1 Credit Risk

The development of the credit derivatives market, and hence the subsequent introduction of structured credit products, was a response to the rising importance attached to credit risk management. For this reason, we believe it is worthwhile beginning this book with a look at credit risk and credit ratings.

1.1 Credit risk and credit derivatives

The emergence of a market in credit derivatives is one of the most important recent developments in financial risk management. Credit derivatives offer bankers a new way to establish themselves as intermediaries in the credit market. Using financial engineering techniques imported from other derivative markets, bankers are busily transforming some readily definable blocks of credit risk into the kind of standardised credit-linked securities that investors demand. Credit derivatives are bilateral financial contracts that transfer credit default risk from one counterparty to another. They represent a natural extension of fixed income (and equity) derivatives in that they isolate and separate the element of credit risk (arguably the largest part of a bank's risk profile) from other risks, such as market and operational risks. They exist in a variety of forms; perhaps the simplest is the *credit default swap*, which is conceptually similar to an insurance policy taken out against the default of a bond, for which the purchaser of the insurance pays a regular premium. However, credit derivatives are different from other forms of credit protection, such as guarantees and mortgage indemnity insurance, because:

- the borrower is generally asked for a mortgage indemnity policy, or a guarantee;
- the credit derivative is requested by the lending bank, and the borrower doesn't have to know that the transaction has taken place;
- in theory credit derivatives are tradable, while other forms of protection are generally not.

Unlike market risk, where traders can move in or out of liquid markets in relatively homogeneous products, credit derivatives are long-term illiquid investments. Each borrower is different, and presents unique credit risk issues that cannot easily be compared to other parties. Unlike most other over-the-counter markets, there is no one single method used to price credit derivatives, and banks have adopted a number of different approaches to pricing. We consider some of these approaches later on in the chapter.

The currency and bond market volatility in Asia in 1997 and 1998 demonstrated the value of credit derivatives. For example, in 1998 the International Finance Corporation of Thailand bought back $500 m of bonds several years before maturity because of a graduated put provision that was exercisable if the bank's credit rating fell below investment grade; the bond would have paid out an additional 50 basis points of yield if the bond fell two levels in creditworthiness and 25 basis points per additional level until the put threshold below investment grade was reached. This in fact occurred when Moody's re-rated Thailand to Ba1 grade. In volatile markets, investors are generally happy to give up yield in return for lower credit risk. Thus financial institutions have started focusing on credit as a separate

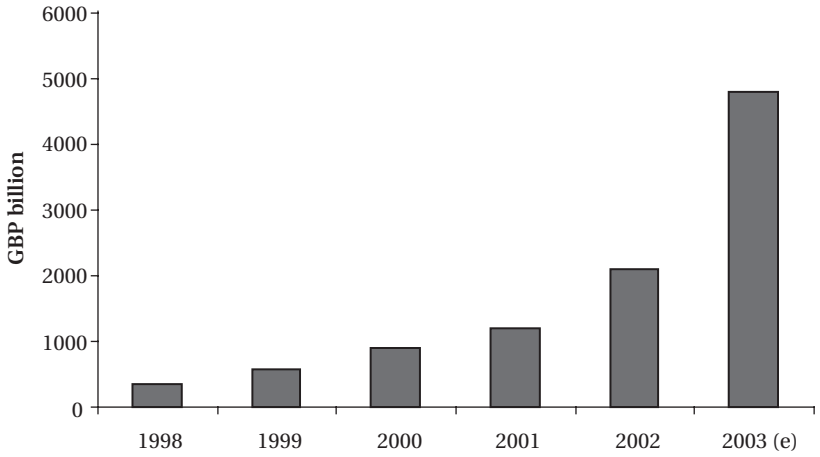


Figure 1.1: Credit default swap volumes, British Bankers Survey.

asset class rather than treating counterparty credit risk as one of the risks associated with an asset.

