will consider investment risks and operational risks as well.

Solvency II has many similarities to Basel II. There are three pillars. Pillar 1 is concerned with the calculation of capital requirements and the types of capital that are eligible. Pillar 2 is concerned with the supervisory review process. Pillar 3 is concerned with the disclosure of risk management information to the market. The three pillars are therefore analogous to the three pillars of Basel II.

Pillar 1 of Solvency II specifies a *minimum capital requirement* (MCR) and a *solvency capital requirement* (SCR). If its capital falls below the SCR level, an insurance company should, at minimum, deliver to the supervisor a plan to restore capital to above the SCR level. The supervisor might require the insurance company to take particular measures to correct the situation. The MCR is regarded as an absolute minimum level of capital. If capital drops below the MCR level, supervisors may prevent the insurance company from taking new business. It might force the insurance company into liquidation, transferring its policies to another company. The MCR will typically be between 25% and 45% of the SCR.

There are two ways to calculate the SCR: the standardized approach and the internal models approach. The internal models approach involves a VaR calculation with a one-year time horizon and a 99.5% confidence limit. (The confidence level is therefore less than the 99.9% confidence level used in Pillar 1 of Basel II.) Longer time horizons with lower confidence levels are also allowed when the protection provided is considered equivalent. The SCR involves a capital charge for investment risk, underwriting risk, and operational risk. Investment risk is subdivided into market risk and credit risk. Underwriting risk is subdivided into risk arising from life insurance, non-life insurance (i.e., property and casualty), and health insurance.

Capital should be adequate to deal with large adverse events. Examples of the events considered in quantitative impact studies are:

1. A 32% decrease in global stock markets
2. A 20% decrease in real estate prices
3. A 20% change in foreign exchange rates
4. Specified catastrophic risk scenarios affecting property and casualty payouts
5. Health care costs increasing by a factor times the historical standard deviation of costs
6. A 10% increase in mortality rates
7. A 25% decrease in mortality rates
8. A 10% increase in expenses

The internal models are required to satisfy three tests. The first is a statistical quality test. This is a test of the soundness of the data and methodology used in calculating VaR. The second is a calibration test. This is a test of whether risks have been

assessed in accordance with a common SCR target criterion. The third is a use test. This is a test of whether the model is genuinely relevant to and used by risk managers.

There are three types of capital in Solvency II. Tier 1 capital consists of equity capital, retained earnings, and other equivalent funding sources. Tier 2 capital consists of liabilities that are subordinated to policyholders and satisfy certain criteria concerning their availability in wind-down scenarios. Tier 3 capital consists of liabilities that are subordinated to policyholders and do not satisfy these criteria. Similarly to Basel II, the amount of capital that must be Tier 1, Tier 1 plus Tier 2, and Tier 1 plus Tier 2 plus Tier 3 is specified.

SUMMARY

This chapter has provided an overview of capital requirements for banks throughout the world. The way in which regulators calculate the minimum capital a bank is required to hold has changed dramatically since the 1980s. Prior to 1988, regulators determined capital requirements by specifying minimum ratios for capital to assets or maximum ratios for assets to capital. In the late 1980s, both bank supervisors and the banks themselves agreed that changes were necessary. Derivatives trading was increasing fast. Also banks were competing globally and it was considered important to create a level playing field by making regulations uniform throughout the world.

The 1988 Basel Accord assigned capital for credit risk for both on and off the balance sheet exposures. This involved calculating a risk-weighted asset for each item. The risk-weighted assets for an on-balance-sheet loan were calculated by multiplying the principal by a risk weight for the counterparty. In the case of derivatives such as swaps, banks were first required to calculate credit equivalent amounts. The risk-weighted assets were obtained by multiplying the credit equivalent amount by a risk weight for the counterparty. Banks were required to keep capital equal to 8% of the total risk-weighted assets. In 1995, the capital requirements for credit risk were modified to incorporate netting. As a result of an amendment introduced in 1996, the Accord was change to include a capital charge for market risk. Sophisticated banks could base the capital charge on a value-at-risk calculation.

Basel II was proposed in 1999 and implemented by many banks in about 2007. It led to no immediate change to the capital requirement for market risk. Credit risk capital was calculated in a more sophisticated way than previously to reflect either (a) the credit ratings of obligors or (b) estimates made by the bank in conjunction with a default correlation parameter specified by regulators. In addition, there was a capital charge for operational risk.

Solvency II is regulatory framework for insurance companies expected to be implemented by the European Union starting in 2016. It will prescribe minimum capital levels for investment risk, underwriting risk, and operational risk. The structure of Solvency II is broadly similar to Basel II.

FURTHER READING

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PRACTICE QUESTIONS AND PROBLEMS (ANSWERS AT END OF BOOK)

15.1 "When a steel company goes bankrupt, other companies in the same industry benefit because they have one less competitor. But when a bank goes bankrupt other banks do not necessarily benefit." Explain this statement.

15.2 "The existence of deposit insurance makes it particularly important for there to be regulations on the amount of capital banks hold." Explain this statement.

15.3 An interest rate swap involves the exchange of a fixed rate of interest for a floating rate of interest with both being applied to the same principal. The principals are not exchanged. What is the nature of the credit risk for a bank when it enters into a five-year interest rate swap with a notional principal of $100 million? Assume the swap is worth zero initially.

15.4 In a currency swap, interest on a principal in one currency is exchanged for interest on a principal in another currency. The principals in the two currencies are exchanged at the end of the life of the swap. Why is the credit risk on a currency swap greater than that on an interest rate swap?

15.5 A four-year interest rate swap currently has a negative value to a financial institution. Is the financial institution exposed to credit risk on the transaction? Explain your answer. How would the capital requirement be calculated under Basel I?

15.6 Estimate the capital required under Basel I for a bank that has the following transactions with a corporation. Assume no netting.
(a) A nine-year interest rate swap with a notional principal of $250 million and a current market value of −$2 million.
(b) A four-year interest rate swap with a notional principal of $100 million and a current value of $3.5 million.
(c) A six-month derivative on a commodity with a principal of $50 million that is currently worth $1 million.

15.7 What is the capital required in Problem 15.6 under Basel I assuming that the 1995 netting amendment applies?

15.8 All the derivatives transactions a bank has with a corporate client have a positive value to the bank. What is the value to the bank of netting provisions in its master agreement with the client?

15.9 Explain why the final stage in the Basel II calculations for credit risk (IRB), market risk, and operational risk is to multiply by 12.5.

15.10 What is the difference between the trading book and the banking book for a bank? A bank currently has a loan of $10 million to a corporate client. At the

end of the life of the loan, the client would like to sell debt securities to the bank instead of borrowing. How does this potentially affect the nature of the bank's regulatory capital calculations?

15.11 Under Basel I, banks do not like lending to highly creditworthy companies and prefer to help them issue debt securities. Why is this? Do you think this changed as a result of Basel II?

