of counterparties in a derivatives portfolio. The stress test might parallel the increase in PD by industry after the dotcom crash in 2001–2. The expected loss, stressed expected loss and the stress loss may all be aggregated and even combined with similar values from the loan portfolio.

In addition, a financial institution has a new set of variables to stress. Exposure, as measured by EPE, depends on market variables such as equity prices and swap rates. A financial institution can stress these market variables and see their impact. It should be noted that it is not clear whether a stress will, in aggregate, increase or decrease expected losses. This will depend on a whole host of factors, including the directional bias of the bank's portfolio, which counterparties are margined and which have excess margin. This is in marked contrast to the case where stresses of the probabilities of default are considered. Stresses to the variables affecting the probability of default generally have similar effects and the effects are in the same direction across counterparties. When conducting stresses to EPE, a bank need not consider aggregation with its loan portfolio.[5] Loans are insensitive to the market variables and thus will not have any change in exposure due to changes in market variables.

There are a whole host of stresses that can be considered. Typically a financial institution will use an instantaneous shock of market variables; these are often the same current exposure shocks from the previous section. In principle, we could shock these variables at some future point in their evolution or create a series of shocks over time. This is not common, however, and shocks to current exposure are the norm. In the performance of these instantaneous shocks, the initial market value of the derivatives is shocked prior to running the simulation to calculate EPE. How this shock affects EPE depends on the degree of collateralisation and the "moneyness" of the portfolio, among other things.

Table 17-3 shows how a financial institution might reconsider its stress test of current exposure in an expected-loss framework. Now, in addition to considering just current exposure, the financial institution must consider including the probability of default over the time horizon and the expected positive exposure in its stress-test framework. In this case we are looking at changes to current exposures and thus EPE. We hold the PD constant here. The expected loss, even under stress, is small and measured in thousands. This is due to the rather small probabilities of default that we are considering. We are able to aggregate expected losses and stress losses by simply adding them up.

A financial institution can consider joint stresses of credit quality and market variables as well. Conceptually, this is a straightforward exercise, but, in practice, deciding how changes in macroeconomic variables or balance-sheet variables are consistent with changes in market variables can be daunting. There is very little that necessarily connects these variables. Equity-based approaches (Merton 1974; Kealhofer 2003) come close to providing a link; however, it remains unclear how to link an instantaneous shock of exposure to the equity-based probability of default. While exposure can and should react immediately, it is unclear whether equity-based probabilities of default should react so quickly.

This leads to another drawback: the difficulty of capturing the connection between the probability of default and exposure that is often of concern in CCR. There are many attempts to capture the wrong-way risk, but most are ad hoc. At present the best approach to identifying wrong-way risk in the credit framework is to stress the current exposure, identify those counterparties that are most exposed to the stress and then carefully consider whether the counterparty is also subject to wrong-way risk.

Stress tests of CCR as a credit risk allow a financial institution to advance beyond simple stresses of current exposure. They allow aggregation of losses with loan portfolios, and also allow consideration of the quality of the counterparty. These are important improvements that

[5] Although exposure for loans is insensitive to market variables for the most part, there can still be some increase in expected losses if probabilities of default are correlated with market variables. Furthermore, loan commitments and some other loan products can have a stochastic exposure.

TABLE 17-3 Expected-Loss Stress Test in a Credit Framework

	Scenario: Equity Market Down 25%								
	PD (%)	MtM (US$m)	Collateral (US$m)	CE (US$m)	EPE (US$m)	EL (US$000)	Stress EPE (US$m)	Stress EL (US$000)	Stress Loss (US$000)
Counterparty A	0.03	0.5	0	0.5	4.37	0.09	303.00	6.09	6.00
Counterparty B	0.02	100	0	100	100.00	1.34	220.00	2.95	1.61
Counterparty C	0.02	35	0	35	35.16	0.47	119.00	1.59	1.12
Counterparty D	0.18	20	20	0	3.99	0.48	76.00	9.16	8.68
Counterparty E	0.18	600	600	0	3.99	0.48	75.00	9.04	8.56
Counterparty F	0.03	−5	0	0	2.86	0.06	68.00	1.37	1.31
Counterparty G	0.03	−10	0	0	1.98	0.04	50.04	1.00	0.96
Counterparty H	1.2	−50	0	0	0.02	0.02	25.12	19.73	19.72
Counterparty I	0.03	35	20	15	16.31	0.33	19.20	0.36	0.04
Counterparty J	0.12	24	24	0	3.99	0.32	14.66	1.03	0.71
Aggregate						**3.62**		**52.32**	**48.70**

allow a financial institution to better manage its portfolio of derivatives. Treating CCR as a market risk allows further improvements (notably, the probability of default will be inferred from market variables), and it will be easier to consider joint stresses of credit quality and exposure.

STRESS TESTING CVA

When stress testing CCR in a market risk context, we are usually concerned with the market value of the counterparty credit risk and the losses that could result due to changes in market variables, including the credit spread of the counterparty. In many cases a financial institution will consider its unilateral CVA for stress testing. Here, the financial institution is concerned with the fact that its counterparties could default under various market scenarios. In addition, we might consider not only that a financial institution's counterparty could default, but also that the financial institution in question could default to its counterparty. In this case, the financial institution is considering its bilateral CVA. Initially we just consider stress testing the unilateral CVA.

First we use a common simplified formula for CVA to a counterparty that omits wrong-way risk (Gregory 2010).

$$CVA_n = LGD_n^* \cdot \sum_{j=1}^{T} EE_n^*\left(t_j\right) \cdot q_n^*\left(t_{j-1}, t_j\right)$$

Where:

$EE_n^*(t_j)$ is the discounted expected exposure during the jth time period calculated under a risk-neutral measure for counterparty n.

$q_n^*(t_{j-1}, t_j)$ is the risk-neutral marginal default probability for counterparty n in the time interval from t_{j-1} to t_j and T is the final maturity.

LGD_n^* is the risk-neutral loss-given default for counterparty n.

Aggregating across N counterparties:

$$CVA = \sum_{n=1}^{N} LGD_n^* \cdot \sum_{j=1}^{T} EE_n^*\left(t_j\right) \cdot q_n^*\left(t_{j-1}, t_j\right)$$

Implicit in this description is that the key components all depend on values of market variables. $q_n^*(t_{j-1}, t_j)$ is derived from credit spreads of the counterparty, LGD_n^* is generally set by convention or from market spreads and $EE_n^*(t_j)$ depends on the values of derivative transactions with the counterparty. To calculate a stressed CVA we would apply an instantaneous shock to some of these market variables. The stresses could affect $EE_n^*(t_j)$ or $q_n^*(t_{j-1}, t_j)$.

Stressed CVA is given by:

$$CVA^s = \sum_{n=1}^{N} LGD_n^* \cdot \sum_{j=1}^{T} EE_n^s\left(t_j\right) \cdot q_n^s\left(t_{j-1}, t_j\right)$$

And the stress loss is $CVA^s - CVA$.

Stressing current exposure, as described previously, has similar effects. An instantaneous shock will have some impact on the expected exposure calculated in later time periods, so all of the expected exposures will have to be recalculated. Stresses to the marginal probability of default are usually derived from credit spread shocks.

Similarities can be seen between stress testing CCR in a credit risk framework and doing so in a market risk framework. There is a reliance in both cases on expected losses being the product of loss-given default, exposure and the probability of default. However, these values will be quite different, depending on the view of CCR as a market risk or credit risk. The reasons for the differences are many, and use of risk-neutral values for CVA as opposed to physical values for expected losses is the most prominent. In addition, CVA uses expected losses over the life of the transactions, whereas expected losses use a specified time horizon, and the model for determining the probability of default is market-based in CVA.

Using a market-based measure for the probability of default provides some benefits. It is possible in these circumstances to incorporate a correlation between the probability of default and the exposure. Hull and White (2012) describe methods to do this. They also demonstrate an important stress test that is available, a stress of the correlation between exposure and the probability of default. They show that the correlation can have an important effect on the measured CVA. Since there is likely to be a high degree of uncertainty around the correlation, a financial institution should run stress tests to determine the impact on profit and loss if the correlation is wrong.

To capture the full impact of various scenarios on CVA profit and loss, a financial institution should include the liability side effects in the stress as well. This part of the bilateral CVA (BCVA), often called DVA, captures the value of the financial institution's option to default on its counterparties. The formula for DVA is similar to the formula for CVA except for two changes. First, instead of expected exposure, we have to calculate the negative expected

exposure (NEE). This is expected exposure calculated from the point of view of the counterparty. Second, the value of the option to default for the financial institution is dependent on the survival of the counterparty, so the probability that the counterparty has survived must enter into the calculation as S_I. A similar change must be made to the CVA portion, since the loss due to the counterparty defaulting now depends on the financial institution not defaulting first. The bilateral CVA formula is (Gregory 2012):

$$BCVA = \sum_{n=1}^{N} LGD_n^* \cdot \sum_{j=1}^{T} EE_n^*(t_j) \cdot q_n^*(t_{j-1}, t_j) \cdot S_I^*(t_{j-1})$$
$$-\sum_{n=1}^{N} LGD_I^* \cdot \sum_{j=1}^{T} NEE_n^*(t_j) \cdot q_I^*(t_{j-1}, t_j) \cdot S_I^*(t_{j-1})$$

The subscript I refers to the financial institution. Notable in this formulation is that the survival probabilities also depend on CDS spreads and now the losses depend on the firm's own credit spread. This may lead to counterintuitive results such as losses occurring because the firm's own credit quality improves. When looking at stress tests from a bilateral perspective, the financial institution will also have to consider how its own credit spread is correlated with its counterparties' credit spread. Stress losses can be calculated in a similar way as for CVA losses by calculating a stress BCVA and subtracting the current BCVA.

BCVA allows CCR to be treated as a market risk. This means CCR can be incorporated into market risk stress testing in a coherent manner. The gains or losses from the BCVA stress loss can be added to the firm's stress tests from market risk. As long as the same shocks to market variables are applied to the trading portfolio and to the BCVA results, they can be aggregated by simple addition.

COMMON PITFALLS IN STRESS TESTING CCR

Financial institutions are only beginning to conduct a level of stress-testing beyond stressing current exposure. The methodologies to conduct these tests are only just being developed. It is also rare for CCR to be aggregated with either stress tests of the loan portfolio or with trading-position stress testing results in a consistent framework. With better modelling of CCR exposures and CVA, it is possible to begin aggregating stress tests of CCR with either the loan portfolio or trading positions.

Since most financial institutions will do some form of stressing current exposure, it is tempting to use those stresses of current exposure when combining the losses with loans or trading positions. The analysis above shows that expected exposure or expected positive exposure should be used as the exposure amount, and that using current exposure instead would be a mistake.

In fact, the use of current exposure instead of expected exposure can lead to substantial errors. This can be shown using a normal approximation (Gregory 2010) to expected exposures, which is accurate for linear derivatives with no intermediate payments. Figure 17-1 plots current exposure and expected exposure after a million-dollar shock to the market value of the derivative. For at-the-money exposures, the difference between current exposure and expected exposure is almost half the value of the shock.

Use of delta sensitivities to calculate changes in exposures is also especially problematic for CCR, since it is highly nonlinear. While this can save on computational resources, the errors introduced are not obvious and the linearisation can be highly misleading. At-the-money portfolios with large price moves applied to the portfolio are especially prone to errors from using delta approximations.

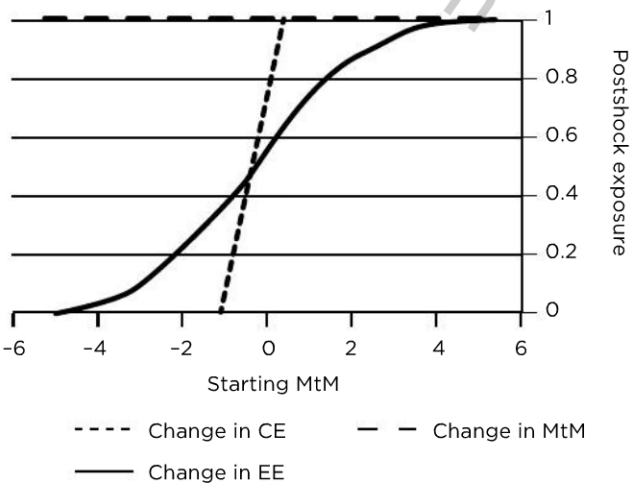

FIGURE 17-1 Current exposure and expected exposure after US$1m shock.

CONCLUSION

A counterparty credit risk manager now has a multiplicity of stress tests to consider. Too many stress tests can hide the risk of a portfolio, but a fair number of stresses is important to develop a comprehensive view of the risks in the portfolio. Both the credit risk and market risk views are important since both fair-value losses and default losses can occur no matter how a financial institution manages its CCR. More integrated stress tests can be generated by combining the credit risk view with the loan portfolio, or the market risk view of CCR can be combined with the trading book. The true difficulty remains combining the default stresses and the fair-value stresses to get a single comprehensive stress test. This difficulty aside, counterparty credit risk managers now have more tools at their disposal to measure and manage CCR. The irony is that regulators have begun to move derivative transactions to central clearing to reduce the counterparty credit risk problem just as the ability to manage counterparty credit risk is making major advances.

The views expressed in this article are the author's own and do not represent the views of the Board of Governors of the Federal Reserve System or its staff.

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Credit Scoring and Retail Credit Risk Management[1]

18

Learning Objectives

After completing this reading you should be able to:

- Analyze the credit risks and other risks generated by retail banking.
- Explain the differences between retail credit risk and corporate credit risk.
- Discuss the "dark side" of retail credit risk and the measures that attempt to address the problem.
- Define and describe credit risk scoring model types, key variables, and applications.
- Discuss the key variables in a mortgage credit assessment, and describe the use of cutoff scores, default rates, and loss rates in a credit scoring model.
- Discuss the measurement and monitoring of a scorecard performance including the use of cumulative accuracy profile (CAP) and the accuracy ratio (AR) techniques.
- Describe the customer relationship cycle, and discuss the trade-off between creditworthiness and profitability.
- Discuss the benefits of risk-based pricing of financial services.

[1] We acknowledge the coauthorship of Rob Jameson for sections of this chapter.

Excerpt is Chapter 9 of The Essentials of Risk Management, *Second Edition, by Michel Crouhy, Dan Galai, and Robert Mark.*

This chapter examines credit risk in retail banking, an industry that is familiar to almost everyone at some level. Once seen as unglamorous compared to the big-ticket lending of corporate banking and trading, retail banking has been transformed over the last few years by innovations in products, marketing, and risk management.

Retail banking has proved particularly important to the financial industry in the postmillennium years. On the positive side, retail businesses provided growing, relatively stable earnings in the early years of the millennium. However, poorly controlled subprime lending in the U.S. mortgage market provided the fuel for the disastrous failures of the U.S. securitization industry in the run-up to the financial crisis of 2007–2009—a topic we address in detail in Chapter 19.

In this chapter, we'll first take a look at the different nature of retail credit risk and commercial credit risk, including the "darker side" of risk in the retail credit businesses. Then we'll take a more detailed look at the process of credit scoring. Credit scoring is now a widespread technique, not only in banking but also in many other sectors where there is a need to check the credit standing of a customer (e.g., a telephone company) or estimate the likelihood that a client will file a claim (e.g., an insurance company).

Retail banking, as defined in Box 18-1, serves both small businesses and consumers and includes the business of accepting consumer deposits as well as the main consumer lending businesses.

- *Home mortgages*. Fixed-rate mortgages and adjustable-rate mortgages (ARMs) are secured by the residential properties financed by the loan. The loan-to-value ratio (LTV) represents the proportion of the property value financed by the loan and is a key risk variable.
- *Home equity loans*. Sometimes called home equity line of credit (HELOC) loans, these can be considered a hybrid between a consumer loan and a mortgage loan. They are secured by residential properties.
- *Installment loans*. These include revolving loans, such as personal lines of credit that may be used repeatedly up to a specified limit. They also include credit cards. automobile and similar loans, and all other loans not included in automobile loans and revolving credit. Such things as residential property, personal property, or financial assets usually secure ordinary installment loans.
- *Credit card revolving loans*. These are unsecured loans.
- *Small business loans (SBL)*. These are secured by the assets of the business or by the personal guarantees of the owners. Business loans of up to $100,000 to $200,000 are usually considered as part of the retail portfolio.