In Europe, the introduction of the euro has accelerated the development of a euroland corporate bond market, and inflation has remained relatively low, as has the euro interest rate; one consequence is that banks can no longer trade interest rates as profitably as they did in the past. At the same time countries are following the lead in the US and to an extent in the UK of maintaining control of budgets, paying off public sector debt so that the supply of government bonds has begun to decline. The euroland corporate bond market is in the process of changing from a predominantly high credit quality one to a more diverse one, with a range of credits similar to that found in the US. The higher credit risk associated with a more diverse corporate bond market can be hedged with credit derivatives.

1.1.1 *Credit risk*

There are two main types of credit risk that a portfolio of assets, or a position in a single asset, is exposed to. These are credit default risk and credit spread risk.

Credit default risk

This is the risk that an issuer of debt (obligor) is unable to meet its financial obligations. This is known as *default*. There is also the case of technical default, which is used to describe a company that has not honoured its interest payments on a loan for (typically) three months or more, but has not reached a stage of bankruptcy or administration. Where an obligor defaults, a lender generally incurs a loss equal to the amount owed by the obligor less any recovery amount which the firm recovers as a result of foreclosure, liquidation or restructuring of the defaulted obligor. This recovery amount is usually expressed as a percentage of the total amount, and is known as the *recovery rate*. All portfolios with credit exposure exhibit credit default risk.

The measure of a firm's credit default risk is given by its *credit rating*. The three largest credit rating agencies are Moody's, Standard & Poor's and Fitch Ratings. These institutions undertake qualitative and quantitative analysis of borrowers, and formally rate the borrower after their analysis. The issues considered in the analysis include:

- the financial position of the firm itself, for example its balance sheet position and anticipated cash flows and revenues;
- other firm-specific issues, such as the quality of management and succession planning;
- an assessment of the firm's ability to meet scheduled interest and principal payments, both in its domestic and in foreign currencies;
- the outlook for the industry as a whole, and competition within it, together with general assessments of the domestic economy.

The range of credit ratings awarded by the three largest rating agencies is shown in Table 1.1. We will discuss credit ratings again shortly. Figure 1.2 shows these ratings on the Bloomberg RATD screen.

Credit spread risk

Credit spread is the excess premium, over and above government or risk-free risk, required by the market for taking on a certain assumed credit exposure. For instance, Figure 1.3 shows the credit spreads in January 2003 for US dollar corporate bonds with different credit ratings (AAA, A and BBB). The benchmark is the on-the-run or *active* US Treasury issue for the given maturity. Note that the higher the credit rating, the smaller the credit spread. Credit spread risk is the risk of financial loss resulting from changes in the level of credit