15.12 Banks sometimes use what is referred to as regulatory arbitrage to reduce their capital. What do you think this means?

15.13 Equation (15.9) gives the formula for the capital required under Basel II. It involves four terms being multiplied together. Explain each of these terms.

15.14 Explain the difference between the simple and the comprehensive approach for adjusting capital requirements for collateral.

15.15 Explain the difference between the standardized approach, the IRB approach, and the advanced IRB approach for calculating credit risk capital under Basel II.

15.16 Explain the difference between the basic indicator approach, the standardized approach, and the advanced measurement approach for calculating operational risk capital under Basel II.

15.17 Suppose that the assets of a bank consist of $200 million of retail loans (not mortgages). The PD is 1% and the LGD is 70%. What is the risk-weighted assets under the Basel II IRB approach? What are the Tier 1 and Tier 2 capital requirements?

15.18 Section 12.10 discusses how statistics can be used to accept or reject a VaR model. Section 15.6 discusses guidelines for bank supervisors in setting the VaR multiplier m_c. It explains that, if the number of exceptions in 250 trials is five or more, then m_c is increased. What is the chance of five or more exceptions if the VaR model is working well?

FURTHER QUESTIONS

15.19 Why is there an add-on amount in Basel I for derivatives transactions? "Basel I could be improved if the add-on amount for a derivatives transaction depended on the value of the transaction." How would you argue this viewpoint?

15.20 Estimate the capital required under Basel I for a bank that has the following transactions with another bank. Assume no netting.

(a) A two-year forward contract on a foreign currency, currently worth $2 million, to buy foreign currency worth $50 million

(b) A long position in a six-month option on the S&P 500. The principal is $20 million and the current value is $4 million.

(c) A two-year swap involving oil. The principal is $30 million and the current value of the swap is –$5 million.

What difference does it make if the netting amendment applies?

15.21 A bank has the following transaction with a AA-rated corporation

(a) A two-year interest rate swap with a principal of $100 million that is worth $3 million

(b) A nine-month foreign exchange forward contract with a principal of \$150 million that is worth –\$5 million

(c) A long position in a six-month option on gold with a principal of \$50 million that is worth \$7 million

What is the capital requirement under Basel I if there is no netting? What difference does it make if the netting amendment applies? What is the capital required under Basel II when the standardized approach is used?

15.22 Suppose that the assets of a bank consist of \$500 million of loans to BBB-rated corporations. The PD for the corporations is estimated as 0.3%. The average maturity is three years and the LGD is 60%. What is the total risk-weighted assets for credit risk under the Basel II IRB approach? How much Tier 1 and Tier 2 capital is required? How does this compare with the capital required under the Basel II standardized approach and under Basel I?

CHAPTER 16

Basel II.5, Basel III, and Other Post-Crisis Changes

It was perhaps unfortunate for Basel II that its implementation date coincided, at least approximately, with the start of the worst crisis that financial markets had experienced since the 1930s. Some commentators have blamed Basel II for the crisis. They point out that it was a move toward self-regulation where banks, when calculating regulatory capital, had the freedom to use their own estimates of model inputs such as PD, LGD, and EAD. In fact, as explained in Chapter 6, the seeds of the crisis were sown well before Basel II was implemented.[1]

This chapter starts by discussing what has become known as Basel II.5. This is a collection of changes to the calculation of market risk capital that was put in place by the Basel Committee on Banking Supervision following the large losses experienced by banks during the crisis. The implementation date for Basel II.5 was December 31, 2011.

The chapter then moves on to consider Basel III, which was a major overhaul of bank regulations, published by the Basel Committee in December 2010. Basel III includes a series of rules concerned with increasing the amount of capital that banks have to keep for credit risk and tightening the definition of capital. An important new feature of Basel III is the specification of liquidity requirements that must be met by banks. Basel III is being phased in over several years. Full implementation is expected to be complete by 2019.

The chapter also discusses other regulations that have been introduced since the 2008 crisis to complement the work of the Basel Committee. These include the Dodd–Frank Act, which was signed into law by President Barack Obama in the United States on July 21, 2010, and rules introduced in the European Union and the United Kingdom.

16.1 BASEL II.5

During the credit crisis, it was recognized that some changes were necessary to the calculation of capital for market risk. These changes are referred to as Basel II.5 and,

[1] Also, the United States was behind other countries in implementing Basel II. If Basel II had been fully implemented by the start of the crisis, capital levels at U.S. banks would probably have been lower.

as already mentioned, the implementation date for them was December 31, 2011.[2] There are three changes involving:

1. The calculation of a stressed VaR;
2. A new incremental risk charge; and
3. A comprehensive risk measure for instruments dependent on credit correlation.

The measures have the effect of greatly increasing the market risk capital that large banks are required to hold.

Stressed VaR

The 1996 Amendment to Basel I, where capital was first required for market risk, allowed banks to base capital on a 10-day 99% VaR measure. Most banks use historical simulation to calculate VaR. This is described in Chapter 13. When banks calculated market risk capital prior to using the rules introduced in 1996, the assumption underlying historical simulation was that the percentage changes in market variables during the following day would be a random sample from their percentage daily changes observed during the previous one to four years. The 2003–2006 period was one where the volatilities of most market variables was low. As a result, the market risk VaRs calculated during this period for regulatory capital purposes were also low. Furthermore, the VaRs continued to be too low for a period of time after the onset of the crisis, because much of the data used to calculate them continued to come from a low-volatility period.

This led the Basel Committee to introduce what has become known as a "stressed VaR" measure. As explained in Section 13.1, stressed VaR is determined by basing calculations on how market variables moved during a 250-day (12-month) period of stressed market conditions, rather than on how they moved during the past one to four years. The historical simulation calculations to arrive at a stressed VaR measure assume that the percentage changes in market variables during the next day are a random sample from their percentage daily changes observed during the 250-day period of stressed market conditions.

Basel II.5 requires banks to calculate two VaRs. One is the usual VaR (based on the previous one to four years of market movements). The other is stressed VaR (calculated from a stressed period of 250 days). The two VaR measures are combined to calculate a total capital charge. The formula for the total capital charge is

$$\max(\mathrm{VaR}_{t-1}, m_c \times \mathrm{VaR}_{\mathrm{avg}}) + \max(\mathrm{sVaR}_{t-1}, m_s \times \mathrm{sVaR}_{\mathrm{avg}})$$

where VaR_{t-1} and sVaR_{t-1} are the VaR and stressed VaR (with a 10-day time horizon and a 99% confidence level) calculated on the previous day. The variables $\mathrm{VaR}_{\mathrm{avg}}$ and $\mathrm{sVaR}_{\mathrm{avg}}$ are the average of VaR and stressed VaR (again with a 10-day time horizon and a 99% confidence level) calculated over the previous 60 days. The parameters m_s and m_c are multiplicative factors that are determined by bank supervisors and

[2] See Basel Committee on Bank Supervision, "Revisions to the Basel II Market Risk Framework," February 2011.

are at minimum equal to three. As explained in Section 15.6, the capital requirement prior to Basel II.5 was

$$\max(\mathrm{VaR}_{t-1}, m_c \times \mathrm{VaR}_{\mathrm{avg}})$$

Because stressed VaR is always at least as great as VaR, the formula shows that (assuming $m_c = m_s$) the impact of this new rule is to at least double the capital requirement.