BOX 18-1 Basel's Definition of Retail Exposures

The Basel Committee. the banking industry's international regulatory body, defines retail exposures as homogeneous portfolios that consist of:

- A large number of small, low-value loans
- With either a consumer or business focus
- Where the incremental risk of any single exposure is small

Examples are:

- Credit cards
- Installment loans (e.g., personal finance. educational loans, auto loans, leasing)
- Revolving credits (e.g., overdrafts, home equity lines of credit)
- Residential mortgages

Small business loans can be managed as retail exposures, provided that the total exposure to a small business borrower is less than 1 million euros.

THE NATURE OF RETAIL CREDIT RISK

The credit risks generated by retail banking are significant, but they are traditionally regarded as having a different dynamic from the credit risk of commercial and investment banking businesses. The defining feature of retail credit exposures is that they arrive in bite-sized pieces, so that default by a single customer is never expensive enough to threaten a bank. Corporate and commercial credit portfolios, by contrast, often contain large exposures to single names and also concentrations of exposures to corporations that are economically intertwined in particular geographical areas or industry sectors.

The tendency for retail credit portfolios to behave like well-diversified portfolios in normal markets makes it easier to estimate the percentage of the portfolio the bank "expects" to default in the future and the losses that this might cause. This expected loss number can then be treated much like other costs of doing business, such as the cost of maintaining branches or processing checks. The relative predictability of retail credit losses means that the expected loss rate can be built into the price charged to the customer. By contrast, the risk of loss from many commercial credit portfolios is dominated by the risk that credit losses will rise to some unexpected level.

Of course, this distinction between retail and corporate lending can be overstated, and sometimes diversification can prove to be a fickle friend. The 2007–2009 financial crisis demonstrated that, at the end of a long credit boom, housing prices could fall at about the same time right across even a large economy such as the United States. Diversification turned out to offer less than perfect protection to large portfolios of mortgage risk, though the extent of the house price fall varied considerably from region to region. Likewise, a systematic change in behavior in consumer lending industries—e.g., advancing money to consumers without checking their incomes—can introduce a hidden systematic risk into credit portfolios, and even whole credit industries. In the event of economic trouble, this can lead to sudden lurches upward in the default rate and to unexpected falls in key asset and collateral values (e.g., house prices). This is the "dark side" of retail credit risk, described in Box 18-2, and it played a significant role in sparking the 2007–2009 crisis.

It would, however, be a mistake to think that the potential for this kind of mishap became apparent only *following* the 2007–2009 crisis: Box 18-2 is reproduced word for word from the pre-crisis 2006 edition of this book. In the same edition, we included a box on subprime lending in the United States that pointed out that subprime was:

> . . . a risky business for the unwary bank. If subprime customers turn out to be much more prone to default than the bank has calculated, or if their behavior changes as part of a social trend, then the associated costs can cut through even the fat interest margins and fees associated with the sector. Subprime lending is a new sector for most retail banks. That means that banks lack the historical

BOX 18-2 Does Retail Credit Risk Have a Dark Side?

In the main text, we deal mainly with how credit scoring helps put a number to the expected level of credit risk in a retail transaction. But there is a dark side to retail credit, too. This is the danger that losses will suddenly rise to unexpected levels because of some unforeseen but systematic risk factor that influences the behavior of many of the credits in a bank's retail portfolio.

The dark side of retail risk management has four prime causes:

- Not all innovative retail credit products can be associated with enough historical loss data to make their risk assessments reliable.
- Even well-understood retail credit products might begin to behave in an unexpected fashion under the influence of a sharp change in the economic environment, particularly if risk factors all get worse at the same time (the so-called perfect storm scenario). For example, in the mortgage industry, one ever-present worry is that a deep recession combined with higher interest rates might lead to a rise in mortgage defaults at the same time that house prices, and therefore collateral values, fall very sharply.
- The tendency of consumers to default (or not) is a product of a complex social and legal system that continually changes. For example, the social and legal acceptability of personal bankruptcy, especially in the United States, is one factor that seemed to influence a rising trend in personal default during the 1990s.
- Any operational issue that affects the credit assessment of customers can have a systematic effect on the whole consumer portfolio. Because consumer credit is run as a semiautomated decision-making process rather than as a series of tailored decisions, it's vital that the credit process be designed and operated correctly.

Almost by definition, it's difficult to put a risk number to these kinds of wild-card risk. Instead, banks have to try to make sure that only a limited number of their retail credit portfolios are especially vulnerable to new kinds of risk, such as subprime lending. A *little* exposure to uncertainty might open up a lucrative business line and allow the bank to gather enough information to measure the risk better in the future; a *lot* makes the bank a hostage to fortune.

Where large conventional portfolios such as mortgage portfolios are vulnerable to sharp changes in multiple risk factors, banks must use stress tests to gauge how devastating each plausible worst-case scenario might be.

data to predict the default rate of their subprime customers reliably.[2]

Since the crisis, various industry reforms and regulations, such as the Consumer Financial Protection Bureau (CFPB) have evolved out of the Dodd-Frank Act (DFA) to help deal with the dark side of retail credit risk. For example, the CFPA requires originators of credit to determine if the consumer has the ability to repay the mortgage. If a mortgage is labeled a "qualified mortgage" (QM), then a creditor can assume the borrower has met this requirement. The CFPA also introduced an "ability to repay" consideration that asks the lender to consider underwriting standards (Box 18-3).

A more benign feature of many retail portfolios is that a rise in defaults is often signaled in advance by a change in customer behavior—e.g., customers who are under financial pressure might fail to make a minimum payback on a credit card account. Warning signals like this are carefully monitored by well-run retail banks (and their regulators) because they allow the bank to take preemptive action to reduce credit risk. The bank can:

- Alter the rules governing the amount of money it lends to existing customers to reduce its exposures.
- Alter its marketing strategies and customer acceptance rules to attract less risky customers.
- Price in the risk by raising interest rates for certain kinds of customers to take into account the higher likelihood of default.

By contrast, a commercial credit portfolio is something of a supertanker. By the time it is obvious that something is going wrong, it's often too late to do much about it.

Of course, the warning signals sometimes apparent in consumer credit markets are not always heeded. Too often, retail banks are tempted to ignore early warnings signs because they would steer the bank away from fast-growing, apparently lucrative business lines. Instead, banks compete for even more business volume by lowering standards: the U.S. subprime mortgage industry in the run-up to the 2007–2009 crisis provided a dramatic example of this (Box 18-4).

Regulators accept the idea that retail credit risk is *relatively* predictable, and also that mortgage loans are safer due to the specific real estate asset that is backing the loan. As a result, retail banks are asked to set aside a relatively small amount of risk capital under Basel II and III compared with regulatory capital for corporate loans. But banks will have to provide regulators with probability of default (PD), loss given default (LGD), and exposure at default (EAD) statistics for clearly differentiated segments of their portfolios. The regulators say that segmentation should be based on credit scores or some equivalent measure and on vintage of exposures—that is, the time the transaction has been on the bank's books.

BOX 18-3 Qualified Mortgages and Ability to Repay

"Qualified mortgages" features include:

- No excess upfront points and fees
- No toxic loan features (e.g., negative amortization loans, terms >30 years, interest-only loans for a specified period of time)
- Cap on how much income can go toward debt (e.g., debt to income (DTI) < 43%)[1]
- No loans with balloon payments

"Ability to repay" calls for a lender to consider eight underwriting standards:

- Current employer status
- Current income or assets
- Credit history
- Monthly payment for mortgage
- Monthly payments on any other loans associated with the property
- Monthly payments on any mortgage-related obligations (such as property taxes)
- Other debt obligations
- The monthly DTI ratio (or residual income) the borrower would be taking on with the mortgage

[1]DTI = Total monthly debt divided by total monthly gross income.

[2] *The Essentials of Risk Management*, 2006, p. 216. While we also dwelt on the degree to which regulatory arbitrage motivated the securitization of consumer portfolios (p. 226) and mentioned the problem of valuing risky residual tranches from a securitization (p. 227). The fragility of AAA-rated securitizations posed an extraordinary threat to financial system stability. We concluded our discusslon of the transfer of consumer risk (p. 227) with an unexplicit warning: "Banks need to watch out for the effect [securitization strategies] can have on liquidity. Can the bank be certain that the option of funding through securitization will remain open if circumstances change (such as deterioration In the institution's credit rating)?"

BOX 18-4 Slipping Standards in Subprime Lending

In the period between 2002 and the onset of the 2007 subprime crisis, consumers and the industry allowed themselves to believe that real estate prices would continue to escalate.

Combined with low interest rates, poorly structured incentives for brokers, and an increasingly competitive environment, this led to a lowering of underwriting standards. Banks and brokers began to offer products to borrowers who often could not afford the loans or could not bear the associated risks.

Many of the subprime mortgage loans underwritten during this time had multiple weaknesses: less creditworthy borrowers, high cumulative loan-to-value ratios, and limited or no verification of the borrower's income.

Some loans took the hybrid form of 2/28 or 3/27 adjustable rate mortgages (ARMs). That is, they offered a fixed low "teaser" rate for the first two or three years and adjustable rates thereafter. The jump in rates this implied meant the mortgages were designed to be refinanced—feasible only under the assumption of an increase in the collateral value (i.e., a rise in house prices)—or risked falling into default. Because many of these mortgages were set around the same time, lenders had inadvertently created an environment that would lead to a systemic wave of either refinancing or default.

In addition, consumer behavior with respect to default on mortgage debt changed in ways that were not anticipated by banks (or rating agencies).

When the subprime crisis broke in 2007, many commentators called it a "perfect storm" in that everything possible seemed to go wrong. But it was a perfect storm that had, to a large degree, been created by the banking industry itself.

BOX 18-5 The Other Risks of Retail Banking

In the main text, we focus on credit risk as the principal risk of retail credit businesses. But just as in commercial banking, retail banking is subject to a whole range of market, operational, business, and reputation risks.

- *Interest-rate risk* is generated on both the asset and liability side whenever the bank offers specific rates to both borrowers and depositors. This risk is generally transferred from the retail business line to the treasury of a retail bank, where it is managed as part of the bank's asset/liability and liquidity risk management.
- *Asset valuation risks* are really a special form of market risk, where the profitability of a retail business line depends on the accurate valuation of a particular asset, liability, or class of collateral. Perhaps the most important is prepayment risk in mortgage banking, which describes the risk that a portfolio of mortgages might lose its value when interest rates fall because consumers intent on remortgaging pay down their existing mortgage unexpectedly quickly, removing its value. The valuation and the hedging of retail assets that are subject to prepayment risk is complex because it relies on assumptions about customer behavior that are hard to validate. Another example of a valuation risk is the estimation of the residual value of automobiles in auto leasing business lines. Where this kind of risk is explicitly recognized, it tends to be managed centrally by the treasury unit of the retail bank.
- *Operational risks* in retail banking are generally managed as part of the business in which they arise. For example, fraud by customers is closely monitored and new processes, such as fraud detection mechanisms, are put in place when they are economically justified. Under Basel II and III, banks allocate regulatory capital against operational risk in both retail and wholesale banking. A subdiscipline of retail operational risk management is emerging that makes use of many of the same concepts as bank operational risk at a firmwide level.
- *Business risks* are one of the primary concerns of senior management. These include business volume risks (e.g., the rise and fall of mortgage business volumes when interest rates go up and down), strategic risks (such as the growth of Internet banking or new payments systems), and decisions about mergers and acquisitions.
- *Reputation risks* are particularly important in retail banking. The bank has to preserve a reputation for delivering on its promises to customers. But it also has to preserve its reputation with regulators, who can remove its business franchise if it is seen to act unfairly or unlawfully.

Credit risk is not the only risk faced by retail banking, as Box 18-5 makes clear, but it is the major financial risk across most lines of retail business. We'll now take a close look at the principal tool for measuring retail credit risk: credit scoring.

Credit Scoring: Cost, Consistency, and Better Credit Decisions

Every time you apply for a credit card, open an account with a telephone company, submit a medical claim, or apply for auto insurance, it is almost certain that a *credit*

scoring model—or, more precisely, a *credit risk scoring* model—is ticking away behind the scenes.[3]

The model uses a statistical procedure to convert information about a credit applicant or an existing account holder into numbers that are then combined (usually added) to form a score. This score is then regarded as an indicator of the credit risk of the individual concerned—that is, the probability of repayment. The higher the score, the lower the risk.

Credit scoring is important because it allows banks to avoid the most risky customers. It can also help them to assess whether certain kinds of businesses are likely to be profitable by comparing the profit margin that remains once operating and estimated default expenses are subtracted from gross revenues.

But credit scoring is also important for reasons of cost and consistency. Major banks typically have millions of customers and carry out billions of transactions each year. By using a credit scoring model, banks can automate as much as possible the adjudication process for small credits and credit cards. Before credit scoring was widely adopted, a credit officer would have to review a credit application and use a combination of experience, industry knowledge, and personal know-how to reach a credit decision based on the large amount of information in a typical credit application. Each application might typically contain about 50 bits of information, although some applications may call for as many as 150 items. The number of possible combinations of information is staggering, and, as a result, it is almost impossible for a human analyst to treat credit decisions in identical ways over time.

By contrast, credit risk scorecards consistently weight and treat the information items that they extract from applications and/or credit bureau reports. The credit industry calls these items *characteristics*, and they correspond to the questions on a credit application or the entries in a credit bureau report. The answers given to the questions in an application or the entries of a credit bureau report are known as *attributes*. For example, "four years" is an attribute of the characteristic "time at address." Similarly, "rents" is an attribute of the characteristic "residential status."

Credit scoring models assess not only whether an attribute is positive or negative but also by how much. The weighting of the values associated with each answer (or attribute) is derived using statistical techniques that look at the odds of repayment based on past performance. ("Odds" is the term the retail banking industry uses to mean "probability.") Population odds are defined as the ratio of the probability of a good event to the probability of a bad event in the population. For example, an applicant drawn randomly from the population with 15:1 odds has a probability of 1 in 16—i.e., 6.25 percent—of being a bad customer (by which we mean delinquent or the subject of a charge-off).

The statistical techniques employed to weight the information in a credit report include linear or logistic regression, mathematical programming or classification trees, neural nets, and genetic algorithms (with logistic regression being the most common).

Figure 18-1 shows what a credit scoring table might look like—in this case, one used to differentiate between credit applications.

WHAT KIND OF CREDIT SCORING MODELS ARE THERE?

For the purpose of scoring consumer credit applications, there are really three types of models:

- *Credit bureau scores*. These are often known as FICO scores, because the methodology for producing them was developed by Fair Isaac Corporation (the leader in credit risk analytics for retail businesses). In the United States and Canada, bureau scores are also maintained and supplied by companies such as Equifax and TransUnion. From the bank's point of view, this kind of generic credit score has a low cost, is quickly installed, and offers a broad overview of an applicant's overall creditworthiness (regardless of the type of credit for which the applicant is applying). For example, Fair Isaac credit bureau risk scores can be tailored to the preferences of a financial institution (they usually range

[3] Good general references to credit scoring include Edward M. Lewis, *An Introduction to Credit Scoring* (San Raphael, CA. Fair Isaac Corporation, 1992); L. C. Thomas, J. N. Crook, and D. B. Edelman, eds., *Credit Scoring and Credit Control* (Oxford: Oxford University Press, 1992); and V. Srinivasan and Y. H. Kim, "Credit Granting: A Comparative Analysis of Classification Procedures," *Journal of Finance* 42, 1987, pp. 665–683. More recent references include E. Mays and Niall Lynas, *Credit Scoring for Risk Managers: The Handbook for Lenders,* 2011, and N. Siddiqi, *Credit Risk Scorecards: Developing and Implementing Intelligent Credit Scoring*, Wiley, 2005.