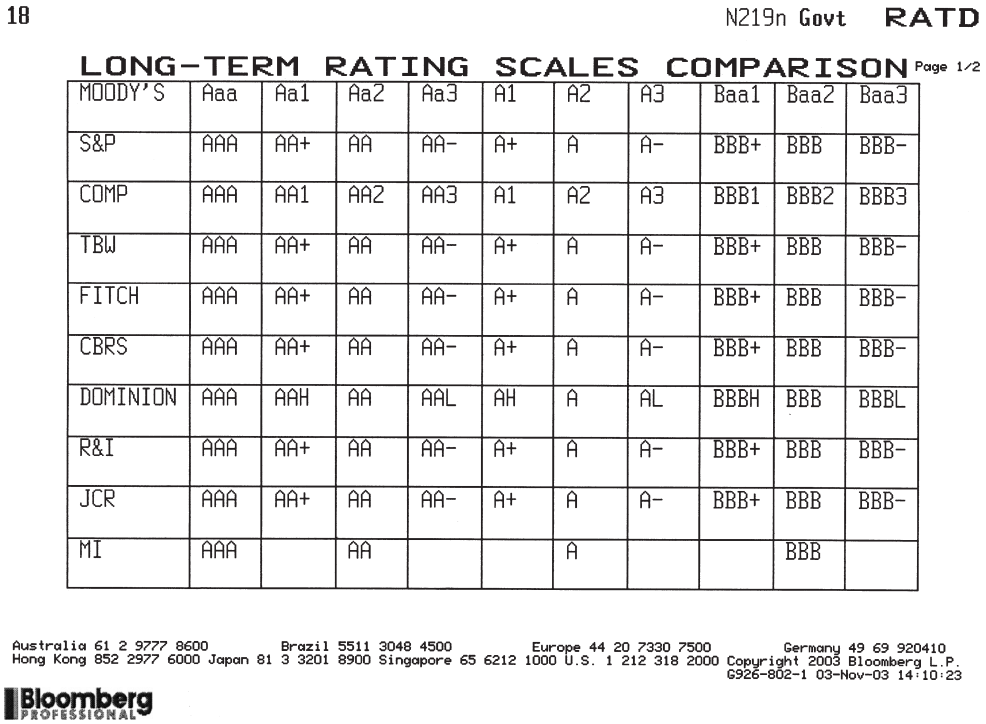
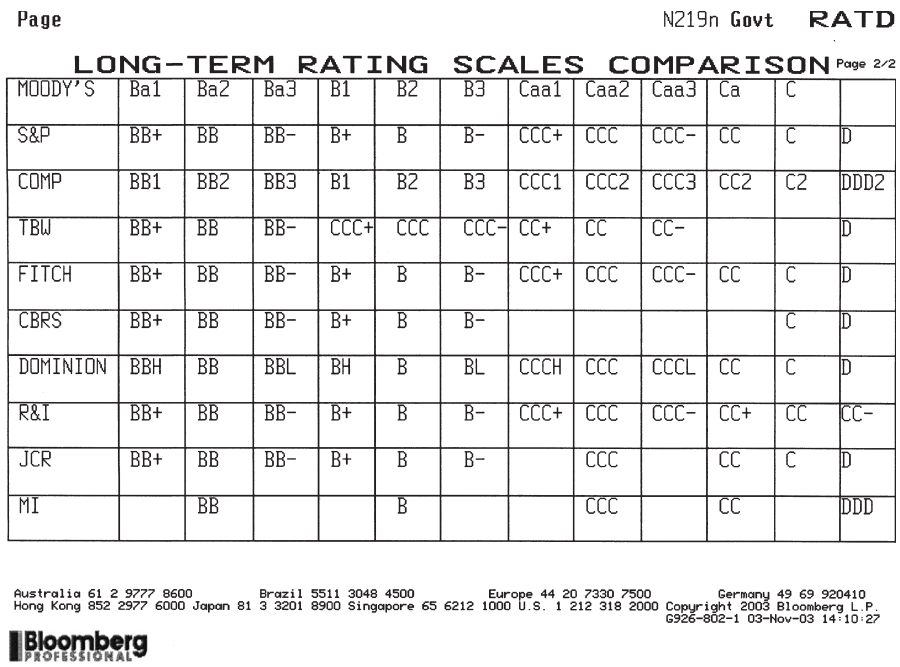


Figure 1.2: Bloomberg screen RATD, long-term credit ratings (© Bloomberg L.P., reproduced with permission).



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LONG-TERM RATING SCALES COMPARISON Page 2/2

MOODY'S	Ba1	Ba2	Ba3	B1	B2	B3	Caa1	Caa2	Caa3	Ca	C	
S&P	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-	CC	C	D
COMP	BB1	BB2	BB3	B1	B2	B3	CCC1	CCC2	CCC3	CC2	C2	DDD2
TBW	BB+	BB	BB-	CCC+	CCC	CCC-	CC+	CC	CC-			D
FITCH	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-	CC	C	D
CBRS	BB+	BB	BB-	B+	B	B-					C	D
DOMINION	BBH	BB	BBL	BH	B	BL	CCCH	CCC	CCCL	CC	C	D
R&I	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-	CC+	CC	CC-
JCR	BB+	BB	BB-	B+	B	B-		CCC		CC	C	D
MI		BB			B			CCC		CC		DDD

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2003 Bloomberg L.P.
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Bloomberg PROFESSIONAL

Figure 1.2 (continued)

spreads used in the marking-to-market of a product. It is exhibited by a portfolio for which the credit spread is traded and marked. Changes in observed credit spreads affect the value of the portfolio and can lead to losses for investors.