Originally it was considered that 2008 would constitute a good one-year period for the calculation of stressed VaR. Later it was realized that the one-year period chosen should reflect a bank's portfolio. A bank is now required to search for a one-year period that would be particularly stressful for its current portfolio. The stressed period used by one bank is therefore not necessarily the same as that used by another bank.

Incremental Risk Charge

In 2005, the Basel Committee became concerned that exposures in the trading book were attracting less capital than similar exposures in the banking book. Consider a bond. If held in the trading book, the capital would be calculated by applying a multiplier to the 10-day 99% VaR, as discussed in Section 15.6. If held in the banking book (and treated like a loan), capital for the bond would be calculated using VaR with a one-year time horizon and a 99.9% confidence level, as discussed in Section 15.8. The trading-book calculation usually gave rise to a much lower capital charge than the banking-book calculation. As a result, banks tended whenever possible to hold credit-dependent instruments in the trading book.[3]

Regulators proposed an incremental default risk charge (IDRC) in 2005 that would be calculated with a 99.9% confidence level and a one-year time horizon for instruments in the trading book that were sensitive to default risk. The effect of this would have been that the capital requirement for these instruments equaled the maximum of the capital using trading book calculations and the capital using banking book calculations. In 2008, the Basel Committee recognized that most of the losses in the credit market turmoil of 2007 and 2008 were from changes in credit ratings, widening of credit spreads, and loss of liquidity, rather than solely as a result of defaults. It therefore amended its previous proposals to reflect this and the IDRC became the incremental risk charge (IRC).[4]

The IRC requires banks to calculate a one-year 99.9% VaR for losses from credit sensitive products in the trading book taking both credit rating changes and defaults into account. Like the IDRC, the aim was to set capital equal to the maximum of that obtained using trading book calculations and that obtained using banking book

[3] If a bank created ABSs from loans in the banking book, as described in Chapter 6, and then bought all the resultant tranches for its trading book, regulatory capital requirements would be lowered even though the bank's risks would be unchanged. This was one reason why banks wanted to securitize loans in the banking book.

[4] Basel Committee on Banking Supervision, "Guidelines for Computing Capital for Incremental Risk in the Trading Book," July 2009.

TABLE 16.1 Standardized Capital Charge for Correlation-Dependent Instruments

External Credit Assessment	AAA to AA–	A+ to A–	BBB+ to BBB–	BB+ to BB–	Below BB– or Unrated
Securitizations	1.6%	4%	8%	28%	Deduction
Resecuritizations	3.2%	8%	18%	52%	Deduction

calculations. Because the instruments subject to the IRC are in the trading book, it is assumed that a bank will have the opportunity to rebalance its portfolio during the course of the year so that default risk is mitigated. Banks are therefore required to estimate a liquidity horizon for each instrument subject to the IRC. The liquidity horizon represents the time required to sell the position or to hedge all material risks in a stressed market.

Suppose that the liquidity horizon for a bond with a credit rating of A is three months. For the purposes of the calculation of VaR over a one-year time horizon, the bank assumes that at the end of three months, if the bond's rating has changed or if it has defaulted, it is replaced by an A-rated bond similar to that held at the beginning of the period. The same thing happens at the end of six months and at the end of nine months. This is known as the *constant level of risk* assumption.

The impact of the constant level of risk assumption is that it is less likely that there will be a default. Instead, small losses are realized from ratings downgrades when rebalancing takes place. The assumption typically has the effect of reducing the one-year 99.9% VaR.[5] The minimum liquidity horizon for IRC is specified by the Basel Committee as three months.

The IRC therefore provides a measure of the default and credit migration risks of credit products over a one-year horizon at a 99.9% confidence level, taking into account the liquidity horizons of individual positions or sets of positions.

The Comprehensive Risk Measure

The comprehensive risk measure (CRM) is designed to take account of risks in what is known as the correlation book. This is the portfolio of instruments such as asset-backed securities (ABSs) and collateralized debt obligations (CDOs) that are sensitive to the correlation between the default risks of different assets. These instruments were discussed in Chapter 6. Suppose a bank has a AAA-rated tranche of an ABS. In the normal market environment, there is very little risk of losses from the tranche. However, in stressed market environments when correlations increase, the tranche is vulnerable—as became apparent during the 2007–2009 crisis.

The CRM is a single capital charge replacing the incremental risk charge and the specific risk charge for instruments dependent on credit correlation. The Basel II.5 standardized approach for calculating the CRM is summarized in Table 16.1. Given the experience of the securitization market during the crisis (see Chapter 6), it is not surprising that capital charges are higher for resecuritizations (e.g., ABS CDOs)

[5] See C. Finger, "CreditMetrics and Constant Level of Risk," MSCI, 2010, for a discussion of the constant level of risk assumption.

than for securitizations (e.g., ABSs). A deduction means than the principal amount is subtracted from capital, which is equivalent to a 100% capital charge.

Basel II.5 allows banks, with supervisory approval, to use their internal models to calculate the CRM. The models developed by banks have to be quite sophisticated to be approved by bank supervisors. For example, they must capture the cumulative impact of multiple defaults, credit spread risk, the volatility of implied correlations, the relationship between credit spreads and implied correlations, recovery rate volatility, the risk of hedge slippage, and potential hedge rebalancing costs. A routine and rigorous program of stress testing is also required. The capital charge calculated from an internal model is subject to a floor calculated from the capital given by the standardized approach.

New rules on capital charges for exposures arising from securitizations come into effect in January 2018. These involve less reliance on external ratings.

16.2 BASEL III

Following the 2007–2009 credit crisis, the Basel Committee realized that a major overhaul of Basel II was necessary. Basel II.5 increased capital requirements for market risk. The Basel Committee wanted to increase capital requirements for credit risk as well. In addition, it considered that the definition of capital needed to be tightened and that regulations were needed to address liquidity risk.

Basel III proposals were first published in December 2009. Following comments from banks, a quantitative impact study, and a number of international summits, the final version of the regulations was published in December 2010.[6] There are six parts to the regulations:

1. Capital Definition and Requirements
2. Capital Conservation Buffer
3. Countercyclical Buffer
4. Leverage Ratio
5. Liquidity Risk
6. Counterparty Credit Risk

The regulations are being implemented gradually between 2013 and 2019.

Capital Definition and Requirements

Under Basel III, a bank's total capital consists of:

1. Tier 1 equity capital
2. Additional Tier 1 capital
3. Tier 2 capital

There is no Tier 3 capital.