Years on job	Less than 6 months **5**	6 months to 1 year 6 months **14**	1 yr 7 months to 6 yrs 8 months **20**	6 yrs 9 months to 10 yrs 5 months **27**	10 yrs 6 months or more **39**	
Own or rent	Own or buying **40**	Rent **19**	All others **26**			
Banking	Checking account **22**	Savings account **17**	Checking and savings account **31**	None **0**		
Major credit cards	Yes **27**	No **11**				
Occupation	Retired **41**	Professional **36**	Clerical **27**	Sales **18**	Service **12**	All others **27**
Age of applicant	18–25 **19**	26–31 **14**	32–34 **22**	35–51 **26**	52–61 **34**	62 and over **40**
Worst credit reference	Major derogatory **–15**	Minor derogatory **–4**	No record **–2**	One satisfactory **9**	Two or more satisfactory **18**	No investigation **0**

FIGURE 18-1 Example of an application scoring table.

Source: Lewis, 1992, p. xv.

from 300 to 850; subprime lending typically targets customers with scores below 660).

- *Pooled models*. These models are built by outside vendors, such as Fair Isaac, using data collected from a wide range of lenders with similar credit portfolios. For example, a revolving credit pooled model might be developed from credit card data collected from several banks. Pooled models cost more than generic scores, but not as much as custom models. They can be tailored to an industry, but they are not company specific.
- *Custom models*. These models are usually developed in-house using data collected from the lender's own unique population of credit applications. They are tailored to screen for a specific applicant profile for a specific lender's product. Custom models have allowed some banks to become expert in particular credit segments, such as credit cards and mortgages. They can give a bank a strong competitive edge in selecting the best customers and offering the best risk-adjusted pricing.

Let's take a closer look at the generic information offered by credit bureaus. Credit bureau data consist of numerous "credit files" for each individual who has a credit history. Each credit file contains five major types of information:

- *Identifying information*. This is personal information; it is not considered credit information as such and is not used in scoring models. The rules governing the nature of the identifying information that can be collected are set by local jurisdictions. In the United States, for example, the U.S. Equal Opportunity Acts prohibits the use of information such as gender, race, or religion in credit scoring models.
- *Public records (legal items).* This information comes from civil court records and includes bankruptcies, judgments, and tax liens.
- *Collection information*. This is reported by debt collection agencies or by entities that grant credit.
- *Trade line/account information*. This is compiled from the monthly "receivables" data that credit grantors send to the credit bureaus. The tapes contain reports of new accounts as well as updates to existing account information.
- *Inquiries*. Every time a credit file is accessed, an inquiry must be placed on the file. Credit grantors only see the inquiries that are placed for the extension of new credit.

Some credit bureaus, such as Equifax, allow individuals to obtain their own score, together with an explanation of how to improve their current score (and what-if analyses, such as the impact on the score of reducing the balance on the customer's credit cards).

A bureau score can be used to derive a more all-encompassing credit score, taking into account a series of key variables including loan-to-value and the quality of the loan documentation. For example:

$$\textit{Risk Score} = f(\textit{Doc Type, Transaction Type, FICO, LTV, DTI, Occup Type, Prop Type, Pmt, Economic Cycle})$$

Box 18-6 gives the definition of the key variables that require more explanation. One of the problems in the run-up to the financial crisis of 2007–2009 was that some originators were relying too heavily on bureau credit scores and not taking into proper account the wider set of risk variables.

After years of very poor underwriting standards and irresponsible lending, mortgage products returned to more traditional standards following the financial crisis—e.g., full documentation loans, with borrowers obliged to have credit scores above 680, and significantly larger down payments. The industry has moved away from

BOX 18-6 Definitions of Some Key Variables In Mortgage Credit Assessment

- Documentation (doc) type:
  - Full doc: A mortgage loan that requires proof of income and assets. Debt-to-income ratios are calculated.
  - Stated income: Specialized mortgage loan in which the mortgage lender verifies employment but not income.
  - No income/No asset: Reduced documentation mortgage that allows the borrower to state income and assets on the loan application without verification by the lender; however, the source of the income is still verified.
  - No ratio: A mortgage loan that documents employment but not income. Income is not listed on the application, and no debt-to-income ratios are calculated.
  - No doc: A mortgage loan that requires no income or asset documentation. Neither is stated on the application, and fields for such information are left blank.
- FICO: Number score of the default risk associated with a borrower's credit history.
- DTI: Debt-to-income ratio is used to qualify mortgage payment and other monthly debt payments versus income.
- LTV: The ratio expresses the amount of a first mortgage lien as a percentage of the total appraised value of the property—i.e., the loan-to-value ratio.
- Payment type (Pmt)—e.g., adjustable rate mortgage, monthly treasury average.

loans featuring negative amortization, stated income, no income/no assets, no documentation, or 100 percent financing.

FROM CUTOFF SCORES TO DEFAULT RATES AND LOSS RATES

In the early stages of the industry's development of credit scoring models, the actual probability of default assigned to a credit applicant did not much matter. The models were designed to put applicants in *ranked order* in relation to their *relative* risk. This was because lenders used the models not to generate an absolute measure of default probability but to choose an appropriate cutoff score—i.e., the point at which applicants were accepted, based on subjective criteria.

We can see how cutoff scores work if we look at Figure 18-2, which shows the distribution of "good" and "bad" accounts by credit score. Suppose we set the minimum acceptable score at 680 points. If only applications scoring that value or higher were accepted, the firm using the scoring system would avoid lending money to the body of bad customers to the left of the vertical line, but would forgo the smaller body of good accounts to the left of the line. Moving the minimum score line to the right will cut off an even higher fraction of bad accounts but forgo a larger fraction of good accounts, and so on. The score at which the minimum score line is set—the cutoff score—is clearly an important decision for the business in terms of both its likely profitability and the risk that the bank is taking on.

Given the cutoff score, the bank can determine, based on its actual experience, the loss rate and profitability for the retail product. Over time, the bank can adjust the cutoff score in order to optimize the profit margin for each product as well as to reduce the false goods and the false bads. In retail banking, unlike wholesale banking, banks have lots of customers, and it doesn't take too much time to accumulate enough data to assess the performance of a scorecard. However, only by using longer time series can the bank hope to capture behavior through a normal economic cycle. Usually, the statistics on loss rates and profitability are updated on a quarterly basis.

The Basel Capital Accord requires that banks segment their retail portfolios into subportfolios with similar loss characteristics, especially similar prepayment risk. Banks will have to estimate both the PD and the LGD for these portfolios. This can be achieved by segmenting each retail portfolio by score band, with each score band corresponding to a risk level. For each score band, the bank can estimate the loss rate using historical data; then, given an estimate of the LGD, the bank can infer the implied PD. For example, if the actual historical loss rate is 2 percent with a 50 percent LGD, then the implied PD is 4 percent.

The bank should adopt similar risk management policies with respect to all borrowers and transactions in a particular segment. These policies should include underwriting and structuring of the loans, economic capital allocations, pricing and other terms of the lending agreement, monitoring, and internal reporting.

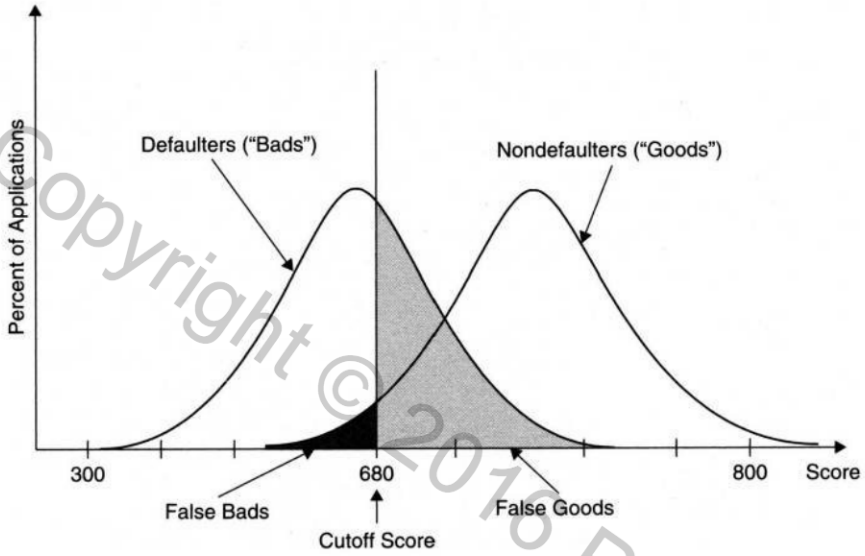


FIGURE 18-2 Distributions of "goods" and "bads."

default in the next 12 months. If our model were perfect, the actual number of accounts that defaulted over that time period would correspond to the first decile of the score distribution—the perfect model line in the figure. Conversely, the 45-degree line corresponds to a random model that cannot differentiate between good and bad customers.

Clearly, the bank hopes that its scoring model results are relatively close to the perfect model line. The area under the perfect model is denoted A_P, while the area under the actual rating model is denoted A_R. The accuracy ratio is AR = A_R/A_P, and the closer this ratio is to 1, the more accurate is the model.

The performance of a scoring model can be monitored—say, every quarter—by means of a CAP curve, and the model replaced when its performance deteriorates. The performance of scoring systems tends not to change abruptly, but it can deteriorate for several reasons: the characteristics of the underlying population may

MEASURING AND MONITORING THE PERFORMANCE OF A SCORECARD

The purpose of credit scoring is to predict which applications will prove to be good or bad risks into the future. To do this, the scorecard must be able to differentiate between the two by assigning high scores to good credits and low scores to poor ones. The goal of the scorecard, therefore, is to minimize the overlapping area of the distribution of the good and bad credits, as we saw in Figure 18-2.

This leads to a number of practical problems that are of interest to risk managers. How can we measure a scorecard's performance? How do we know when to adjust and rebuild scorecards or to change the operating policy?

The validation technique traditionally employed is the cumulative accuracy profile (CAP) and its summary statistic, the accuracy ratio (AR), illustrated in Figure 18-3. On the horizontal axis are the population sorted by score from the highest risk score to the lowest risk score. On the vertical axis are the actual defaults in percentage terms taken from the bank's records. For example, assume that the scoring model predicts that 10 percent of the accounts will

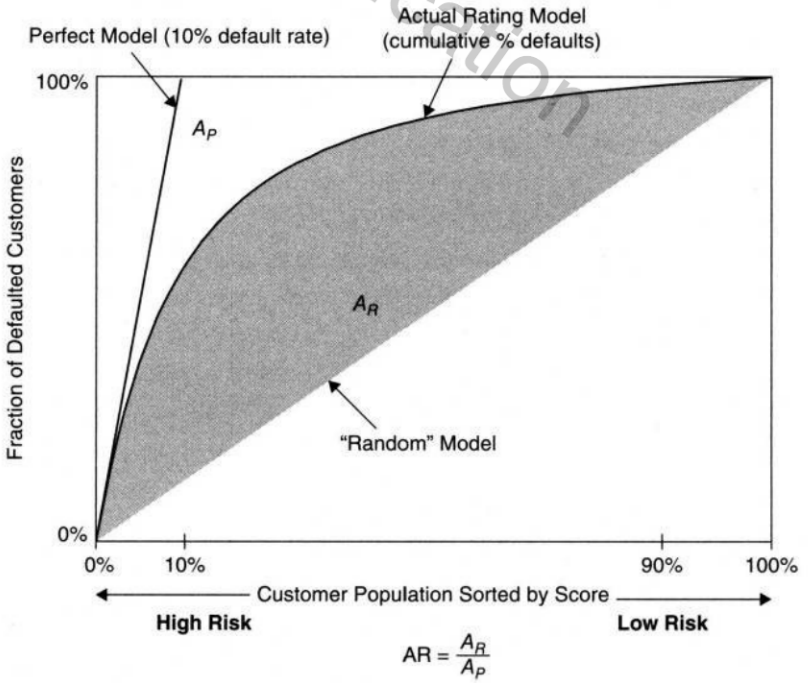


FIGURE 18-3 Cumulative Accuracy Profile (CAP) and Accuracy Ratio (AR).

change over time, and/or the behavior of the population may evolve so as to change the variables associated with a high likelihood of default.

Another reason for replacing a scoring model is that the bank has changed the nature of the products that it is offering to customers. If a financial institution that offers auto loans decides to sell this business and issue credit cards instead, it is highly probable that the target customer population will be different enough to justify the development of a new custom scorecard.

FROM DEFAULT RISK TO CUSTOMER VALUE

As the technology of scorecards has developed, banks have progressed from scoring applications at one point in time to periodic "behavior scoring." Here the bank uses information on the behavior of a current customer, such as usage of the credit line and social demographic information, to determine the risk of default over a fixed period of time. The approach is similar to application scoring, but it uses many more variables that describe the past performance of customers.

This kind of risk modeling is no longer restricted to default estimation. Some time ago, lenders began to shift from simply assessing default risk to making more subtle assessments that are directly linked to the value of customers to the bank. Credit scoring techniques have been applied to new areas, such as response scorecards that predict whether the consumer is likely to respond to a direct marketing offer, usage scorecards that predict how likely it is that the customer will make use of the credit product, and attrition scorecards that estimate how long the customer will remain loyal to the lender. Each customer may now be described by a number of different scores (Box 18-7).

There is often a trade-off to be made between the creditworthiness of customers and their profitability. After all, there's not much point in issuing costly credit cards to creditworthy customers who never use them. Conversely, customers who are marginally more likely to default might still be more profitable than customers with higher scores—e.g., if they tend to borrow money often or are prepared to pay a higher rate of interest. (The key risk management question here is whether the additional profitability really does offset the risks run by the business

BOX 18-7 Some Different Kinds of Scorecards

- *Credit bureau scores* are the classic FICO credit scores available from the main credit bureaus in the United States and Canada.
- *Application scores* support the initial decision as to whether to accept a new applicant for credit.
- *Behavior scores* are risk estimators similar to application scores, but they use information on the behavior of existing credit account holders—e.g., usage of credit and delinquency history.
- *Revenue scores* aim at predicting the profitability of existing customers.
- *Response scores* predict the likelihood that a customer will respond to an offer.
- *Attrition scores* estimate the likelihood that existing customers will close their accounts, won't renew a credit such as a mortgage, or will reduce their balance on existing credits.
- *Insurance scores* predict the likelihood of claims from insured parties.
- *Tax authority scores* predict whom the tax inspector should audit in order to collect additional revenues.

line over the longer term—i.e., will the default rate for the marginally less creditworthy customer shoot up if the economy turns sour?)

Leading banks are therefore experimenting with ways to take into account the complex interplay of risk and reward. They are moving away from traditional credit default scoring toward product profit scoring (which seeks to estimate the profit the lender makes on a specific product from the customer) and to customer profit scoring (which tries to estimate the total profitability of the customer to the lender). Using this kind of advanced information, lenders can select credit limits, interest margins, and other product features to maximize the profitability of the customer. And they can adjust these risk, operating, and marketing parameters during their relationship with the customer.

In particular, the market is becoming accustomed to "risk-based pricing" for credit products—the idea that customers with different risk profiles should pay different amounts for the same product. Increasingly, banks understand that a "one price fits all" policy in a competitive market leads to *adverse selection*—i.e., the bank will primarily attract high-risk customers, to whom the

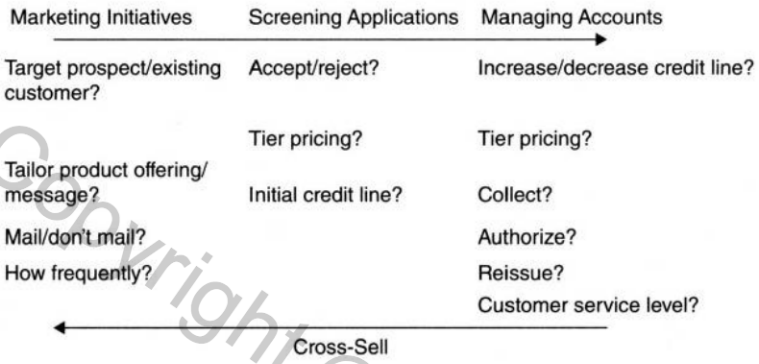


FIGURE 18-4 The customer relationship cycle.

product is attractive, and discourage low-risk customers (for the opposite reason). The degree of adverse selection suffered by a bank may only become apparent when the economic climate deteriorates.