The value-at-risk measurement methodology was first applied for credit risk by JPMorgan, which introduced the *CreditMetrics* tool in 1995. The measurement of credit risk requires a slightly different approach to that used for market risk, because the distribution of credit losses follows a different pattern to market risk. In the following sections we describe the approach used to measuring such risk.

1.2 Credit ratings

The risks associated with holding a fixed interest debt instrument are closely connected with the ability of the issuer to maintain the regular coupon payments as well as redeem the debt on maturity. Essentially, the *credit risk* is the main risk of holding a bond. Only the highest quality government debt, and a small number of supra-national and corporate debts, may be considered to be entirely free of credit risk. Therefore, at any time the yield on a bond reflects investors' views on the ability of the issuer to meet its liabilities as set out in the bond's terms and conditions. A delay in paying a cash liability as it becomes due is known as technical default, and is a cause for extreme concern for investors; failure to pay will result in the matter being placed in the hands of the legal court as investors seek to recover their funds. To judge the ability of an issue to meet its obligations for a particular debt issue, for the entire life of the issue, requires judgemental analysis of the issuer's financial strength and business prospects. There are a number of factors that must be considered, and larger banks, fund managers and

Fitch	Moody's	S&P	Summary Description
Investment grade – high creditworthiness			
AAA	Aaa	AAA	Gilt-edged, prime, maximum safety, lowest risk
AA+	Aa1	AA+	
AA	Aa2	AA	High-grade, high credit quality
AA−	Aa3	AA−	
A+	A1	A+	
A	A2	A	Upper-medium grade
A−	A3	A−	
BBB+	Baa1	BBB+	
BBB	Baa2	BBB	Lower-medium grade
BBB−	Baa3	BBB−	
Speculative – lower creditworthiness			
BB+	Ba1	BB+	
BB	Ba2	BB	Low-grade; speculative
BB−	Ba3	BB−	
B+	B1		
B	B	B	Highly speculative
B−	B3		
Predominantly speculative, substantial risk or in default			
CCC+		CCC+	
CCC	Caa	CCC	Substantial risk, in poor standing
CC	Ca	CC	May be in default, very speculative
C	C	C	Extremely speculative
		CI	Income bonds – no interest being paid
DDD			
DD			Default
D		D	

Table 1.1: Corporate bond credit ratings.

corporates carry out their own *credit analysis* of individual borrowers' bond issues. The market also makes a considerable use of formal *credit ratings* that are assigned to individual bond issues by a formal credit rating agency. In the international markets, arguably the two most influential ratings agencies are Standard & Poor's Corporation (S&P) and Moody's Investors Service, Inc. (Moody's), based in the US. In the US domestic market, Fitch Investors Service, Inc. (Fitch) also has a high profile, as does Dun & Bradstreet in the UK.

The specific factors that are considered by a ratings agency, and the methodology used in conducting the analysis, differ slightly amongst the individual ratings agencies. Although