[6] See Basel Committee for Bank Supervision, "Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems," June 2011, and Basel Committee for Bank Supervision, "Basel III: International Framework for Liquidity Risk Measurement Standards and Monitoring," December 2010.

Tier 1 equity capital (also referred to as core Tier 1 capital) includes share capital and retained earnings but does not include goodwill or deferred tax assets. It must be adjusted downward to reflect defined benefit pension plan deficits but is not adjusted upward to reflect defined benefit plan surpluses. (See Section 3.12 for a discussion of defined benefit plans.) Changes in retained earnings arising from securitized transactions are not counted as part of capital for regulatory purposes. The same is true of changes in retained earnings arising from the bank's own credit risk. (The latter is referred to as DVA and will be discussed in Chapter 20.) There are rules relating to the inclusion of minority interests and capital issued by consolidated subsidiaries. The additional Tier 1 capital category consists of items, such as non-cumulative preferred stock, that were previously Tier 1 but are not common equity. Tier 2 capital includes debt that is subordinated to depositors with an original maturity of five years.

Common equity is referred to by the Basel Committee as "going-concern capital." When the bank is a going concern (i.e., has positive equity capital), common equity absorbs losses. Tier 2 capital is referred to as "gone-concern capital." When the bank is no longer a going concern (i.e., has negative capital), losses have to be absorbed by Tier 2 capital. Tier 2 capital ranks below depositors in a liquidation. While Tier 2 capital remains positive, depositors should in theory be repaid in full.

The capital requirements are as follows:

1. Tier 1 equity capital must be at least 4.5% of risk-weighted assets at all times.
2. Total Tier 1 capital (Tier 1 equity capital plus additional Tier 1 capital) must be at 6% of risk-weighted assets at all times.
3. Total capital (total Tier 1 plus Tier 2) must be at least 8% of risk-weighted assets at all times.

Basel I required Tier 1 equity capital to be at least 2% of risk-weighted assets and total Tier 1 capital to be at least 4% of risk-weighted assets. The Basel III rules are much more demanding because (a) these percentages have been increased and (b) the definition of what qualifies as equity capital for regulatory purposes has been tightened. However, the Tier 1 plus Tier 2 requirement is the same as under Basel I and Basel II.

The transitional arrangements were that Tier 1 equity capital and total Tier 1 capital must be 3.5% and 4.5%, respectively, by January 1, 2013. They must be 4% and 5.5%, respectively, by January 1, 2014. The new capital levels must be in place by January 1, 2015. The new rules for the definition of what constitutes capital are being phased in over a longer period stretching until January 1, 2018.

The Basel Committee also calls for more capital for "systemically important" banks as will be discussed later in this chapter.

Capital Conservation Buffer

In addition to the capital requirements just mentioned, Basel III requires a capital conservation buffer in normal times consisting of a further amount of core Tier 1 equity capital equal to 2.5% of risk-weighted assets. This provision is designed to ensure that banks build up capital during normal times so that it can be run down when losses are incurred during periods of financial difficulties. (The argument in favor of

TABLE 16.2 Dividend Restrictions Arising from the Capital Conservation Buffer

Tier 1 Equity Capital Ratio	Minimum Percent of Earnings Retained
4.000% to 5.125%	100%
5.125% to 5.750%	80%
5.750% to 6.375%	60%
6.375% to 7.000%	40%
>7%	0%

this is that it is much easier for banks to raise capital during normal times than during periods of stressed market conditions.) In circumstances where the capital conservation buffer has been wholly or partially used up, banks are required to constrain their dividends until the capital has been replenished. The dividend rules are summarized in Table 16.2. For example, if Tier 1 equity capital is 5.5% of risk-weighted assets, the minimum retained earnings is 80% so that the maximum dividends as a percent of retained earnings is 20%. The difference between the 4.5% basic equity capital requirement and the 7.0% equity capital requirement that includes the capital conservation buffer is in some ways analogous to the difference between the MCR and SCR in Solvency II. (see Section 15.12.)

The capital conservation buffer means that the Tier 1 equity capital that banks are required to keep in normal times (excluding any extra capital required for systemically important banks) is 7% of risk-weighted assets; total Tier 1 capital is required to be at least 8.5% of risk-weighted assets; Tier 1 plus Tier 2 capital is required to be at least 10.5% of risk-weighted assets. These numbers can decline to 4.5%, 6%, and 8% in stressed market conditions (because of losses), but banks are then under pressure to bring capital back up to the required levels. One of the consequences of the increased equity capital requirement is that banks may find it difficult to achieve the returns on equity that they had during the 1990 to 2006 period. However, bank shareholders can console themselves that bank stock is less risky as a result of the extra capital.

The capital conservation buffer requirement is being phased in between January 1, 2016, and January 1, 2019.

Countercyclical Buffer

In addition to the capital conservation buffer, Basel III has specified a countercyclical buffer. This is similar to the capital conservation buffer, but the extent to which it is implemented in a particular country is left to the discretion of national authorities. The buffer is intended to provide protection for the cyclicality of bank earnings. The buffer can be set to between 0% and 2.5% of total risk-weighted assets and must be met with Tier 1 equity capital.

For jurisdictions where the countercyclical buffer is non-zero, Table 16.2 is modified. For example, when the countercyclical buffer is set at its maximum level of 2.5%, it is replaced by Table 16.3. Like the capital conservation buffer, the countercyclical buffer requirements will be phased in between January 1, 2016, and January 1, 2019.

TABLE 16.3 Dividend Restrictions Arising from the Capital Conservation Buffer and 2.5% Countercyclical Buffer

Tier 1 Equity Capital Ratio	Minimum Percent of Earnings Retained
4.50% to 5.75%	100%
5.75% to 7.00%	80%
7.00% to 8.25%	60%
8.25% to 9.50%	40%
>9.50%	0%

Leverage Ratio

In addition to the capital requirements based on risk-weighted assets, Basel III specifies a minimum leverage ratio of 3%.[7] The leverage ratio is the ratio of a capital measure to an exposure measure. The capital measure is total Tier 1 capital. The exposure measure is the sum of (a) on-balance-sheet exposures, (b) derivatives exposures, (c) securities financing transaction exposures, and (d) off-balance-sheet items. No risk-weighting adjustments are made. The on-balance-sheet exposures include all assets on the balance sheet. Derivatives exposures are calculated as "replacement cost plus add-on" similarly to the way they are calculated under Basel I (see Section 15.3). Securities financing transaction exposures include transactions such as repurchase agreements and security lending/borrowing when the transaction does not lead to balance sheet assets. Off-balance-sheet items include loan commitments, loan substitutes, acceptances, and letters of credit.