Figure 18-4 summarizes the customer relationship cycle that best-practice banks have been developing for some years. *Marketing initiatives* include targeting new and existing customers for a new product or tailoring an existing product and/or offer to the specific needs of a customer; these initiatives are the result of detailed marketing studies that analyze the most likely response of various client segments. *Screening applicants* consists of deciding which applications to accept or reject on the basis of scorecards, in terms of both granting the initial credit line and setting the appropriate pricing for the risk level of the client. *Managing the account* is a dynamic process that involves a series of decisions based on observed past behavior and activity. These include modifying a credit line and/or the pricing of a product, authorizing a temporary excess in the use of a credit line, renewing a credit line. and collecting past due interest and/or principal on a delinquent account. *Cross-selling* initiatives close the loop on the customer relationship cycle. Based on a detailed knowledge of existing customers, the bank can initiate actions to induce existing customers to buy additional retail products. For example, for a certain category of customers who already have checking and savings accounts, the bank can offer a mortgage, a credit card, insurance products, and so on. In this retail relationship cycle, risk management has become an integral part of the broader business decision-making process.

Since the 2007–2009 financial crisis, a couple of significant trends have emerged to improve this classic approach to credit scoring and its application.[4] First, there has been a bigger push to understand how changes in macroeconomic factors (e.g., house prices, unemployment) might affect the behavior of given score bands so that predicted default rates can be adjusted to account for the current stage of the economic cycle. This effort ties in with the efforts to stress test how retail credit risk portfolios might perform in stressful macroeconomic scenarios. The hope is that business decisions can be made more forward-looking if they are adjusted to account for baseline projections for the economy (i.e., consensus macroeconomic expectations) and also take into account the capital costs and potential losses implied by the raised default rates of adverse scenarios. This kind of forward-looking economic calibration can be augmented with other kinds of adjustment for potential social and behavioral changes—e.g., changes in the laws surrounding personal finance.

Second, firms have begun to look more closely at how they can test responses to variations in product offerings and then monitor the early performance of those taking up retail offers (e.g., credit cards). Lessons from this market and performance "tasting" exercise can then be fed back into the wider marketing campaign, after the implications have been filtered through a sophisticated understanding of how any strategy adjustments will affect capital costs and risk-adjusted profitability.

Both of these trends can be seen as part of the broader attempt to make risk-adjusted decision making in retail banking more forward-looking, granular, and responsive to social and economic change (as opposed to a more static, less focused view based on historical data).

THE BASEL REGULATORY APPROACH

Traditionally, consumer credit evaluation has modeled each loan or customer in isolation—a natural outcome of the development of application scoring. But lenders are really interested in the characteristics of whole *portfolios* of retail loans. This interest has been reinforced by the emphasis on internal ratings-based modeling in Basel II and III.

[4] For example, see discussion in Andrew Jennings, "A 'New Normal' Is Emerging—But Not Where Most Banks Expect," *FICO Insights*, No. 53, July 2011.

The Basel III regulatory framework allows banks to use either a Standardized Approach or an Advanced Approach to calculate the required amount of regulatory capital. Under the Advanced Approach, the bank itself estimates parameters for probability of default and loss given default and applies these to its consumer credit risk model in order to estimate the distribution of default loss for various consumer segments.

The Accord considers three retail subsectors—residential mortgages, revolving credit, and other retail exposures such as installment loans—and applies three different formulas to capture the risk of the risk-weighted assets. It's an approach that has highlighted the need for banks to develop accurate estimates of default probability (rather than simply rely on relative credit scores) and to be able to segment their loan portfolios. Provided banks can convince regulators that their risk estimates are accurate, they will be able to minimize the amount of capital required to cover expected and unexpected retail default losses.

SECURITIZATION AND MARKET REFORMS

We discuss securitization and the transfer of consumer credit risk in Chapter 19, with a quick recap here because securitization has been such an important feature of the consumer lending markets.

Before the start of the subprime crisis in 2007, around 50 percent of all home mortgages were securitized in the United States. Though the crisis halted almost all private label mortgage securitizations (i.e., those not backed by the guarantees of government-sponsored entities), the private label market was reformed in the post-crisis years and is slowly reviving. Meanwhile, certain securitization markets based on consumer lending, including those for auto lending, credit card receivables, and student loans, continued to perform in relatively good health.

The phenomenon of securitization initially took hold in the U.S. home mortgage markets. By the late 1970s, a substantial proportion of home mortgages were being securitized, and the trend intensified in the 1980s. A catalyst for the development of mortgage securitization in the United States was the federal government's sponsorship of some key financial agencies—namely, the Federal National Mortgage Association (FNMA, or Fannie Mae), the Federal Home Loan Mortgage Corporation (FHLMC, or Freddie Mac), and the Government National Mortgage Association (GNMA, or Ginnie Mae). These agencies issue securities that pay out to investors using income derived from pools of home mortgages originated by banks and other financial intermediaries. In order to qualify for inclusion in these pools, mortgages must meet various requirements in terms of structure and amount. However, from the 1990s, the market for private label securitization began to grow quickly and to develop various different kinds of mortgage-backed and other securitization products.

Collateralized Mortgage Obligation (CMO) payments are divided into tranches (such as mortgage-backed securities or MBS), with the first tranche receiving the first set of payments and other tranches taking their turn. Asset-backed securities (ABSs) is a term that applies to instruments based on a much broader array of assets than MBSs, including, for example, credit card receivables, auto loans, home equity loans, and leasing receivables.

Selling the cash flows from these loans to investors through some kind of securitization means that the bank gains a principal payment up front, rather than having the money trickle in over the life of the retail product. The securities might be sold to third parties or issued as tranched bonds in the public marketplace—i.e., classes of senior and subordinated bonds awarded ratings by a rating agency.

Securitizations can take many forms in terms of their legal structure, the reliability of the underlying cash flows, and the degree to which the bank sells off or retains the riskier tranches of cash flows. In some instances, the bank substantially shifts the risk of the portfolio to the investors and through this process reduces the economic risk (and the economic capital) associated with the portfolio. The bank gives up part of its income from the borrowers and is left with a profit margin that should compensate it for the initiation of the loans and for servicing them.

In other instances, the securitization is structured with regulatory rules in mind to reduce the amount of risk capital that regulators will require the bank to set aside for the particular consumer portfolio in question. Sometimes, this means that only a much smaller amount of the economic risk of the portfolio is transferred to investors, a practice motivated by *regulatory arbitrage*—i.e., reduction in the capital charges attracted by different kinds of asset.

In the run-up to the 2007–2009 financial crisis, three key trends undermined the health of the mortgage (and other) securitization markets:

- Subprime and similarly risky lending began to be originated specifically for securitization, often by firms (e.g., brokers) that were lightly capitalized and regulated and that had no long-term interest in controlling the quality of the underlying loans (Box 18-4).
- Subprime credit was wrapped up into complex securities, which were given high ratings that turned out to be based on fragile assumptions.
- Banks failed to distribute the securitized risk and instead held large amounts of the securitized risk themselves, either directly or through investment vehicles of various kinds.

We discuss the crisis and the securitization reforms it led to in more detail in Chapter 19. From the perspective of originators of consumer credit, the key effect of these reforms will be to:

- Improve disclosure and transparency by providing investors with more detailed and accurate information about the assets underlying the securitization
- Make originators more accountable by obliging them to retain a portion (e.g., 5%) of the economic interest
- Make rating methodologies and assumptions public, and rating agencies more accountable
- Set capital requirements to a level that better reflects the risks of securitizations

In addition, the crisis led to a series of reforms aimed at preventing financial institutions from abusing customers. These are likely to have a significant effect on behavior in the U.S. retail markets over the long term.

RISK-BASED PRICING

We mentioned earlier that risk-based pricing (RBP) is increasingly popular in retail financial services, encouraged by both competitive and regulatory trends. By risk-based pricing for financial services we mean explicitly incorporating risk-driven account economics into the annualized interest rate that is charged to the customer at the account level. The key economic factors here include operating expenses, the probability of take-up (i.e., the probability that the customer will accept a product offering), the probability of default, the loss given default, the exposure at default, the amount of capital allocated to the transaction, and the cost of equity capital to the institution.

Many leading financial institutions have already adopted some form of RBP for acquisitions in their auto loan, credit card, and home mortgage business lines. Since the 2007–2009 financial crisis, banks have recognized the need to factor into RBP some longer-term considerations. Still, RBP in the financial retail area remains in its infancy. A bank's key business objectives are seldom adequately reflected in its pricing strategy. For example, the ability to properly price low-balance accounts versus high-balance revolvers is often inadequate. Further, setting cutoff scores in concert with *tiered pricing*[5] is often based on ad hoc heuristics rather than deep pragmatic analytics. A tiered pricing policy that sets price as an increasing function of riskier score bands can make risk-based pricing easier and more effective. A well-designed RBP strategy allows the bank to map alternative pricing strategies at the credit score level to key corporate metrics (e.g., revenue, profit, loss, risk-adjusted return, market share, and portfolio value) and is a critical component of best-practice retail management. RBP incorporates key factors from both the external market data (such as the probability of take-up, which in turn is a function of price and credit limit) and internal data (such as the cost of capital).

RBP enables retail bank managers to raise shareholder value by achieving management objectives while taking multiple constraints into consideration, including trade-offs among profit, market share, and risk. Mathematical programming algorithms (such as integer programming solutions) have been developed to efficiently achieve these management objectives, subject to the aforementioned constraints. Pricing is a key tool for retail bankers as they balance the goal of increasing market share against the goal of reducing the rate of bad accounts.

To increase market share in a risk-adjusted manner, a retail bank might examine the rate of bad accounts as a function of the percentage of the overall population acceptance rate (strategy curve). Traditional retail pricing leaves a considerable amount of money on the table; better

[5] By tiered pricing, we mean pricing differentiated by score bands above the cutoff score—the higher the score, the lower the price.

pricing can improve key corporate performance metrics by 10 to 20 percent or more.

RBP should also be used, in our view, when nonbanks offer credit to customers and small businesses. However, it requires a logistical and operational infrastructure that many retailers lack. Hence they tend to rely more on credit card payments as well as payments backed by financial institutions.

TACTICAL AND STRATEGIC RETAIL CUSTOMER CONSIDERATIONS

There are various tactical applications for scoring technologies, such as determining which customers are more likely to stay (or to leave) and finding approaches to reduce attrition (or increase loyalty) among the right customers. The technologies might also help banks decide on the best product to offer a particular customer, help them work out how to interest customers in new types of services such as retirement planning, and help them determine how aggressively they should be approaching customers.

There are also many strategic considerations. For example, is the bank extracting enough "lifetime value" from an individual account? How much future value can the bank expect from its customer portfolio, and what are the real sources of this value? Ideally, the bank should be able to compare its performance relative to its peers (e.g., in terms of market share) as it strives to win and keep the right kind of customer portfolios.

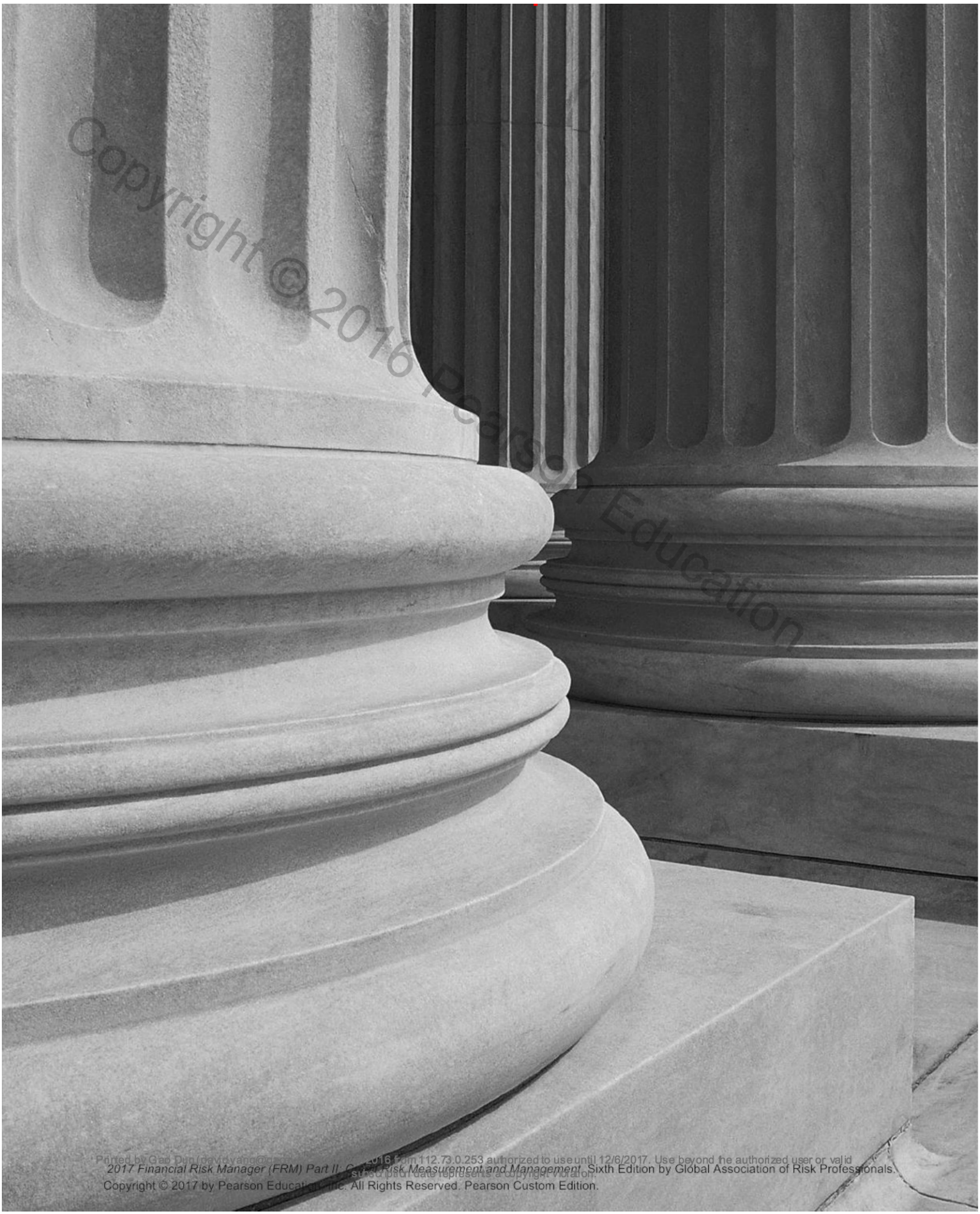
CONCLUSION

In this chapter, we've seen that many quantitative advances have emerged in the retail credit risk area to help shape business strategies throughout the customer life cycle.