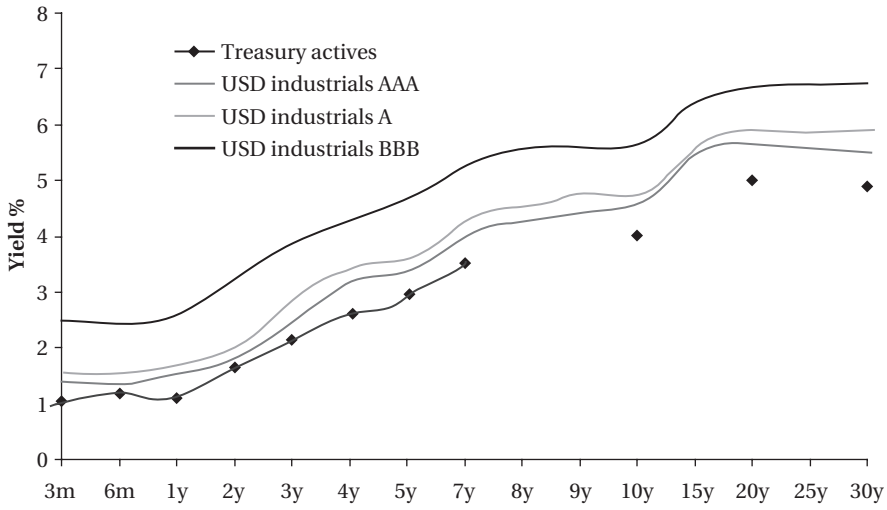

Figure 1.3: US dollar bond yield curves, January 2003.

in many cases the ratings assigned to a particular issue by different agencies are the same, they occasionally differ and in these instances investors usually seek to determine what aspect of an issuer is given more weight in an analysis by which individual agency. Note that a credit rating is not a recommendation to buy (or equally sell) a particular bond, nor is it a comment on market expectations. Credit analysis does take into account general market and economic conditions, but the overall point of credit analysis is to consider the financial health of the issuer and its ability to meet the obligations of the specific issue being rated. Credit ratings play a large part in the decision-making of investors, and also have a significant impact on the interest rates payable by borrowers.

1.2.1 *Understanding credit ratings*

A credit rating is a formal opinion, given by a rating agency, of the *credit risk* for investors in a particular issue of debt securities. Ratings are given to public issues of debt securities by any type of entity, including governments, banks and corporates. They are also given to short-term debt such as commercial paper, as well as bonds and medium-term notes.

Purpose of credit ratings

Investors in securities accept the risk that the issuer will default on coupon payments or fail to repay the principal in full on the maturity date. Generally credit risk is greater for securities with a long maturity, as there is a longer period for the issuer potentially to default. For example, if a company issues ten-year bonds, investors cannot be certain that the company will still exist in ten years' time. It may have failed and gone into liquidation some time before that. That said, there is also risk attached to short-dated debt securities; indeed there have been instances of default by issuers of commercial paper, which is a very short-term instrument.

The prospectus or offer document for an issue provides investors with some information about the issuer so that some credit analysis can be performed on the issuer before the bonds are placed. The information in the offer documents enables investors themselves to

perform their own credit analysis by studying this information before deciding whether or not to invest. Credit assessments take time, however, and also require the specialist skills of credit analysts. Large institutional investors do in fact employ such specialists to carry out credit analysis; however, often it is too costly and time-consuming to assess every issuer in every debt market. Therefore, investors commonly employ two other methods when making a decision on the credit risk of debt securities:

- name recognition;
- formal credit ratings.

Name recognition is when the investor relies on the good name and reputation of the issuer and accepts that the issuer is of such good financial standing, or is of sufficient financial standing, that a default on interest and principal payments is highly unlikely. An investor may feel this way about, say, Microsoft or British Petroleum plc. However, the experience of Barings in 1995 suggested to many investors that it may not be wise to rely on name recognition alone in today's marketplace. The tradition and reputation behind the Barings name allowed the bank to borrow at Libor or occasionally at sub-Libor interest rates in the money markets, which put it on a par with highest-quality clearing banks in terms of credit rating. However name recognition needs to be augmented by other methods to reduce the risk against unforeseen events, as happened with Barings. Credit ratings are a formal assessment, for a given issue of debt securities, of the likelihood that the interest and principal will be paid in full and on schedule. They are increasingly used to make investment decisions about corporate or lesser-developed government debt.