The definitions of both capital and exposure may change as the Basel Committee collects data on the application of the leverage ratio from banks. The 3% minimum level for the ratio may also change. Indeed, in April 2014 regulators in the United States indicated that they regarded 3% as too low. They proposed rules requiring a 5% leverage ratio for eight large bank holding companies (which, as we will explain, are known as G-SIBs), and 6% for the FDIC-insured subsidiaries of these bank holding companies. In October 2014, the Bank of England's Financial Policy Committee increased the leverage ratio for UK banks to 4.05%, a level that could be increased to 4.95% in boom times to rein in excessive lending.

Why did the Basel Committee introduce the leverage ratio? The reason is that regulators thought that banks had too much discretion in the way risk-weighted assets were calculated. They have far less discretion in the way "total exposure" is calculated. It should be emphasized that this does not mean that regulators are discarding capital requirements based on risk-weighted assets. They require banks to satisfy both (a) the ratios of capital to risk-weighted assets mentioned earlier in this chapter and (b) the ratio of capital to non-risk-weighted exposure leverage requirement explained here.

How successful the leverage ratio will be and how it influences the risks taken by banks remain to be seen. Proponents of the leverage ratio would argue that the

[7] See Bank for International Settlements, "Basel III Leverage Ratio Framework and Disclosure Requirements," January 2014.

rules for determining risk-weighted assets have become too complicated, creating an impossible problem for bank supervisors, and that it is necessary to introduce a ratio similar to that used pre-1988 (see Section 15.2). Opponents would argue that the leverage ratio encourages banks to hold risky assets, becoming more likely to fail. The leverage ratio is scheduled to be introduced on January 1, 2018, after a transition period.

Liquidity Risk

Prior to the crisis, the focus of the Basel regulations had been on ensuring that banks had sufficient capital for the risks they were taking. It turned out that many of the problems encountered by financial institutions during the crisis were not as a result of shortage of capital. They were instead a result of liquidity risks taken by the banks.

Liquidity risks arise because there is a tendency for banks to finance long-term needs with short-term funding, such as commercial paper. Provided the bank is perceived by the market to be financially healthy, this is usually not a problem.[8] Suppose that a bank uses 90-day commercial paper to fund its activities. When one 90-day issue of commercial paper matures, the bank refinances with a new issue; when the new issue matures, it refinances with another issue; and so on. However, as soon as the bank experiences financial difficulties—or is thought to be experiencing financial difficulties—it is liable to become impossible for the bank to roll over its commercial paper. This type of problem led to the demise to Northern Rock in the United Kingdom and Lehman Brothers in the United States.

Basel III has introduced requirements involving two liquidity ratios that are designed to ensure that banks can survive liquidity pressures. The ratios are:

1. Liquidity Coverage Ratio (LCR); and
2. Net Stable Funding Ratio (NSFR)

The LCR focuses on a bank's ability to survive a 30-day period of liquidity disruptions. It is defined as:

$$\frac{\text{High-Quality Liquid Assets}}{\text{Net Cash Outflows in a 30-Day Period}}$$

The 30-day period considered in the calculation of this ratio is one of acute stress involving a downgrade of the bank's debt by three notches (e.g., from AA– to A–), a partial loss of deposits, a complete loss of wholesale funding, increased haircuts on secured funding (so that instruments posted as collateral are not valued as highly), and drawdowns on lines of credit. The Basel III regulations require the ratio to be greater than 100% so that the bank's liquid assets are sufficient to survive these pressures.

[8] If the funds are being used to finance long-term fixed-rate loans and interest rates rise, net interest margins are squeezed. But this risk can be hedged with instruments such as interest rate swaps (see Section 5.6).

TABLE 16.4 ASF Factors for Net Stable Funding Ratio

ASF Factor	Category
100%	Tier 1 and Tier 2 capital
	Preferred stock and borrowing with a remaining maturity greater than one year
90%	"Stable" demand deposits and term deposits with remaining maturity less than one year provided by retail or small business customers
80%	"Less Stable" demand deposits and term deposits with remaining maturity less than one year provided by retail or small business customers
50%	Wholesale demand deposits and term deposits with remaining maturity less than one year provided by non-financial corporates, sovereigns, central banks, multilateral development banks, and public sector entities
0%	All other liability and equity categories

The NSFR focuses on liquidity management over a period of one year. It is defined as

$$\frac{\text{Amount of Stable Funding}}{\text{Required Amount of Stable Funding}}$$

The numerator is calculated by multiplying each category of funding (capital, wholesale deposits, retail deposits, etc.) by an available stable funding (ASF) factor, reflecting their stability. As shown in Table 16.4, the ASF for wholesale deposits is less than that for retail deposits, which in turn is than that for Tier 1 or Tier 2 capital. The denominator is calculated from the items requiring funding. Each category of these is multiplied by a required stable funding (RSF) factor to reflect the permanence of the funding required. Some of the applicable factors are indicated in Table 16.5.

TABLE 16.5 RSF Factors for Net Stable Funding Ratio

RSF Factor	Category
0%	Cash
	Short-term instruments, securities, loans to financial entities if they have a residual maturity of less than one year
5%	Marketable securities with a residual maturity greater than one year if they are claims on sovereign governments or similar bodies with a 0% risk weight
20%	Corporate bonds with a rating of AA– or higher and a residual maturity greater than one year
	Claims on sovereign governments or similar bodies with a risk weight of 20%
50%	Gold, equity securities, bonds rated A+ to A–
65%	Residential mortgages
85%	Loans to retail and small business customers with a remaining maturity less than one year
100%	All other assets

Basel III requires the NSFR to be greater than 100% so that the calculated amount of stable funding is greater than the calculated required amount of stable funding.

EXAMPLE 16.1

A bank has the following balance sheet:

Cash	5	Retail Deposits (stable)	40
Treasury Bonds (> 1 yr)	5	Wholesale Deposits	48
Mortgages	20	Tier 2 Capital	4
Small Business Loans	60	Tier 1 Capital	8
Fixed Assets	10		
	100		100

The Amount of Stable Funding is

$$40 \times 0.9 + 48 \times 0.5 + 4 \times 1.0 + 8 \times 1.0 = 72$$

The Required Amount of Stable Funding is

$$5 \times 0 + 5 \times 0.05 + 20 \times 0.65 + 60 \times 0.85 + 10 \times 1.0 = 74.25$$

The NSFR is therefore

$$\frac{72}{74.25} = 0.970$$

or 97.0%. The bank does not therefore satisfy the NSFR requirement.

The new rules are tough and have the potential to dramatically change bank balance sheets. It was estimated in September 2014 that the rules will require U.S. banks to hold an extra $100 billion of liquid assets. The LCR requirement is scheduled by the Basel Committee to be implemented in stages between January 1, 2015, and January 1, 2019 (but regulators in the United States require full implementation by January 1, 2017). The NSFR requirement is scheduled to be implemented on January 1, 2018.