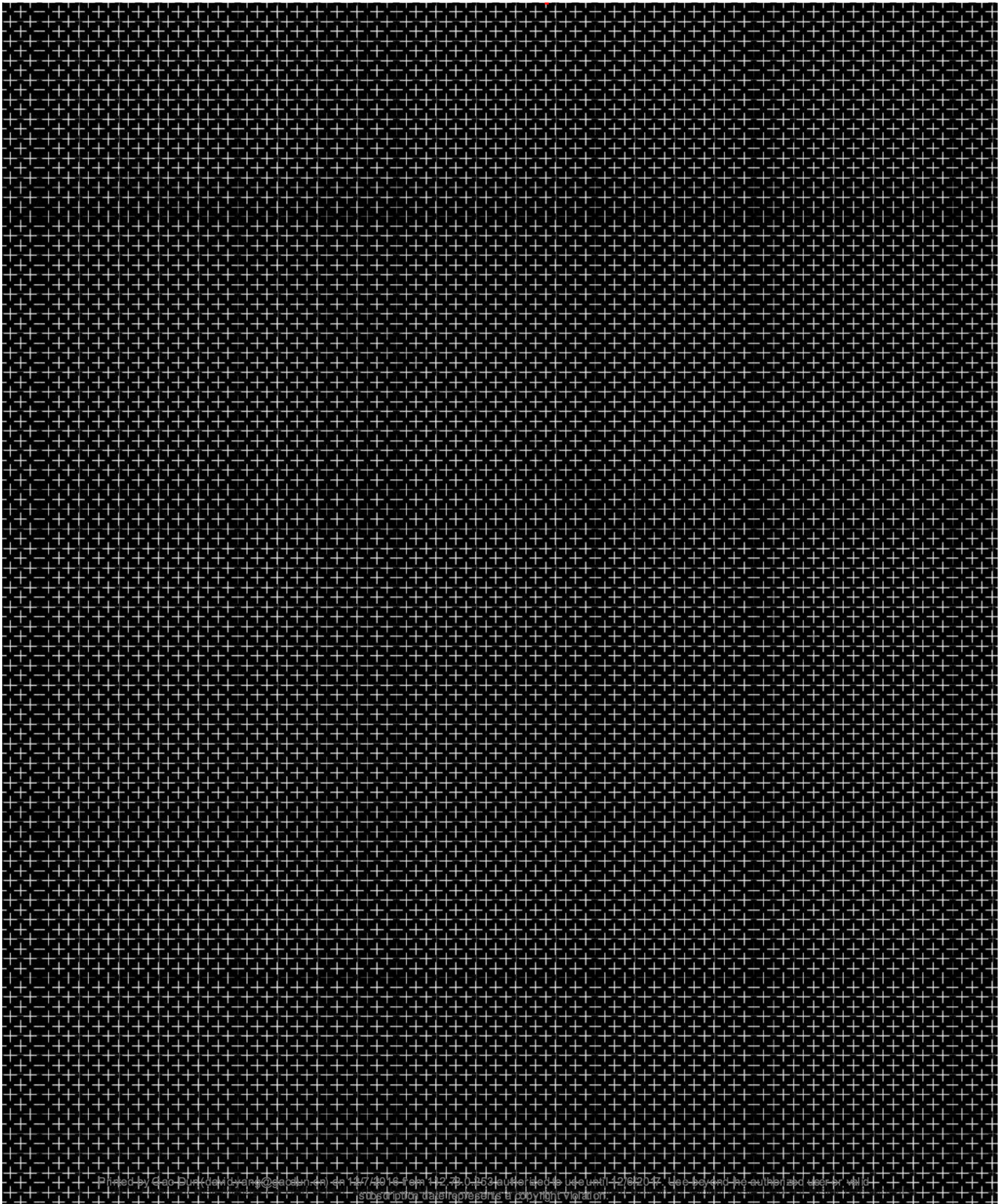
At credit origination, analytical models can now help to identify customers who are likely to be profitable, predict their propensity to respond to an offering, align consumer preferences with products, assess borrowers' creditworthiness, determine line/loan authorization, apply risk-based pricing, and evaluate the relationship value of the customer.

Throughout loan servicing, analytical methods are used to anticipate consumer behavior or payment patterns, determine opportunities for cross-selling, assess prepayment risk, identify any fraudulent transactions, optimize customer relationship management, and prioritize the collection effort (to maximize recoveries in the event of delinquency). Increasingly, risk-based pricing can be used to analyze trade-offs and to determine the "optimal" multitier, risk-based pricing strategy.

However, in applying the quantitative methodologies to measure expected loss, banks have to be sure they are not overlooking the darker side of retail risk. Every new product or marketing technology introduces the danger that a systematic risk will be introduced into the credit portfolio—i.e., a common risk factor that causes losses to rise unexpectedly high once the economy or consumer behavior moves into a new configuration. The new scoring models are a tool that must be applied with a considerable dose of judgment, based on a deep understanding of each consumer product and the role it plays in the relevant customer segment.



2017 Financial Risk Manager (FRM) Part II: Credit Risk Measurement and Management, Sixth Edition by Global Association of Risk Professionals.



The Credit Transfer Markets—and Their Implications

19

Learning Objectives

After completing this reading you should be able to:

- Discuss the flaws in the securitization of subprime mortgages prior to the financial crisis of 2007.
- Identify and explain the different techniques used to mitigate credit risk, and describe how some of these techniques are changing the bank credit function.
- Describe the originate-to-distribute model of credit risk transfer, and discuss the two ways of managing a bank credit portfolio.
- Describe the different types and structures of credit derivatives including credit default swaps (CDS), first-to-default puts, total return swaps (TRS), asset-backed credit-linked notes (CLN), and their applications.
- Explain the credit risk securitization process, and describe the structure of typical collateralized loan obligations (CLOs) or collateralized debt obligations (CDOs).
- Describe synthetic CDOs and single-tranche CDOs.
- Assess the rating of CDOs by rating agencies prior to the 2007 financial crisis.

Excerpt is Chapter 12 of The Essentials of Risk Management, *Second Edition, by Michel Crouhy, Dan Galai, and Robert Mark.*

A number of years ago, Alan Greenspan, then chairman of the U.S. Federal Reserve, talked of a "new paradigm of active credit management." He and other commentators argued that the U.S. banking system weathered the credit downturn of 2001–2002 partly because banks had transferred and dispersed their credit exposures using novel credit instruments such as credit default swaps (CDSs) and securitization such as collateralized debt obligations (CDOs).[1] This looked plain wrong in the immediate aftermath of the 2007–2009 financial crisis, with credit transfer instruments deeply implicated in the catastrophic buildup of risk in the banking system.

Yet, as the dust has settled in the years after the crisis, a more measured view has taken hold. First, it became evident that in certain respects the CDS market had performed quite robustly during and after the crisis and had indeed helped to manage and transfer credit risk, though at the cost of some major systemic and counterparty concerns that needed to be addressed. Second, many commentators came around to the view that although the crisis was precipitated in part by complex credit securitization such as CDOs, this may have had more to do with the inadequacies of the pre-crisis securitization process than with the underlying principle of credit risk transfer. Some parts of the securitization industry, such as securitizing credit card receivables, remained viable through much of the crisis and beyond—perhaps because risk remained relatively transparent to investors.

Going forward, the picture for credit transfer markets and strategies is mixed (Table 19-1). Some pre-crisis markets and instruments were killed off by the turmoil and seem likely never to reappear, at least in the shape and size they once assumed. Others remained moribund for a couple of years after the crisis but then began to recover and reform: they may grow quickly again once the economy picks up and interest rates rise high enough to support expensive securitization processes. Still others were relatively unhurt in the crisis.

Meanwhile, new credit risk transfer strategies are appearing, including a trend for insurance companies to purchase loans from banks to build asset portfolios that match their long-term liabilities. Indeed, the high capital costs associated with post-crisis reforms (e.g., Basel III)

[1] Alan Greenspan, "The Continued Strength of the U.S. Banking System," speech, October 7, 2002.

TABLE 19-1 Credit Transfer Markets: Will They Survive and Revive?

Under scrutiny, but relatively robust	• Credit default swaps. • Consumer asset-backed securities (non-real estate)—e.g., auto loans, credit card receivables, leases, student loans. • Government entity sponsored MBS. • Asset-backed commercial paper programs (traditional model).
Low-state convalescence, but reforming with potentially fast revival	• Private label mortgage backed securities (MBS): U.S. market gradually picking up but suffering from uncertainty about regulatory proposals. • CLO: Despite some mild downgrades, CLO credit quality was relatively robust during and after the crisis. The market was largely dormant for a few years, but volumes of new CLOs began to grow quite quickly through 2011 and 2012 into 2013.
Moribund, with limited chance of revival	• CDO-squared. • Other forms of overly complex securitization (single-tranche CDOs). • Asset-backed commercial paper nontraditional programs (including complex securitizations).
New and revived post-crisis markets	• Partnerships with insurance companies: Banks originate and structure loans—e.g., long-term infrastructure loans—which are funded by insurance companies. Risk is transferred in total or partially to the insurance company. • Covered bonds: These are funding instruments, as no credit risk is transferred. Covered bond markets were well established in some countries—e.g., Germany (Pfandbriefe)—before the crisis and have spread and grown since the crisis as a funding technique trusted by investors. • Resecuritization of downgraded AAA products (Re-Remics, etc.).

suggest that the "buy and hold" model of banking will remain a relatively inefficient way for banks to manage the credit risk that lending and other banking activities generate. Regulators as well as industry participants are keen to support the reemergence of reformed securitization markets in order to help banks obtain funding and encourage economic growth. In the longer term, the 2007–2009 crisis is likely to be seen as a constructive test by fire for the credit transfer market rather than a test to destruction.

It is another episode in a longer process, observable since the 1970s, in which developing and maturing credit markets have driven changes in the business models of banks. Each crisis, each new regulation, eventually drives banks further away from the buy-and-hold traditional intermediation model toward adopting the originate-to-distribute (OTD) business model that surfaces throughout this chapter and that is introduced in Box 19-1.

The first section of this chapter discusses what went wrong with the securitization of subprime mortgages and the important lessons to be learned. The rest of the chapter takes a look at how leading global banks and major financial institutions continue to manage their credit portfolios using credit risk transfer instruments and strategies,

BOX 19-1 Credit Markets Are Driving Long-Term Changes in Banks

New technologies aren't the only thing that's driving change in the banking industry. Over the last two decades or so, the portfolios of loans and other credit assets held by banks have become increasingly more concentrated in less creditworthy obligors. This situation has made some banks more vulnerable during economic downturns, such as in 2001–2002 and 2008–2009, when some banks experienced huge credit-related losses in sectors such as telecommunications, cable, energy, and utilities (2001–2002) or real estate, financial institutions and insurance, and automobiles (2008–2009).

Defaults have reached new levels during each successive credit crisis since the early 1990s. Default rates for speculative-grade corporate bonds were 9.2 percent and 9.5 percent in 2001 and 2002, respectively, versus 8 percent and 11 percent in 1990 and 1991, respectively, and 3.6 percent and 9.5 percent in 2008 and 2009, respectively. However, in terms of volume, the default record was much worse in later crises than in the early 1990s: it reached the unprecedented peak of $628 billion in 2009, according to Standard & Poor's, compared with approximately $20 billion in 1990 and 1991 and $190 billion in 2002.[1]

At the same time that default rates were high, recovery rates were also abnormally low, producing large credit-related losses at most major banks.

Two forces have combined to lead to a concentration of low-quality credits in loan portfolios:

- First, there is the "disintermediation" of banks that started in the 1970s and continues today. This trend means that large investment-grade firms are more likely to borrow from investors by issuing bonds in the efficient capital markets, rather than borrowing from individual banks.
- Second, current regulatory capital rules make it more economical for banks on a risk-adjusted return basis to extend credit to lower-credit-quality obligors.

As a consequence, and due to enhanced competition, banks have found it increasingly difficult to earn adequate economic returns on credit extensions, particularly those to investment-grade borrowers. Lending institutions, primarily commercial banks, have determined that it is no longer profitable to simply make loans and then hold them until they mature.

But we can put a positive spin on this story, too. Banks are finding it more and more profitable to concentrate on the origination and servicing of loans because they have a number of natural advantages in these activities. Banks have built solid business relationships with clients over the years through lending and other banking services. Banks also have hugely complex back offices that facilitate the efficient servicing of loans. In addition, despite setbacks from the 2007–2009 financial crisis, the major banks have a distribution network that allows them to dispose of financial assets to retail and institutional investors, either directly or through structured products. Finally, some banks have developed a strong expertise in analyzing and structuring credits.

Banks are better able to leverage these advantages as they move away from the traditional "buy and hold" business model toward an "originate to distribute" (OTD) business model. Under this model, banks service the loans, but the funding of the loans is outsourced to investors and, to some extent, the risk of default is shared with outside parties. Much of this chapter discusses the problems with the execution of the OTD model that helped provoke the 2007–2009 financial crisis—a mode of execution that required reform. However, the OTD model itself has not gone away and is likely to continue to help shape the future of banking.

[1] Standard & Poor's, *Annual Global Corporate Default Study*, March 2012.

including traditional strategies such as loan sales. We explore how these techniques affect the way in which banks organize their credit function, and we examine the different kinds of credit derivatives and securitization. Although the following discussion is framed in terms of the banking industry, much of it is relevant to the management of credit risks borne by leasing companies and large nonfinancial corporations in the form of account receivables and so on. This is particularly true for manufacturers of capital goods, which very often provide their customers with long-term credits.

WHAT WENT WRONG WITH THE SECURITIZATION OF SUBPRIME MORTGAGES?

Securitization involves the repackaging of loans and other assets into securities that can then be sold to investors. Potentially, this removes considerable liquidity, interest rate, and credit risk from the originating bank's balance sheet compared to a traditional "buy and hold" banking business model.

Over a number of years, certain banking markets shifted quite significantly to this new "originate to distribute" (OTD) business model, and the move gathered pace in the years after the millennium. Credit risk that would once have been retained by banks on their own books was sold, along with the associated cash flows, to investors in the form of mortgage-backed securities and similar investment products. In part, the banking industry's enthusiasm for the OTD model was driven by Basel capital adequacy requirements: banks sought to optimize their use of capital by moving capital-hungry assets off their books. Accounting and regulatory standards also tended to encourage banks to focus on generating the upfront fee revenues associated with the securitization process.

For many years, the shift toward the OTD business model seemed to offer many benefits to the financial industry, not least by facilitating portfolio optimization through diversification and risk management through hedging.

- Originators benefited from greater capital efficiency, enhanced funding availability, and, at least in the short term, lower earnings volatility (since the OTD model seemed to disperse credit and interest rate risk across many participants in the capital markets).
- Investors benefited from a greater choice of investments, allowing them to diversify and to match their investment profile more closely to their preferences.
- Borrowers benefited from the expansion in credit availability and product choice, as well as lower borrowing costs.

However, the benefits of the OTD model were progressively weakened in the years preceding the financial crisis, and risks began to accumulate. The fundamental reasons for this remain somewhat controversial, at least in terms of their relative importance. However, everyone agrees that one problem was that the OTD model of securitization reduced the incentives for the originator of the loan to monitor the creditworthiness of the borrower—and that too few safeguards had been in place to offset the effects of this.

For example, in the securitization food chain for U.S. mortgages, every intermediary in the chain charged a fee: the mortgage broker, the home appraiser, the bank originating the mortgages and repackaging them into mortgage-backed securities (MBS), the investment bank repackaging the MBS into collateralized debt obligations, and the credit rating agencies giving their AAA blessing to such instruments. But the intermediaries did not necessarily retain any of the risk associated with the securitization, and the intermediary's income, as well as any bonuses paid, was tied to deal completion and deal volume rather than quality.

Eventually the credit risk was transferred to a structure that was so complex and opaque that even the most sophisticated investors had no real idea what they were holding, Instead, investors relied heavily on rating agency opinions and on the credit enhancements made to the securities by financial guarantors (monolines and insurance companies such as AIG). The lack of transparency of the securitized structures made it difficult to monitor the quality of the underlying loans and added to the fragility of the system.

The growth of the credit default swap market and related credit index markets made credit risk easier to trade and to hedge. This greatly increased the perceived liquidity of credit instruments. In the broader market, the low credit risk premiums and rising asset prices contributed to low default rates, which again reinforced the perception of low levels of risk.

Nevertheless, although the flawed securitization process and the failures of the rating agencies (see Appendix 19.1) were clearly important factors, the financial crisis occurred largely because banks did *not* follow the OTD business model. Rather than acting as intermediaries by transferring the risk from mortgage lenders to capital market investors, many banks themselves took on the role of investors.[2] For example, relatively little credit transfer took place in the mortgage market; instead, banks retained or bought a large amount of securitized mortgage credit risk.

In particular, risks that should have been broadly dispersed under a classic OTD model turned out to have been concentrated in entities set up to get around regulatory capital requirements. Banks and other financial institutions achieved this by establishing highly leveraged off-balance-sheet asset-backed commercial paper (ABCP) conduits and structured investment vehicles (SIVs). These vehicles allowed the banks to move assets off their balance sheets; it cost a lot less capital[3] to hold a AAA-rated CDO tranche at arm's length in an investment vehicle than it did to hold a loan on the balance sheet.