Formal credit ratings

Credit ratings are provided by the specialist agencies. The major credit rating agencies are Standard & Poor's, Fitch and Moody's, based in the United States. There are other agencies both in the US and other countries. On receipt of a formal request, the credit rating agencies will carry out a rating exercise on a specific issue of debt capital. The request for a rating comes from the organisation planning the issue of bonds. Although ratings are provided for the benefit of investors, the issuer must bear the cost. However, it is in the issuer's interest to request a rating as it raises the profile of the bonds, and investors may refuse to buy paper that is not accompanied by a recognised rating. Although the rating exercise involves a credit analysis of the issuer, the rating is applied to a specific debt issue. This means that in theory the credit rating is applied not to an organisation itself, but to specific debt securities that the organisation has issued or is planning to issue. In practice, it is common for the market to refer to the creditworthiness of organisations themselves in terms of the rating of their debt. A highly-rated company such as Rabobank is therefore referred to as a 'triple-A rated' company, although it is the bank's debt issues that are rated as triple-A.

The rating for an issue is kept constantly under review, and if the credit quality of the issuer declines or improves the rating will be changed accordingly. An agency may announce in advance that it is reviewing a particular credit rating, and may go further and state that the review is a precursor to a possible downgrade or upgrade. This announcement is referred to as putting the issue under *credit watch*. The outcome of a credit watch is in most cases likely to be a rating downgrade; however, the review may re-affirm the current rating or possibly upgrade it. During the credit watch phase, the agency will advise investors to use the current rating with caution. When an agency announces that an issue is under

credit watch, the price of the bonds will fall in the market as investors look to sell out of their holdings. This upward movement in yield will be more pronounced if an actual downgrade results. For example, in October 1992 the government of Canada was placed under credit watch and subsequently lost its AAA credit rating; as a result there was an immediate and sharp sell-off in Canadian government eurobonds before the rating agencies had announced the actual results of their credit review.

1.3 Ratings changes over time

1.3.1 *Ratings transition matrix*

We have noted that the rating agencies constantly review the credit quality of firms they have rated. As might be expected, the credit rating of many companies will fluctuate over time as they experience changes in their corporate well-being. As a guide to the change in credit rating that might be expected over a one-year period, Moody's and S&P publish historical transition matrices, which provide average rating transition probabilities for each class of rating. An example is shown in Table 1.2, which is Moody's one-year ratings transition matrix for 2002. These results are obtained from a sample of a large number of firms over many years. In Table 1.2, the first column shows the initial rating and the first row the final rating. For instance, the probability of an A-rated company being downgraded to Baa in one year is 4.63%. The probability of the A-rated company defaulting in this year is 0.00%.

There are some inconsistencies in the ratings transition matrix, and this is explained by Moody's as resulting from scarcity of data for some ratings categories. For instance, an Aa-rated company has a 0.02% probability of being in default at year-end, which is higher than the supposedly lower-rated A-rated company. Such results must be treated with care. The clearest conclusion from the matrix is that the most likely outcome at year-end is that the company rating remains the same. It may be that a one-year time horizon provides little real value; hence the rating agencies also publish transition matrices for longer periods, such as five and ten years.

We might expect an increased level of default as we move lower down the credit ratings scale. This is borne out in Figure 1.4, which is a reproduction of data published by Moody's. It shows one-year default rates by credit rating category for the period 1985–2000. We see that the average one-year default rate rises from zero for the highest-rated Aaa to 15.7% for the B3 rating category. As we suggested above, though, some investors attach little value to

	Aaa	**Aa**	**A**	**Baa**	**Ba**	**B**	**Caa**	**Default**
Aaa	93.40%	5.94%	0.64%	0.00%	0.02%	0.00%	0.00%	0.00%
Aa	1.61%	90.55%	7.46%	0.26%	0.09%	0.01%	0.00%	0.02%
A	0.07%	2.28%	92.44%	4.63%	0.45%	0.12%	0.01%	0.00%
Baa	0.05%	0.26%	5.51%	88.48%	4.76%	0.71%	0.08%	0.15%
Ba	0.02%	0.05%	0.42%	5.16%	86.91%	5.91%	0.24%	1.29%
B	0.00%	0.04%	0.13%	0.54%	6.35%	84.22%	1.91%	6.81%
Caa	0.00%	0.00%	0.00%	0.62%	2.05%	4.08%	69.20%	24.06%

Table 1.2: Moody's one-year rating transition matrix, 2002 (reproduced with permission).