Counterparty Credit Risk

For each of its derivatives counterparties, a bank calculates a quantity known as the *credit value adjustment* (CVA). This is the expected loss because of the possibility of a default by the counterparty. The way in which the calculation of CVA is carried out is described in Chapter 20. Reported profit is reduced by the total of the CVAs for all counterparties.

As we will see in Chapter 20, the CVA for a counterparty can change because either (a) the market variables underlying the value of the derivatives entered into with the counterparty change or (b) the credit spreads applicable to the counterparty's borrowing change. Basel III requires the CVA risk arising from changing credit

spreads to be a component of market risk capital. As will be explained in Chapter 20, once CVA has been calculated, it is a relatively simple matter to calculate the delta and gamma with respect to a parallel shift in the term structure of the counterparty's credit spread. These can be used to calculate appropriate market risk measures.

G-SIBs, SIFIs, and D-SIBs

Regulators are particularly concerned that large, systemically important financial institutions keep sufficient capital to avoid a repeat of the government bailouts during the 2007 to 2009 credit crisis.

The term G-SIB stands for global systemically important bank, whereas the term SIFI (systemically important financial institution) is used to describe both banks and nonbanks that are considered to be systemically important. The popular view of SIFIs is that they are "too big to fail," and have been identified as the financial institutions that will have to be bailed out if they run into financial difficulties.

The systemic importance of a bank or other financial institution depends on the effect that its failure could have on the global financial system. This in turn depends on the nature of its activities and the contracts it has entered into with other financial institutions globally. The Basel Committee uses a scoring methodology to determine which banks are G-SIBs. Other approaches involving network theory have been attempted by some researchers.

In 2013, the Basel Committee published the final version of rules that call for more Tier 1 equity capital for G-SIBs.[9] G-SIBs are categorized according to whether the extra equity capital is 1%, 1.5%, 2%, 2.5%, or 3.5% of risk-weighted assets. The new rules take effect in January 2016.

A list of G-SIBs is published by the Financial Stability Board annually. In November 2014 the list included 30 banks. Of these, 18 were in the 1% category, six were in the 1.5% category, four were in the 2% category, and two (HSBC and JPMorgan Chase) were in the 2.5% category. None were in the 3.5% category. G-SIBs are required to keep a baseline amount of Tier 1 equity capital equal to 4.5% of risk-weighted assets plus a further 2.5% for the capital conservation buffer plus the additional amount we have just mentioned. In the case of HSBC and JPMorgan Chase the total equity capital therefore amounts to $4.5 + 2.5 + 2.5 = 9.5\%$ of risk-weighted assets. These calculations do not include extra capital requirements required by national supervisors, such as the countercyclical buffer.

In November 2014 the Financial Stability Board issued proposals concerning the total loss-absorbing capacity (TLAC) of G-SIBs. The proposals were developed in consultation with the Basel Committee for Banking Supervision and were in response to a call by G20 leaders at the 2013 St. Petersburg Summit. The proposals require total capital (including equity, debt and other eligible liabilities, but excluding capital buffers) to be between 16% and 20% of risk-weighted assets and at least twice the Basel III Tier 1 leverage ratio requirements.

[9] See Basel Committee on Banking Supervision, "Global Systemically Important Banks: Updated Assessment Methodology and the Higher Loss Absorbancy Requirement," July 2013.

Some countries are requiring greater capital than the minimums set by the Basel Committee and the Financial Stability Board or are implementing the rules earlier than required. An example of a country requiring that its banks hold high amounts of capital is Switzerland, which has two G-SIBs (UBS and Credit Swiss). The high capital requirements are understandable because the banks are large in relation to the Swiss economy, so that a failure of either of them would be catastrophic.

National regulators designate some banks that have not been classified as G-SIBs as domestic systemically important banks (D-SIBs). These banks may be subject to capital requirements higher than the minimum, extra disclosure requirements, or (see Chapter 22) stringent stress tests. In the United States in 2014, eight banks (Bank of America, Bank of New York Mellon, Citigroup, Goldman Sachs, JPMorgan Chase, Morgan Stanley, State Street, and Wells Fargo) were designated as G-SIBs and all other banks with assets over $50 billion (22 banks in total) were designated as D-SIBs.

16.3 CONTINGENT CONVERTIBLE BONDS

An interesting development in the capitalization of banks has been what are known as *contingent convertible bonds* (CoCos). Traditionally, convertible bonds have been bonds issued by a company where, in certain circumstances, the holder can choose to convert them into equity at a predetermined exchange ratio. Typically the bond holder chooses to convert when the company is doing well and the stock price is high. CoCos are different in that they automatically get converted into equity when certain conditions are satisfied. Typically, these conditions are satisfied when the company is experiencing financial difficulties.

CoCos are attractive to banks because in normal times the bonds are debt and allow the bank to report a relatively high return on equity. When the bank experiences financial difficulties and incurs losses, the bonds are converted into equity and the bank is able to continue to maintain an equity cushion and avoid insolvency. From the point of view of regulators, CoCos are potentially attractive because they avoid the need for a bailout. Indeed, the conversion of CoCos is sometimes referred to as a "bail-in." New equity for the financial institution is provided from within by private sector bondholders rather than from outside by the public sector.

A key issue in the design of CoCos is the specification of the trigger that forces conversion and the way that the exchange ratio (number of shares received in exchange for one bond) is set. A popular trigger in the bonds issued so far is the ratio of Tier 1 equity capital to risk-weighted assets. Another possible trigger is the ratio of the market value of equity to book value of assets.

Lloyd's Banking Group, Rabobank Nederlands, and Credit Suisse were among the first banks to issue CoCos. Business Snapshot 16.1 provides a description of the bonds issued by Credit Suisse in 2011. These bonds get converted into equity if either Tier 1 equity capital falls below 7% of risk-weighted assets or the Swiss bank regulators determine that the bank requires public sector support. It has been estimated that over $1 trillion of CoCos will be issued by banks during the decade beginning 2010 as they respond to the new Basel III regulatory requirements on capital adequacy.

BUSINESS SNAPSHOT 16.1

Credit Suisse's CoCo Bond Issues

On February 14, 2011, Credit Suisse announced that it had agreed to exchange $6.2 billion of existing investments by two Middle Eastern investors, Qatar Holding LLC and the Olayan Group LLC, for CoCo bonds. The bonds automatically convert into equity if either of the following two conditions are satisfied:

1. The Tier 1 equity capital of Credit Suisse falls below 7% of risk-weighted assets.
2. The Swiss bank regulator determines that Credit Suisse requires public sector support to prevent it from becoming insolvent.

Credit Suisse followed this announcement on February 17, 2011, with a public issue of $2 billion of CoCos. These securities have similar terms to ones held to the Middle Eastern investors and were rated BBB+ by Fitch. They mature in 2041 and can be called any time after August 2015. The coupon is 7.875%. Any concerns that the market had no appetite for CoCos were alleviated by this issue. It was 11 times oversubscribed.