While the capital charges fell, the risks mounted up. The conduits and SIVs were backed by small amounts of equity and were funded by rolling over short-term debt in the asset-backed commercial paper markets, mainly bought by highly risk-averse money market funds. If things went wrong, the investment vehicles had immediate recourse to their sponsor bank's balance sheet through various pre-agreed liquidity lines and credit enhancements (and because bank sponsors did not want to incur the reputational damage of a vehicle failure).[4]

In many cases, banks set up their investment vehicles to warehouse undistributed CDO tranches for which they could not find any buyers. In other cases, banks set up the vehicles to hold senior tranches of CDOs and similar, rated AAA or AA, because the yield was much higher than the yield on corporate bonds with the same rating. There was a reason for this higher yield, of course. In Boxes 19-2 and 19-3 we discuss why banks bought so many subprime securities and how the involvement of European banks helped to transfer a crisis in U.S. subprime lending across the Atlantic.

While the banks' investment vehicles benefited from regulatory and accounting incentives, they operated without real capital buffers and were running considerable risks in the event of a fall in market confidence.

BOX 19-2 Why Did Banks Buy So Many Subprime Securities?

In mid-2007, at the start of the financial crisis, U.S. financial institutions such as banks and thrifts, government sponsored enterprises (GSEs), broker-dealers, and insurance companies, were holding more than $900 billion of tranches of subprime MBS. Why did they hold so much?

At the peak of the housing bubble, spreads on AAA-rated tranches of subprime MBSs (based on the ABX index) were 18 bps versus 11 bps for similarly rated bonds. The yields were 32 bps versus 16 bps for AA· rated securities, 54 bps versus 24 bps for A-rated securities, and 154 bps versus 48 bps for BBB-rated securities.

Taking a position in highly rated subprime securities therefore seemed to promise an outsized return, most of the time. Investing institutions would face losses only in the seemingly unlikely event that, say, the AAA-rated tranches of the CDOs were obliged to absorb losses. If this rare event occurred, however, it would surely be in the form of a systemic shock affecting all markets. Financial firms were, in essence, writing a very deep out-of-the-money put option on the market.

Of course, the problem with writing a huge amount of systemic insurance like this is that in the middle of any general crisis, firms would be unlikely to easily absorb the losses and the financial system would be destabilized. Put simply, firms took a huge asymmetric bet on the U.S. real estate market—and the financial system lost.

[2] According to the *Financial Times* (July 1, 2008), 50 percent of AA-rated asset-backed securities were held by banks, conduits, and SIVs. As much as 30 percent was simply parceled out by banks to each other, while 20 percent sat in conduits and SIVs.

[3] Capital requirements for such off-balance-sheet entities were roughly one-tenth of the requirement had the assets been held on the balance sheet.

[4] These enhancements implied that investors in conduits and SIVs had recourse to the banks if the quality of the assets deteriorated—i.e., investors had the right to return assets to the bank if they suffered a loss. There was very little in the way of a capital charge for these liquidity lines and credit enhancements.

BOX 19-3 Sachsen and Subprime Securities

It is striking that some of the biggest buyers of U.S. subprime securities were European banks, including publicly owned banks in Germany: the Landesbanken.

One of the most notorious examples was the Sachsen Landesbank located in Leipzig in the State of Saxony, deep within the boundaries of the old East Germany. Landesbanks traditionally specialize in lending to regional small- and medium-sized companies, but during the boom years some began to open overseas branches and develop investment banking businesses.

Sachsen opened a unit in Dublin, Ireland, which focused on establishing off-balance-sheet vehicles to hold very large volumes of mainly highly rated U.S. mortgage-backed securities. However, in effect, the vehicles benefited from the guarantee of the parent bank, Sachsen itself.

The operation was highly profitable until 2007, contributing 90 percent of the group's total profit in 2006.[1] However, the operation was too large relative to the size of the balance sheet and capital of the parent bank. When the subprime crisis struck in 2007, the rescue operation wiped out the capital of the parent bank, and Sachsen had to be sold to another German state bank.

[1] See P. Honohan, "Bank Failures: The Limitations of Risk Modelling," Working Paper, 2008, for a discussion of this and other bank failures. Honohan (p. 24) says that reading Sachsen's 2007 Annual Report suggests, "The risk management systems of the bank did not consider this [funding liquidity commitment] as a credit or liquidity risk, but merely as an operational risk, on the argument that only some operational failure could lead to the loan facility being drawn down. As such it was assigned a very low risk weight attracting little or no capital."

- Some leveraged SIVs incurred significant liquidity and maturity mismatches, making them vulnerable to a classic bank run (or, in this case, shadow bank run).
- The banks and those that rated the bank vehicles misjudged the liquidity and credit concentration risks that would be posed by any deterioration in economic conditions.
- Investors often misunderstood the composition of the assets in the vehicles; this made it even more difficult to maintain confidence once markets began to panic.
- Banks also misjudged the risks created by their explicit and implicit commitments to the vehicles, including reputational risks arising from the sponsorship of the vehicles.
- Financial institutions adopted a business model that assumed substantial ongoing access to funding liquidity and asset market liquidity to support the securitization process.
- Firms that pursued a strategy of actively packaging and selling their original credit exposures retained increasingly large pipelines of these exposures without adequately measuring and managing the risks that would materialize if markets were disrupted and the assets could not be sold.

These problems, and the underlying weaknesses that gave rise to them, show that the underpinnings of the OTD model need to be strengthened. Bank leverage, poor origination practices, and the fact that financial firms chose not to transfer the credit risk they originated—while pretending to do so—were major contributors to the crisis. Among the issues that need to be addressed are:[5]

- Misaligned incentives along the securitization chain, driven by the search for short-term profits. This was the case at many originators, arrangers, managers, and distributors, while investor oversight of these participants was weakened by complacency and the complexity of the instruments.

[5] Currently, regulations under the Dodd-Frank Wall Street Reform and Consumer Protection Act propose that banks keep 5 percent of each CDO structure they issue. The regulations shall, according to the Dodd-Frank Act, "prohibit a securitizer from directly or indirectly hedging or otherwise transferring the credit risk that the securitizer is required to retain with respect to an asset." However, as discussed in Acharya et al. (2010), an important missing element in the Dodd-Frank Act is a precise discussion of how the 5 percent allocation should be spread across the tranches and how this will affect capital requirements. In particular, regulators should decree that first-loss positions be included in the retained risks.

As proposed by Acharya et al. (2010), it may be necessary to enforce rigorous underwriting standards—e.g., a maximum loan-to-value (LTV) ratio, a maximum loan to income that varies with the credit history of the borrower, and so on. More generally, the answer might be found in some careful combination of underwriting standards and skin-in-the-game risk retentions.

V. Acharya, T. Cooley, M. Richardson, and I. Walter, eds., *Regulating Wall Street: The Dodd-Frank Act and the New Architecture of Global Finance*, Wiley, 2010.

- Lack of transparency about the risks underlying securitized products, in particular the quality and potential correlations of underlying assets.
- Poor management of the risks associated with the securitization business, such as market, liquidity, concentration, and pipeline risks, including insufficient stress testing of these risks.
- Overreliance on the accuracy and transparency of credit ratings. Despite their central role in the OTD model, CRAs did not adequately review the data underlying securitized transactions and also underestimated the risks of subprime CDO structuring. We discuss this further in Appendix 19.1.

Later in the chapter, we summarize some of the practical industry reforms that have been taken, or are in development, to address these issues. For the moment, though, let's remind ourselves of why various forms of credit transfer are so important to the future of the banking industry.

WHY CREDIT RISK TRANSFER IS REVOLUTIONARY . . . IF CORRECTLY IMPLEMENTED

Over the years, banks have developed various "traditional" techniques to mitigate credit risk, such as bond insurance, netting, marking to market, collateralization, termination, or reassignment (see Box 19-4). Banks also typically syndicate loans to spread the credit risk of a big deal (as we describe in Box 19-5) or sell off a portion of the loans that they have originated in the secondary loan market.

These traditional mechanisms reduce credit risk by mutual agreement between the transacting parties, but they lack flexibility. Most important, they do not separate or

BOX 19-4 "Traditional" Credit Risk Enhancement Techniques

In the main text, we talk about the newer generation of instruments for managing or insuring against credit risk. Here, let's remind ourselves about the many traditional approaches to credit protection:

- *Bond insurance*. In the U.S. municipal bond market, the issuer purchases insurance to protect the purchaser of the bond (in the corporate debt market, it is usually the lender who buys default protection). Approximately one-third of new municipal bond issues are insured, helping municipalities to reduce their cost of financing.
- *Guarantees*. Guarantees and letters of credit are really also a type of insurance. A guarantee or letter of credit from a third party of a higher credit quality than the counterparty reduces the credit risk exposure of any transaction.
- *Collateral*. A pledge of collateral is perhaps the most ancient way to protect a lender from loss. The degree to which a bank suffers a loss following a default event is often driven largely by the liquidity and value of any collateral securing the loan; collateral values can be quite volatile, and in some markets they fall at the same time that the probability of a default event rises (e.g., the collateral value of real estate can be quite closely tied to the default probability of real estate developers).
- *Early termination*. Lenders and borrowers sometimes agree to terminate a transaction by means of a mid-market quote on the occurrence of an agreed-upon event, such as a credit downgrade.
- *Reassignment*. A reassignment clause conveys the right to assign one's position as a counterparty to a third party in the event of a ratings downgrade.
- *Netting*. A legally enforceable process called netting is an important risk mitigation mechanism in the derivative markets. When a counterparty has entered into several transactions with the same institution, some with positive and others with negative replacement values, then, under a valid netting agreement, the net replacement value represents the true credit risk exposure.
- *Marking to market*. Counterparties sometimes agree to periodically make the market value of a transaction transparent and then transfer any change in value from the losing side to the winning side of the transaction. This is one of the most efficient credit enhancement techniques, and in many circumstances it can practically eliminate credit risk. However, it requires sophisticated monitoring and back-office systems.
- *Put options*. Many of the put options traditionally embedded in corporate debt securities also provide investors with default protection, in the sense that the investor holds the right to force early redemption at a prespecified price—e.g., par value.

BOX 19-5 Primary Syndication

Loan syndication is the traditional way for banks to share the credit risk of making very large loans to borrowers. The loan is sold to third-party investors (usually other banks or institutional investors) so that the originating or lead banks reach their desired holding level for the deal (usually set at around 20 percent by the bank's senior credit committee) at the time the initial loan deal is closed. Lead banks in the syndicate carry the largest share of the risk and also take the largest share of the fees.

Syndicates operate in one of two ways: firm commitment (underwritten) deals, under which the borrower is guaranteed the full face value of the loan, and "best efforts" deals.

Each syndicated loan deal is structured to accommodate both the risk/return appetite of the banks and investors that are involved in the deal and the needs of the borrower. Syndicated loans are often called leveraged loans when they are issued at LIBOR plus 150 basis points or more.

As a rule, loans that are traded by banks on the secondary loan market begin life as syndicated loans. The pricing of syndicated loans is becoming more transparent as the syndicated market grows in volume and as the secondary loans market and the market for credit derivatives become more liquid.

Under the active portfolio management approach that we describe in the main text, the retained part of syndicated bank loans is generally transfer-priced at par to the credit portfolio management group.

"unbundle" the credit risk from the underlying positions so that it can be redistributed among a broader class of financial institutions and investors.

Credit derivatives, such as credit default swaps (CDS), are specifically designed to deal with this problem. They are off-balance-sheet arrangements that allow one party (the beneficiary) to transfer the credit risk of a reference asset to another party (the guarantor) without actually selling the asset. They allow users to strip credit risk away from market risk and to transfer credit risk independently of funding and relationship management concerns. (In the same way, the development of interest rate and foreign exchange derivatives in the 1980s allowed banks to manage market risk independently of liquidity risk.)

Nevertheless, the credit derivative revolution arrives with its own unique set of risks. Counterparties must make sure that they understand the amount and nature of risk that is transferred by the derivative contract, and that the contract is enforceable. Even before the 2007–2009 financial crisis, regulators were concerned about the relatively small number of institutions—mainly large banks such as IP Morgan Chase and Deutsche Bank—that currently create liquidity in the credit derivatives market. They feared that this immature market might be disrupted if one or more of these players ran into trouble. However, it is interesting to note that even at the height of the credit crisis, the single-name and index CDS market operated relatively smoothly—given the extreme severity of the crisis—under the leadership of ISDA (International Swaps and Derivatives Association).[6]

As we've already discussed, securitization gives institutions the chance to extract and segment a variety of potential risks from a pool of portfolio credit risk exposures and to sell these risks to investors. Securitization is also a key funding source for consumer and corporate lending. According to the IMF, securitization issuance soared from almost nothing in the early 1990s to reach a peak of almost $5 trillion in 2006. Then, with the advent of the subprime crisis in 2007, volumes collapsed, especially for mortgage CDOs as well as collateralized loan obligations (CLOs). Only the securitization of credit card receivables, auto loans, and leases remained relatively unaffected. Since 2012, the market for the securitization of corporate loans (CLOs) has begun to revive, as these structures are transparent for investors and the collateral is reasonably easy to value.

When properly executed in a robust and transparent market, credit derivatives should contribute to the "price discovery" of credit. That is, they make clear how much economic value the market attaches to a particular type of credit risk. As well as putting a number against the default risk associated with many large corporations, CDS market prices also offer a means to monitor the default risk attached to large corporations in real time (as opposed to periodic credit rating assessments).

[6] As mentioned in Box 19-6, some 103 CDS credit events have triggered settlements of CDS between June 2005 and April 2013 without disrupting the CDS market, partly thanks to ISDA's, Credit Derivatives Determinations Committees (DCs). These DCs were established in 2009 to make binding decisions as to whether a credit event triggering the settlement of a CDS has occurred, whether an auction should be held to determine the final price for CDS settlement, and which obligations should be delivered or valued in the auction.

Over time, the hope is that improvements in price discovery will lead to improved liquidity, more efficient market pricing, and more rational credit spreads (i.e., the different margins over the bank's cost of funds charged to customers of different credit quality) for *all* credit-related instruments.

The traditional corporate bond markets perform a somewhat similar price discovery function, but corporate bonds are an asset that blends together interest rate and credit risk, and corporate bonds offer a limited lens on credit risk because only the largest public companies tend to be bond issuers. Credit derivatives can, potentially at least, reveal a pure market price for the credit risk of high-yield loans that are not publicly traded, and for whole portfolios of loans.

In a mature credit market, credit risk is not simply the risk of potential default. It is the risk that credit premiums will change minute by minute, affecting the relative market value of the underlying corporate bonds, loans, and other derivative instruments. In such a market, the "credit risk" of traditional banking evolves into the "market risk of credit risk" for certain liquid credits.

The concept of credit risk as a variable with a value that fluctuates over time is apparent, to a degree, in the traditional bond markets. For example, if a bank hedges a corporate bond with a Treasury bond, then the spread between the two bonds will rise as the credit quality of the corporate bond declines. But this is a concept that will become increasingly critical in bank risk management as the new credit technologies and markets make the price of credit more transparent across the credit spectrum.

HOW EXACTLY IS ALL THIS CHANGING THE BANK CREDIT FUNCTION?

In the traditional model, the bank lending business unit holds and "owns" credit assets such as loans until they mature or until the borrowers' creditworthiness deteriorates to unacceptable levels. The business unit manages the quality of the loans that enter the portfolio, but after the lending decision is made, the credit portfolio remains basically unmanaged.

Let's remind ourselves here of some credit terminology and work out how it relates to the evolution of bank functions.

In modern banking, exposure is measured in terms of the notional value of a loan, or exposure at default (EAD) for loan commitments. The risk of a facility is characterized by:

- The external and/or internal rating attributed to each obligor, usually mapped to a probability of default (PD)
- The loss given default (LGD) and EAD of the facilities

The expected loss (EL) for each credit facility is a straightforward multiplicative function of these variables:

$$EL = PD \times EAD \times LGD$$

Expected loss, as defined here, is the basis for the calculation of the institution's allowance for loan losses, which should be sufficient to absorb both specific (i.e., identified) and more general credit-related losses.[7] EL can be viewed as the cost of doing business. That is, on average, over a long period of time and for a well-diversified portfolio, the bank will incur a credit loss amounting to EL. However, actual credit losses may differ substantially from EL for a given period of time, depending on the variability of the bank's actual default experience. The potential for variability of credit losses beyond EL is called unexpected loss (UL) and is the basis for the calculation of economic and regulatory capital using credit portfolio models.