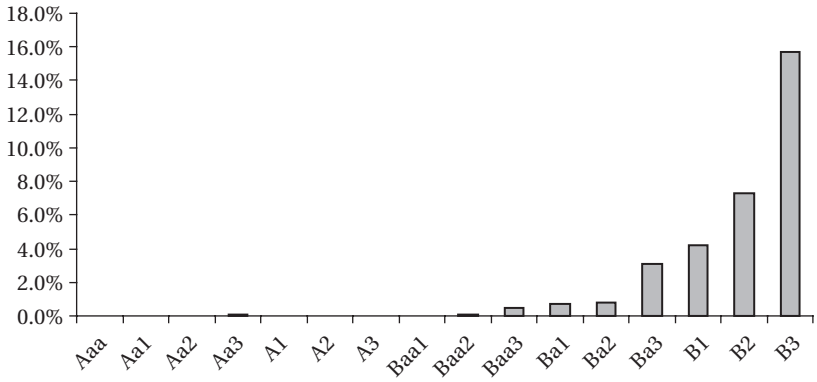

Figure 1.4: Moody's 1-year default rates by credit rating category, 1985–2000 (reproduced with permission).

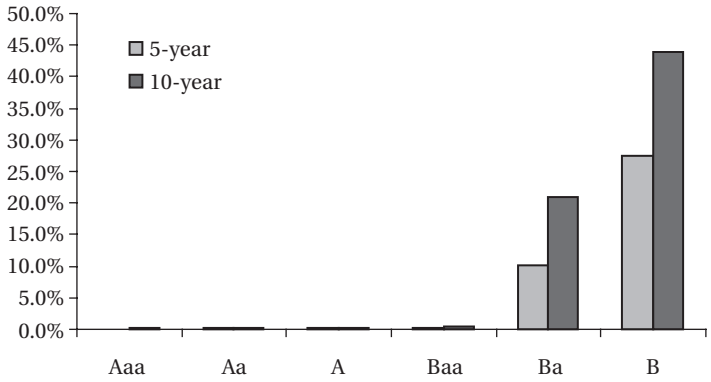

Figure 1.5: Moody's 5- and 10-year average cumulative default rates, 1985–2000 (reproduced with permission).

one-year results. Figure 1.5 shows the average cumulative default rates for five- and ten-year time horizons, for the same period covered in Table 1.2. In fact this repeats the results shown in Table 1.2, with higher default rates associated with lower credit ratings.

1.3.2 *Corporate recovery rates*

When a corporate obligor experiences bankruptcy or enters into liquidation or administration, it will default on its loans. However, this does not mean that all the firm's creditors will lose everything. At the end of the administration process, the firm's creditors typically will receive back a portion of their outstanding loans, a *recovery* amount.[1] The percentage of the original loan that is received back is known as the *recovery rate*, which is defined as the percentage of par value that is returned to the creditor.

[1] This recovery may be received in the form of other assets, such as securities or physical plant, instead of cash.

Seniority	Mean	Standard deviation
Senior secured bank loans	60.70%	26.31%
Senior secured	53.83%	25.41%
Senior unsecured	52.13%	25.12%
Senior subordinated	39.45%	24.79%
Subordinated	33.81%	21.25%
Junior subordinated	18.51%	11.26%
Preference shares	8.26%	10.45%

Table 1.3: Moody's recovery rates, according to loan seniority, for 2002 (reproduced with permission).

The seniority of a loan strongly influences the level of the recovery rate. Table 1.3 shows recovery rates for varying levels of loan seniority in 2002 as published by Moody's. The standard deviation for each recovery rate reported is high, which illustrates the dispersion around the mean and reflects widely varying recovery rates even within the same level of seniority. It is clear that the more senior a loan or a bond is, the higher recovery it will enjoy in the event of default.