Credit Suisse indicated that it plans to satisfy one-third of the non-equity capital requirement with bonds similar to those just described and two-thirds of the non-equity capital requirement with bonds where the conversion trigger is about 5% (rather than 7%) of risk-weighted assets.

CoCos (prior to conversion) qualify as additional Tier 1 capital if the trigger, defined in terms of the ratio of Tier 1 equity capital to risk-weighted assets, is set at 5.125% or higher. Otherwise they qualify as Tier 2 capital.

16.4 DODD–FRANK ACT

The Dodd–Frank Act in the United States was signed into law in July 2010. Its aim is to prevent future bailouts of financial institutions and protect the consumer. A summary of the main regulations is as follows:

1. Two new bodies, the Financial Stability Oversight Council (FSOC) and the Office of Financial Research (OFR), were created to monitor systemic risk and research the state of the economy. Their tasks are to identify risks to the financial stability of the United States, promote market discipline, and maintain investor confidence.
2. The orderly liquidation powers of the Federal Deposit Insurance Corporation (FDIC) were expanded. The Office of Thrift Supervision was eliminated.
3. The amount of deposits insured by the FDIC was increased permanently to $250,000. (Previously, the $250,000 limit had been regarded as temporary.)

4. Regulations were introduced requiring large hedge funds and similar financial intermediaries to register with the SEC and report on their activities.
5. A Federal Insurance Office was created to monitor all aspects of the insurance industry and work with state regulators.
6. Proprietary trading and other similar activities of deposit-taking institutions were curtailed. This is known as the "Volcker rule" because it was proposed by former Federal Reserve chairman Paul Volcker.
7. Some high-risk trading operations were required to be spun off into separately capitalized affiliates.
8. Standardized over-the-counter derivatives must be traded on electronic platforms known as swap execution facilities (SEFs). These are similar to exchanges and will, it is hoped, make prices in the OTC market more transparent. Standardized over-the-counter derivatives between financial institutions must be cleared by central clearing parties (CCPs) (See Chapter 18 for a further discussion of CCPs.) The Commodity Futures Trading Commission (CFTC) was given responsibility for monitoring the activities of CCPs and SEFs.
9. The Federal Reserve was required to set risk management standards for systemically important financial utilities engaged in activities such as payment, settlement, and clearing.
10. Protection for investors was increased and improvements were made to the regulation of securities.
11. Rating agencies were required to make the assumptions and methodologies behind their ratings more transparent and the potential legal liabilities of rating agencies were increased. An Office of Credit Ratings was created at the SEC to provide oversight of rating agencies.
12. The use of external credit ratings in the regulation of financial institutions was discontinued. (This provision of the Act brings Dodd–Frank into direct conflict with the Basel Committee, which, as we have seen in this chapter and the last one, does make some use of external credit ratings.)
13. A Bureau of Financial Protection was created within the Federal Reserve to ensure that consumers get clear and accurate information when they shop for financial products, such as mortgages and credit cards.
14. Issuers of securitized products were required (with some exceptions) to keep 5% of each product created.
15. Federal bank regulators were required to issue regulations that discourage the use of compensation arrangements that might lead to excessive risk taking (e.g., compensation arrangements based on short-run performance). Shareholders were given a non-binding vote on executive compensation. A requirement that board compensation committees be made up of independent directors was introduced.
16. Mortgage lenders were required to make a reasonable good faith determination based on verified and documented information that the borrower has the ability to repay a loan. Failure to do this might lead to a foreclosure being disallowed.
17. Large financial firms were required to have board committees where at least one expert has risk management experience at a large complex firm.
18. The FDIC was allowed to take over a large financial institution when it was failing, and sell its assets, imposing losses on shareholders and creditors with the costs of failures being paid for by the financial industry.

19. FSOC and OFR, which as mentioned earlier have the responsibility of monitoring systemic risk, are charged with identifying systemically important financial institutions (SIFIs).
20. The Federal Reserve Board and the FDIC require all SIFIs to prepare what is known as *living wills*, mapping out how they could raise funds in a crisis and how their operations would be wound up in the event of failure.

The Dodd–Frank Act did not define a future role for Fannie Mae and Freddie Mac, which were key players in the U.S. mortgage market. These agencies were taken over by the U.S. government in September 2008.

An important objective of legislators post-crisis is to increase transparency of derivatives markets. One way they are doing this is by creating a trade repository of all derivatives transactions. A key part of this will be the creation of a new Legal Entity Identifier system. In the United States, this will be the responsibility of the Office of Financial Research. AIG's positions in credit derivatives were apparently unknown to financial regulators prior to AIG's bailout in September 2008. A central repository for all derivatives transactions should mean that regulators are never taken by surprise in this way again.

16.5 LEGISLATION IN OTHER COUNTRIES

The large banks are truly global and when regulations vary throughout the world, they are liable to move all or part of their operations from one jurisdiction to another to obtain more favorable treatment. Although all countries are subject to the same Basel III rules, local regulators have some discretion in the application of rules, and legislation is not the same across all countries. In 2011, the Swiss bank UBS made headlines by suggesting that it might move its investment bank headquarters from Zurich to London, Singapore, or New York to avoid the higher capital requirements imposed by Swiss regulators. (It did not do this.)

The previous section outlined the rules introduced by legislators in the United States. Legislation in other countries has addressed some of the same issues. In the United Kingdom, an independent committee was chaired by Sir John Vickers to consider issues facing the banking industry, and new legislation in the form of the Financial Services (Banking Reform) Act 2013 was passed. In the European Union a committee headed by Erkki Liikanen was set up in November 2011 and published its report in October 2012.

Some of the rules and recommendations in the United Kingdom, European Union, and other countries are similar to those in the United States. For example, the Dodd–Frank Act requires originators of securitized products in the United States to keep 5% of all assets created. (See item 14 of the previous list.) A similar provision exists in the Capital Requirement Directive 2 (CRD2) of the European Union.[10] Most national legislators have agreed that standardized over-the-counter derivatives

[10] However, Germany has increased the 5% to 10%.

should be cleared through central clearing houses instead of being cleared bilaterally (see list item 8).

Sometimes the rules in different countries are similar but not exactly the same. The Dodd–Frank Act included the requirement that standardized derivatives be traded on swap execution facilities (see list item 8). The European Union has introduced similar trading platforms known as organized trading facilities (OTFs). However, it is not as dogmatic about requiring their use for all trading in standardized products.

The most controversial aspect of Dodd-Frank is probably the Volcker rule (see item 6), which prohibits banks from proprietary trading and restricts investment in hedge funds and private equity companies by banks and their affiliates. The rationale for the rule is reasonable: Banks should not be allowed to speculate with depositors' funds, because those funds are insured by the FDIC. The rule may be difficult to enforce, though, because for a bank with a large portfolio of positions, it can be difficult to tell whether a particular new trade is entered into for hedging or speculative purposes.[11] In spite of this, many U.S. banks have closed down their proprietary trading desks, and some employees working on those desks have left to join hedge funds. The Vickers committee in the United Kingdom recognized the importance of protecting depositors' funds but did not go so far as to prohibit proprietary trading. The retail operations of banks must (by 2019) be ring-fenced so that they are insulated from riskier activities such as trading and investment banking. The Liikanen committee in the European Union similarly requires a separation of core banking activities from proprietary trading and other high-risk activities.