In the traditional business model, risk assessment is mostly limited to EL and ignores UL. EL, meanwhile, is usually priced into the loan in the form of a spread charged to the borrower above the funding cost of the bank. To limit the risk of default resulting from unexpected credit losses—i.e., actual losses beyond EL—banks hold capital, although traditionally they did not employ rigorous quantitative techniques to link their capital to the size of UL. (This is in contrast to more modern techniques, which use UL for capital attribution and also for the risk-sensitive pricing of loans.)

Under the traditional business model, risk management is limited to a binary approval process at origination. The business unit compensation for loan origination is

[7] When a loan has defaulted and the bank has decided that it won't be able to recover any additional amount, the actual loss is written off and the EL is adjusted accordingly—i.e., the written-off loan is excluded from the EL calculation. Once a loan is in default, special provisions come into effect, in addition to the general provisions, in anticipation of the loss given default (LGD) that will be incurred by the bank once the recovery process undertaken by the workout group of the bank is complete.

based, in many cases, more on volume than on a pure risk-adjusted economic rationale. Likewise, the pricing of the loans by the business unit is driven by the strength of competition in the local banking market rather than by risk-based calculations. To the extent that traditional loan pricing reflects risk at all, this is generally in accordance with a simple grid that relates the price of the loan to its credit rating and to the maturity of the facilities.

By contrast, under the originate-to-distribute business model, loans are divided into core loans that the bank holds over the long term (often for relationship reasons) and noncore loans that the bank would like to sell or hedge. Core loans are managed by the business unit, while noncore loans are transfer-priced to the credit portfolio management group. For noncore loans, the credit portfolio management unit is the vital link between the bank's origination activities (making loans) and the increasingly liquid global markets in credit risk, as we can see in Figure 19-1.

Economic capital is the key to assessing the performance of a bank under this new model. Economic capital is allocated to each loan based on the loan's contribution to the risk of the portfolio. At origination, the spread charged to a loan should produce a risk-adjusted return on capital that is greater than the bank's hurdle rate. Table 19-2 notes how all this changes the activities of a traditional credit function, and helps to make clear how the move to active portfolio management is linked to improved credit-market pricing and the kind of risk-adjusted performance measures.

In part, the credit portfolio management group must work alongside traditional teams within the bank such as the loan workout group. The workout group is responsible for "working out" any loan that runs into problems after the credit standing of the borrower deteriorates below levels set by bank policy. The workout process typically involves either restructuring the loan or arranging for compensation in lieu of the value of the loan (e.g., receiving equity or some of the assets of the defaulted company).

But managing risk at the portfolio level also means monitoring the kind of risk concentrations that can threaten bank solvency—and that help to determine the amount of expensive risk capital the bank must set aside. Banks commonly have strong lending relationships with a number of large companies, which can create significant concentrations of risk in the form of overlending to single names. Banks are also prone to concentration as a function of their geography and industry expertise. In Canada, for example, banks are naturally heavily exposed to the oil and gas, mining, and forest products sectors.

Some credit portfolio strategies are therefore based on defensive actions. Loan sales, credit derivatives, and loan securitization are the primary tools banks use to deal with local, regional, country, and industry risk concentrations. Increasingly, however, banks are interested in reducing concentration risk not only for its own sake, but also as a means of managing earnings volatility—the ups and downs in their reported earnings caused by their exposure to the credit cycle.

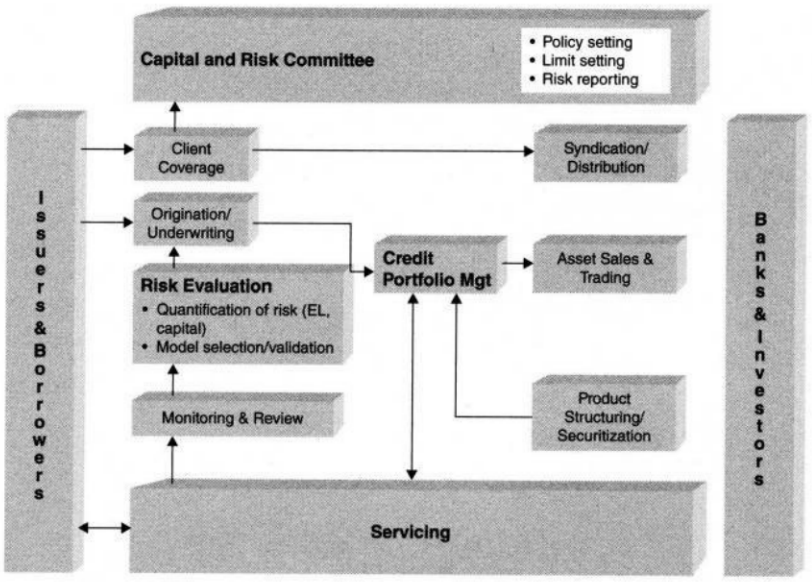


FIGURE 19-1 Originate-to-distribute model.

The credit portfolio management group also has another important mandate: to increase the velocity of capital—that is, to free capital that is tied up in low-return credits and reallocate it to more profitable opportunities. Nevertheless, the credit portfolio management group should not be a profit center but should instead be run on a budget that allows it to meet its objectives.

Trading in the credit markets could potentially lead to accusations of insider trading if the bank trades credits of firms with which it also has some sort of confidential banking

TABLE 19-2 Changes in the Approach to Credit Risk Management

	Traditional Credit Function	Portfolio-Based Approach
Investment strategy	Buy and hold	Originate to distribute
Ownership of the credit assets	Business unit	Portfolio management or business unit/portfolio management
Risk measurement	Use notional value of the loan Model losses due only to default	Use risk-based capital Model losses due to default and risk migration
Risk management	Use a binary approval process at origination	Apply rlsk/return decision-making process
Basis for compensation for loan origination	Volume	Risk-adjusted performance
Pricing	Grid	Risk contribution
Valuation	Held at book value	Marked-to market (MTM)

relationship. For this reason, the credit portfolio management group must be subject to specific trading restrictions monitored by the compliance group. In particular, the bank has to establish a "Chinese wall" that separates credit portfolio management, the "public side," from the "private side" or insider functions of the bank (where the credit officers belong). The issue is somewhat blurred in the case of the loan workout group, but here, too, separation must be maintained. This requires new policies and extensive reeducation of the compliance and insider functions to develop sensitivity to the handling of material nonpublic information. The credit portfolio management team may also require an independent research function.

The counterparty risk that arises from trading OTC derivatives has become a major component of credit risk in some banks and a major concern since the fall of Lehman Brothers in September 2008. In some institutions, both credit risk related to the extension of loans and counterparty credit risk arising from trading activities are managed centrally by new credit portfolio management groups. The credit portfolio management group also advises deal originators on how best to structure deals and mitigate credit risks. In addition, the bank personnel managing credit risk transfers have to deal with the new transparency, disclosure, and fiduciary duties that post-crisis regulation is imposing on banks. Figure 19-2

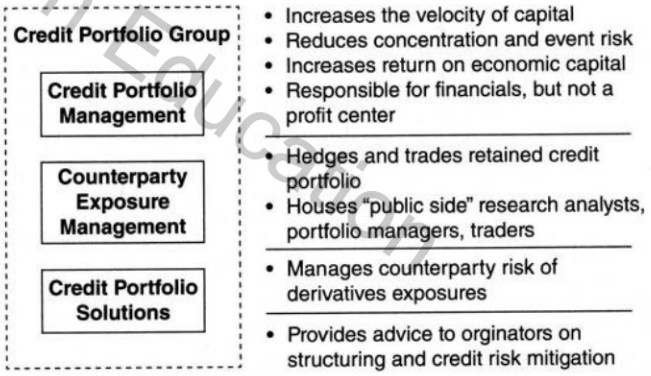


FIGURE 19-2 Credit portfolio management.

summarizes the various functions of the credit portfolio management group.

LOAN PORTFOLIO MANAGEMENT

There are really two main ways for the bank credit portfolio team to manage a bank credit portfolio:

- Distribute large loans to other banks by means of primary syndication at the outset of the deal so that the bank retains only the desired "hold level" (see Box 19-5).

- Reduce loan exposure by selling down or hedging loans (e.g., by means of credit derivatives or loan securitization).

In turn, these lend themselves to two key strategies:

- Focus first on high-risk obligors, particularly those that are leveraged in market value terms and that experience a high volatility of returns.
- Simultaneously sell or hedge low-risk, low-return loan assets to free up bank capital.

In pursuit of these ends, the credit portfolio management group can combine traditional and modern tools to optimize the risk/return profile of the portfolio. At the traditional end of the spectrum, banks can manage an exit from a loan through negotiation with their customer. This is potentially the cheapest and simplest way to reduce risk and free up capital, but it requires the borrower's cooperation.

The bank can also simply sell the loan directly to another institution in the secondary loan market. This requires the consent of the borrower and/or the agent, but in many cases modern loan documentation is designed to facilitate the transfer of loans. (In the secondary loan market, *distressed loans* are those trading at 90 percent or less of their nominal value.)

As we've discussed, the bank may also use securitization and credit derivatives to transfer credit risk to other financial institutions and to investors. In the rest of this chapter, we'll take a more detailed look at the techniques of securitization and credit derivative markets and the range of instruments that are available.

CREDIT DERIVATIVES: OVERVIEW

Credit derivatives such as credit default swaps (CDS), spread options, and credit-linked notes are over-the-counter financial contracts with payoffs contingent on changes in the credit performance or credit quality of a specified entity.

Both the pace of innovation and the volume of activity in the credit derivative markets were quite spectacular until the beginning of the subprime crisis in 2007. Post-crisis, as of 2013, most of the activity remains concentrated on single-name CDS and index CDS. The Bank for International Settlements reports that the outstanding notional amount for CDS (including single names, multinames, and tranches) was almost nil in 1997 and reached its highest level of $62.2 trillion in 2007. This number dropped to $41.9 trillion in 2008 and has fallen further since to reach $25 trillion at year-end 2012; this includes $14.3 trillion of single-name CDS notionals (including the notionals of $2.9 trillion of sovereign single-name CDS) and $10.8 trillion of multiname CDS notionals (mostly index products).[8] However, we should be careful about assuming these numbers fully capture CDS market trends as there are a number of challenges in accurately assessing CDS volumes; notably, compression techniques designed to remove offsetting and redundant positions have grown fast since 2008, significantly reducing gross notional values.[9] The general picture of the post-crisis CDS market is of a relatively stable market that is in a downward trend in terms of volume. Sovereign CDS (SCDS) is the exception (Box 19-6).

In line with this, there have been a number of significant improvements in market infrastructure over the last few years, notably the introduction of the "Big Bang Protocol"—i.e., the revised Master Confirmation Agreement published by ISDA in 2009. Alongside changes intended to improve the standardization of contracts, the protocol set in place Determination Committees, to determine when a credit event has taken place, and established auctions as the standard way to fix an agreed price for distressed bonds. Fixing this price is a key task for the cash settlement of CDS after a credit event has occurred because the market for a distressed bond soon after a credit event tends to be very thin.

More generally, the CDS market has been moving toward increased transparency,[10] standardization of contracts, and the use of electronic platforms. Even so, the market remains relatively opaque compared to some other investment

[8] According to the Bank for International Settlements (OTC Derivatives Statistics at year-end 2012), these numbers pale before the aggregate notional amount outstanding for interest rate contracts (FRAs, swaps, and options) of $490 trillion. The amount for foreign exchange contracts is $67.4 trillion.

[9] International Organization of Securities Commissions, *The Credit Default Swap Market*, Report, June 2012, pp. 6–7.

[10] For example, since 2006 the Depository Trust & Clearing Corporation has run a Trade Information Warehouse to serve as a centralized global electronic data repository containing detailed trade information for the CDS market. From January 2011, this has included a Regulators Portal to give regulators better access to more granular trade data. Larry Thompson (Managing Director, DTCC), "Derivatives Trading in the Era of Dodd-Frank's Title VII," Speech, September 6, 2012.

BOX 19-6 The Special Case of Sovereign CDS (SCDS)

SCDS are still a small part of the CDS market with, year-end 2012, an amount outstanding of $2.9 trillion versus $25 trillion in CDS as a whole. They also represent a small part of the sovereign debt market when compared to the total government debt outstanding (roughly $50 trillion).

However, the market for SCDS has been growing since the early 2000s and has increased in size noticeably since 2008, while other CDS markets have declined. The post-2008 surge corresponded with a perceived increase in sovereign debt risk, culminating in the European sovereign debt crisis in 2010 and the restructuring of Greek sovereign debt in March 2012.

Although SCDS can provide useful insurance against governments defaulting, their role has been controversial during the European debt crisis. After accusations that speculative trading was exacerbating the crisis, the European Union decided in November 2012 to ban buying naked sovereign credit default swap protection—i.e., where the investor does not own the underlying government bond. The ban had already negatively affected the liquidity and trading volumes of SCDS that referenced the debt of eurozone countries because of the fear of less efficient hedging.

The measure was criticized by the International Monetary Fund (IMF), which said that it found no evidence that SCDS spreads had been out of line with government bond spreads and that, for the most part, premiums reflected the underlying country's fundamentals, even if they reflected them faster than the bond market.[1]

The measure was also criticized on the grounds that sovereign debt holders are not the only ones affected when a country defaults. Every sector is affected except possibly the domestic export sector and the tourism industry. Domestic importers and foreign exporters suffer when the default is followed by a devaluation; financial institutions and investors in domestic corporate debt suffer depreciation in the value of their assets; and domestic companies suffer as their credit risk increases.[2]

According to the IMF report, between June 2005 and April 2013 there were 103 CDS credit events, but only two SCDS credit events with publicly documented settlements (Ecuador in 2008 and Greece in 2012). The most recent SCDS credit event was the March 2012 Greek debt exchange, which was the largest sovereign restructuring event in history. About €200 billion of Greek government bonds were exchanged for new bonds. Holders of the old bonds who had SCDS protection ultimately recovered roughly the par value of their holdings. However, there was uncertainty about the payout of the SCDS contracts in this particular situation, caused by the exchange of new bonds for old bonds. The International Swaps and Derivatives Association (ISDA) is looking at modifying the CDS documentation to deal with such situations.

[1] International Monetary Fund, *Global Financial Stability Report*, April 2013.

[2] L. M. Wakeman and S. Turnbull, "Why Markets Need 'Naked' Credit Default Swaps," *Wall Street Journal*, September 12, 2012.

markets—e.g., in terms of posttrade information and information about deals outside the interdealer community.

Furthermore, the CDS market remains dominated by a relatively small number of large banks, leading to continuing fears about the collapse of a major market participant and the effect of this on the CDS and wider financial markets. The proportion of CDS cleared through central counterparties is low but increasing,[11] in line with the regulatory push for all standardized OTC derivative contracts to move to central clearing. Collateralization has also tended to increase, though it varies considerably from market to market in terms of both frequency and adequacy.[12]

Today, the risks in the corporate universe that can be protected by using credit derivative swaps are largely limited to investment-grade names. In the shorter term, using credit derivative swaps might therefore have the effect of shifting the remaining risks in the banking system further toward the riskier, non-investment-grade end of the spectrum. For the market to become a significant force in moving risk away from banks, the non-investment-grade

[11] The Bank of England Financial Stability Report of June 2012 remarked that "around 50% of IRS contracts are centrally cleared compared with around 10% of CDS contracts." (Bank of England, *Financial Stability Report*, June 2012, Box 5, p. 38). Other accounts put the number of *new* trades that are centrally cleared rather higher, at around a third (International Organization of Securities Commissions, *The Credit Default Swap Market*, Report, June 2012, p. 26). The proportion of cleared trades may increase quite rapidly.

[12] For estimates, see International Organization of Securities Commissions, *The Credit Default Swap Market*, Report, June 2012, p. 24.

market in credit derivatives needs to become much deeper and more liquid than it is today. There is some evidence that this is occurring, at least in the United States.

END USER APPLICATIONS OF CREDIT DERIVATIVES

Like any flexible financial instrument, credit derivatives can be put to many purposes. Table 19-3 summarizes some of these applications from an end user's perspective.