Regulators in most countries consider living wills (see list item 20) to be important for SIFIs and are applying pressure on SIFIs to develop them. SIFIs tend to have developed complex organizational structures for tax and regulatory purposes. The living will requirement may result in this being simplified so that the different activities of a SIFI are in separately capitalized legal entities, not all of which need to be bailed out in the event of the SIFI's failure. Regulators have the option of forcing SIFIs to divest certain operations, or even break up entirely, if their living wills are deemed unsatisfactory. They hope that living wills avoid a replay of the panic and cross-border litigation that erupted when the Lehman Brothers investment bank collapsed in 2008. They also think that the multiyear litigation concerned with the termination of Lehman's derivatives portfolio could have been avoided if Lehman and its ISDA Master agreements had been structured so that it was possible to keep the portfolio alive and to unwind it in an orderly way in the few days after bankruptcy.

Compensation is an important issue. Pre-crisis, the annual bonus was a large part of the compensation for many traders and other employees and led them to have a relatively short-term horizon in their decision making. If losses were incurred after the payment of a bonus, they did not have to return the bonus. Many banks have recognized the problem and voluntarily moved to bonuses that are deferred by being spread out over three to five years, rather than all being paid in one year. If a trader shows good results in one year and bad results in the next, some of the bonus applicable to the good year will be deferred and then "clawed back" during

[11] A joke circulating on Wall Street is that banks will have to employ psychologists or psychiatrists to determine what was going on in the mind of the trader at the time of a trade!

the bad year. The Dodd–Frank Act restrictions on pay in the financial sector are relatively mild. When financial institutions received funds during the crisis under the Troubled Asset Relief Program (TARP), compensation was restricted. But, as soon as the funds were paid back, banks had much more freedom in their compensation arrangements.[12]

Some other countries have restricted compensation. Sometimes the restriction is temporary. For example, in 2009 the United Kingdom introduced a one-time "supertax" on bonuses in excess of £25,000. But in other cases it is permanent. For example, in April 2013, the European Union introduced CRD 4, which imposes a cap on bankers' bonuses. Under this directive the maximum ratio of bonus to fixed pay is 1.0 (with some flexibility to increase that ratio to 2.0 with shareholder approval). Banks in the United Kingdom seem intent on finding ways around this rule.

SUMMARY

The financial crisis that started in 2007 was the worst that many parts of the world had seen since the 1930s. Some financial institutions failed. Others had to be bailed out with taxpayer's money. Not surprisingly, both the Basel Committee and national governments decided that a major overhaul of the regulations affecting financial institutions was required.

The Basel II.5 regulations increased the capital banks were required to keep for market risk. They recognized that capital should reflect the volatilities and correlations experienced during stressed market conditions as well as during normal market conditions; they eliminated some of the ways banks could reduce regulatory capital by moving items from the banking book to the trading book; and they created a special capital requirement for derivatives dependent on credit correlation, which had been a particular problem during the crisis.

Basel III dramatically increased the amount of equity capital banks were required to keep. It also recognized that many of the problems of banks during the crisis were liquidity problems and imposed new liquidity requirements for financial institutions.

National governments have also introduced new rules for financial institutions. In the United States, the Dodd–Frank Act has many provisions designed to protect consumers and investors, avoid future bailouts, and monitor the functioning of the financial system more carefully. Similar, though not necessarily identical, regulations exist in other countries.

Exactly how Basel III and national legislation such as Dodd–Frank will be implemented is still somewhat uncertain—and this uncertainty is one of the major risks that banks face. How successful will the measures be once they have been implemented? We will not know this for some time. One problem facing regulators is what are referred to as *unintended consequences*. Basel I had the unintended consequence of discouraging loans to high-quality corporations because of the 100% risk weight that would be assigned. The 1996 Amendment and the development of the credit derivatives market that came after it encouraged banks to find ways of moving credit risks from the banking book to the trading book in order to reduce capital

[12] Indeed, this was a major incentive to repay the TARP money as quickly as possible!

requirements. There will no doubt be unintended consequences of Basel III and the legislation that is being introduced throughout the world. Hopefully, the benefits of the new measures will outweigh any harm to the financial system arising from the unintended consequences.

FURTHER READING

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Finger, C. "CreditMetrics and Constant Level of Risk." MSCI, 2010.

PRACTICE QUESTIONS AND PROBLEMS (ANSWERS AT END OF BOOK)

16.1 What are the three major components of Basel II.5?

16.2 What are the six major components of Basel III?

16.3 What is the difference between VaR as it has been traditionally measured and stressed VaR?

16.4 Explain how the incremental risk charge is calculated. Why was it introduced by the Basel Committee?

16.5 What is the difference between the capital required for a AAA-rated ABS with principal of $100 million and a AAA-rated ABS CDO with a principal of $100 million using the standardized approach?

16.6 By how much has the Tier 1 equity capital (including the capital conservation buffer) increased under Basel III compared with the Tier 1 equity capital requirement under Basel I and II?

16.7 Suppose that the Tier 1 equity ratio for a bank is 6%. What is the maximum dividend, as a percent of earnings, that can be paid if (a) there is no countercyclical buffer and (b) there is a 2.5% countercyclical buffer?

16.8 Explain how the leverage ratio differs from the usual capital ratios calculated by regulators.

16.9 Explain how the liquidity coverage ratio and the net stable funding ratio are defined.

16.10 How would the net stable funding ratio in Example 16.1 change if half the wholesale deposits were replaced by stable retail deposits?

16.11 What is CVA? What new regulations concerning CVA were introduced in Basel III?

16.12 Explain how CoCo bonds work. Why are they attractive to (a) banks and (b) regulators?

FURTHER QUESTIONS

16.13 Explain one way that the Dodd–Frank Act is in conflict with (a) the Basel international regulations and (b) the regulations introduced by other national governments.

16.14 A bank has the following balance sheet:

Cash	3	Retail Deposits (stable)	25
Treasury Bonds (>1 yr)	5	Retail Deposits (less stable)	15
Corporate Bonds Rated A	4	Wholesale Deposits	44
Mortgages	18	Preferred Stock (>1 yr)	4
Small Business Loans (<1 year)	60	Tier 2 Capital	3
Fixed Assets	10	Tier 1 Capital	9
	100		100

(a) What is the Net Stable Funding Ratio?

(b) The bank decides to satisfy Basel III by raising more (stable) retail deposits and keeping the proceeds in Treasury bonds. What extra retail deposits need to be raised?