Let's develop a simple example to explain why banks might want to use credit derivatives to reduce their credit concentrations. Imagine two banks, one of which has developed a special expertise in lending to the airline industry and has made $100 million worth of AA-rated loans to airline companies, while the other is based in an oil-producing region and has made $100 million worth of AA-rated loans to energy companies.

In our example, the banks' airline and energy portfolios make up the bulk of their lending, so both banks are very vulnerable to a downturn in the fortunes of their favored industry segment. It's easy to see that, all else equal, both banks would be better off if they were to swap $50 million of each other's loans. Because airline companies generally benefit from declining energy prices, and energy companies benefit from rising energy prices, it is relatively unlikely that the airline and energy industries would run into difficulties at the same time. Alter swapping the risk, each bank's portfolio would be much better diversified.

TABLE 19-3 End User Applications of Credit Derivatives

Investors	• Access to previously unavailable markets (e.g., loans, foreign credits, and emerging markets) • Unbundling of credit and market risks • Ability to borrow the bank's balance sheet, as the investor does not have to fund the position and also avoids the cost of servicing the loans • Yield enhancement with or without leverage • Reduction in sovereign risk of asset portfolios
Banks	• Reduce credit concentrations • Manage the risk profile of the loan portfolio
Corporations	• Hedging trade receivables • Reducing overexposure to customer/supplier credit risk • Hedging sovereign credit-related project risk

Having swapped the risk, both banks would be in a better position to exploit their proprietary information, economies of scale, and existing business relationships with corporate customers by extending more loans to their natural customer base.

Let's also look more closely at another end user application noted in Table 19-3 with regard to investors: yield enhancement. In an economic environment characterized by low (if potentially rising) interest rates, many investors have been looking for ways to enhance their yields. One option is to consider high-yield instruments or emerging market debt and asset-backed vehicles. However, this means accepting lower credit quality and longer maturities, and most institutional investors are subject to regulatory or charter restrictions that limit both their use of non-investment-grade instruments and the maturities they can deal in for certain kinds of issuer. Credit derivatives provide investors with ready, if indirect, access to these high-yield markets by combining traditional investment products with credit derivatives. Structured products can be customized to the client's individual specifications regarding maturity and the degree of leverage. For example, as we discuss later, a total return swap can be used to create a seven-year structure from a portfolio of high-yield bonds with an average maturity of 15 years.

This said, users must remember the lessons of the 2007–2009 financial crisis: these tools can be very effective in the right quantity so long as they are priced properly and counterparty credit risk is not ignored.

Even when institutional investors can access high-yield markets directly, credit derivatives may offer a cheaper way for them to invest. This is because, in effect, such instruments allow unsophisticated institutions to piggyback on the massive investments in back-office and administrative operations made by banks.

Credit derivatives may also be used to exploit inconsistent pricing between the loan and the bond market for the same issuer or to take advantage of any particular view that an investor has about the pricing (or mispricing) of corporate credit spreads. However, users of credit derivatives must remember that as well as transferring credit

risk, these contracts create an exposure to the creditworthiness of the counterparty of the credit derivative itself—particularly with leveraged transactions.

TYPES OF CREDIT DERIVATIVES

Credit derivatives are mostly structured or embedded in swap, option, or note forms and normally have tenures that are shorter than the maturity of the underlying instruments. For example, a credit default swap may specify that a payment be made if a 10-year corporate bond defaults at any time during the next two years.

Single-name CDS remain the most popular instrument type of credit derivative, commanding more than 50 percent of the market in terms of their notional outstanding value. The demand for single-name CDSs has been driven in recent years by the demand for hedges of pre-crisis legacy positions such as synthetic single-tranche collateralized debt obligations—we discuss the mechanics of these instruments later—and by hedge funds that use credit derivatives as a way to exploit capital structure arbitrage opportunities. The next most popular instruments are portfolio/correlation products, mostly index CDS.

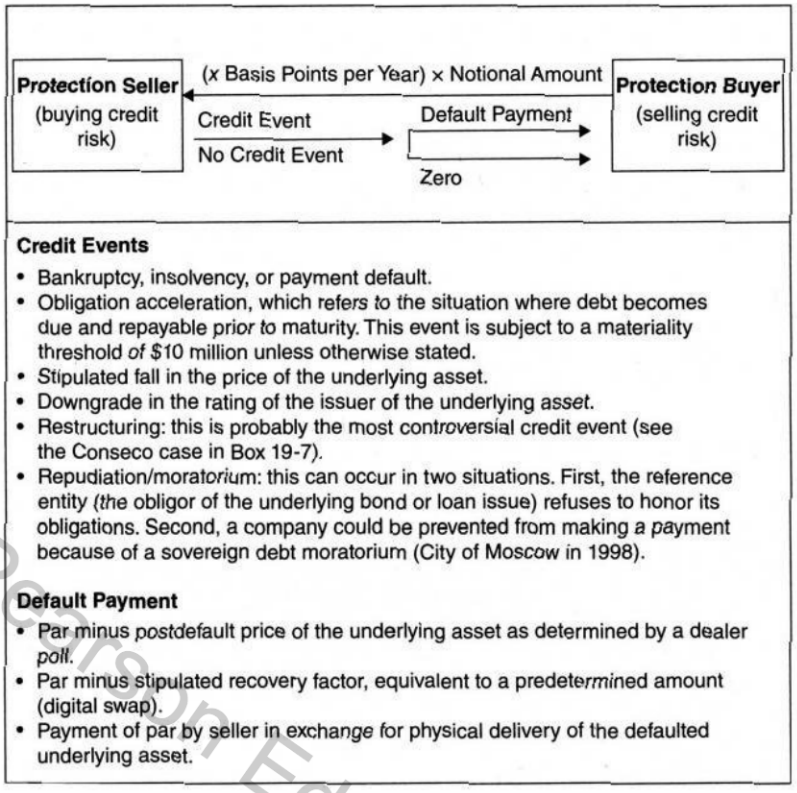


FIGURE 19-3 Typical credit default swap.

Credit Default Swaps

Credit default swaps can be thought of as insurance against the default of some underlying instrument or as a put option on the underlying instrument.

In a typical CDS, as shown in Figure 19-3, the party selling the credit risk (or the "protection buyer") makes periodic payments to the "protection seller" of a negotiated number of basis points times the notional amount of the underlying bond or loan.[13] The party buying the credit risk (or the protection seller) makes no payment unless the issuer of the underlying bond or loan defaults or there is an equivalent credit event. Under these circumstances, the protection seller pays the protection buyer a default payment equal to the notional amount minus a prespecified recovery factor.

Since a credit event, usually a default, triggers the payment, this event should be clearly defined in the contract to avoid any litigation when the contract is settled. Default swaps normally contain a "materiality clause" requiring that the change in credit status be validated by third-party evidence. However, Box 19-7 explores the difficulty the CDS market has had in defining appropriate credit events. For this reason, the Determination Committees we mentioned earlier have been on hand since 2009 to settle whether a credit event has occurred or not.

The payment made following a legitimate credit event is sometimes fixed by agreement, but a more common practice is to set it at par minus the recovery rate. (For a bond, the recovery rate is determined by the market price

[13] Before 2009, the "par spread," or premium, was paid monthly by the protection buyer and was calculated so that the spread discounted back to the origination date was equal to the expected discounted value of the settlement amount in case of a credit event. Starting in 2009, the protection buyer pays an annual premium paid in quarterly installments that has been set at one of several standardized levels—i.e., 25, 100, 300, 500, or 1,000 basis points plus or minus an upfront payment to compensate for the difference between the par spread and the fixed premium. This convention already applied to index CDS and was generalized to single-name CDS in 2009.

BOX 19-7 Controversies Around the "Restructuring" Credit Event

"Cheapest To Deliver": The Conseco Case

In its early years, the credit derivatives market struggled to define the kind of credit events that should trigger a payout under a credit derivative contract. One of the most controversial aspects was whether the restructuring of a loan—which can include changes such as an agreed-upon reduction in interest and principal, postponement of payments, or changes in the currencies of payment—should count as a credit event.

The Conseco case famously highlighted the problems that restructuring can cause. Conseco is an insurance company, headquartered in suburban Indianapolis, that provides supplemental health insurance, life insurance, and annuities. In October 2000, a group of banks led by Bank of America and Chase granted to Conseco a three-month extension of the maturity of approximately $2.8 billion of short-term loans, while simultaneously increasing the coupon and enhancing the covenant protection. The extension of credit might have helped prevent an immediate bankruptcy,[1] but as a significant credit event, it also triggered potential payouts on as much as $2 billion of CDSs.

The original sellers of the CDSs were not happy, and they were annoyed further when the CDS buyers seemed to be playing the "cheapest to deliver" game by delivering long-dated bonds instead of the restructured loans; at the time, these bonds were trading significantly lower than the restructured bank loans. (The restructured loans traded at a higher price in the secondary market because of the new credit mitigation features.)

In May 2001, following this episode, the International Swaps and Derivatives Association (ISDA) amended its definition of a restructuring credit event and imposed limitations on deliverables.

The "Bail-In" Type Event

The new resolution regimes in the United States (Dodd-Frank Act) and Europe (European Banking Law) will give supervisory authorities the power to "bail in" the debt of failing financial institutions. Regulatory authorities will have the power to write down debt to avoid bankruptcies and to ensure that bondholders, rather than taxpayers, absorb bank losses.

Although these resolution measures are not yet effective, the European sovereign debt crisis provides a preview of how these regimes may play out in practice. For example, the Irish bank restructuring in 2011 meant that subordinated debt was written down by 80 percent, while the Dutch government later nationalized SNS, a mid-tier lender (wiping out subordinated bondholders). The Cyprus bailout wrote down senior debt and forced a haircut on uninsured depositors.

These bank restructurings raise the concern that the current CDS definitions may not properly cover future reorganizations, such as nationalizations. ISDA is working on a proposal for the specific credit event of a government's using a restructuring resolution law to write down, expropriate, convert, exchange, or transfer a financial institution's debt obligations.

At the same time, the rules governing CDS auctions are being altered to ensure that the payout on the contracts will adequately compensate protection buyers for losses incurred on their bond holdings. In particular, the rules would allow written-down bonds to be delivered into a CDS auction based on the outstanding principal balance before the bail-in happened. In other words, if $100 of bonds were written down to 40 percent of face value, then to satisfy $100 of CDS protection it would only be necessary to deliver into the auction the $40 of the newly written down bonds. This should apply also to sovereign debt (see Box 19-6).

[1] Conseco filed a voluntary petition to reorganize under Chapter 11 in 2002 and emerged from Chapter 11 bankruptcy in September 2003.

of the bond after the default.[14]) For most standardized CDS the recovery is contractually set at 60 percent for a bank loan and 40 percent for a bond. The protection buyer stops paying the regular premium following the credit event. CDSs provide major benefits for both buyers and sellers of credit protection (see Box 19-8) and are very effective tools for the active management of credit risk in a loan portfolio.

Since single-name CDSs are natural credit risk hedges for bonds issued by corporations or sovereigns, it is also natural to arbitrage pricing differences between CDS and underlying reference bonds by taking offsetting positions. This is the purpose of "basis trading." To give some sense of the intuition underlying this kind of trade, consider a 10-year par bond with a 6 percent coupon that could be funded over the life of the bond

[14] For a discussion of the contract liquidation procedures and other aspects of how the CDS market functions, see International Organization of Securities Commissions, *The Credit Default Swap Market*, Report, June 2012.

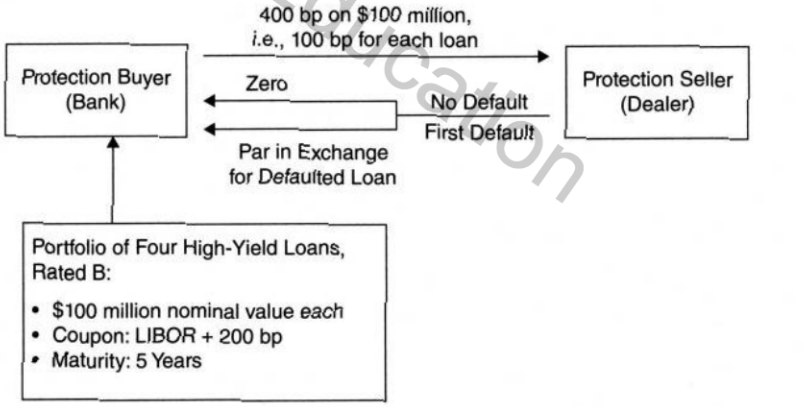
BOX 19-8 Benefits of Using CDSs

- CDSs act to divorce funding decisions from credit risk-taking decisions. The purchase of insurance, letters of credit, guarantees, and so on are relatively inefficient credit risk transfer strategies, largely because they do not separate the management of credit risk from the asset associated with the risk.
- CDSs are unfunded, so it's easy to make leveraged transactions (some collateral might be required), though this may also increase the risk of using CDSs. The fact that CDSs are unfunded is an advantage for institutions with a high funding cost. CDSs also offer considerable *flexibility* in terms of leverage; the user can define the required degree of leverage, if any, in a credit transaction. This makes credit an appealing asset class for hedge funds and other nonbank institutional investors. In addition, investors can avoid the administrative cost of assigning and servicing loans.
- CDSs are customizable—e.g., their maturity may differ from the term of the loan.
- CDSs improve flexibility in risk management, as banks can shed credit risk more easily than by selling loans. There is no need to remove the loans from the balance sheet.
- CDSs are an efficient vehicle for banks to reduce risk and thereby free up capital.
- CDSs can be used to take a spread view on a credit. They offer the first mechanism by which short sales of credit instruments can be executed with any reasonable liquidity and without the risk of a "short squeeze."
- Dislocations between the cash and CDS markets present new "relative value" opportunities (e.g., trading the default swap basis).
- CDSs divorce the client relationship from the risk decision. The reference entity whose credit risk is being transferred does not need to be aware of the CDS transaction. This contrasts with any reassignment of loans through the secondary loan market, which generally requires borrower/agent notification.
- CDSs bring liquidity to the credit market, as they have attracted nonbank players into the syndicated lending and credit arena.

at 5 percent.[15] This would produce a positive annual cash flow of 1 percent, or 100 basis points. The CDS referencing that bond should also be trading at a "par spread" of 100 basis points. Also, if a credit event occurs, the loss on the bond would be covered by the gain on the CDS.

First-to-Default CDS

A variant of the credit default swap is the *first-to-default* put, as illustrated in the example in Figure 19-4. Here, the bank holds a portfolio of four high-yield loans rated B, each with a nominal value of $100 million, a maturity of five years, and an annual coupon of LIBOR plus 200 basis points (bp). In such deals, the loans are often chosen such that their default correlations are very small—i.e., there is a very low probability at the time the deal is struck that more than one loan will default over the time until the expiration of the put in, say, two years. A first-to-default put gives the bank the opportunity to reduce its credit risk exposure: it will automatically be compensated if one of the loans in the pool of four loans defaults at any time during the two-year period. If more than one loan defaults during this period, the bank is compensated only for the first loan that defaults.



Probability of Experiencing Two Defaults = $(1\%)^2 \, 4 \times 3/2 = 0.0006 = 0.06\%$[1]

[1] The probability that more than one loan will default is the sum of the probabilities that two, three, or four loans will default. The probability that three loans or four loans will default during the same period is infinitesimal and has been neglected in the calculation. Moreover, there are six possible ways of pairing loans in a portfolio of four loans.

FIGURE 19-4 First-to-default put.

[15] In order to obtain fixed-rate funding, the bonds are typically funded in the repo market on a floating-rate basis and swapped into fixed rates over the full term using interest rate swaps. In practice, the trade is more complex since, if the bond defaults, the swap should be canceled.

If default events are assumed to be uncorrelated, the probability that the dealer (protection seller) will have to compensate the bank by paying it par—that is, $100 million—and receiving the defaulted loan is the sum of the default probabilities, or 4 percent. This is approximately, at the time, the probability of default of a loan rated B for which the default spread was 400 bp, or a cost of 100 bp per loan—i.e., half the cost of the protection for each individual name.

Note that, in such a deal, a bank may choose to protect itself over a two-year period even though the loans might have a maturity of five years. First-to-default structures are, in essence, pairwise correlation plays. The yield on such structures is primarily a function of:

- The number of names in the basket
- The degree of correlation between the names

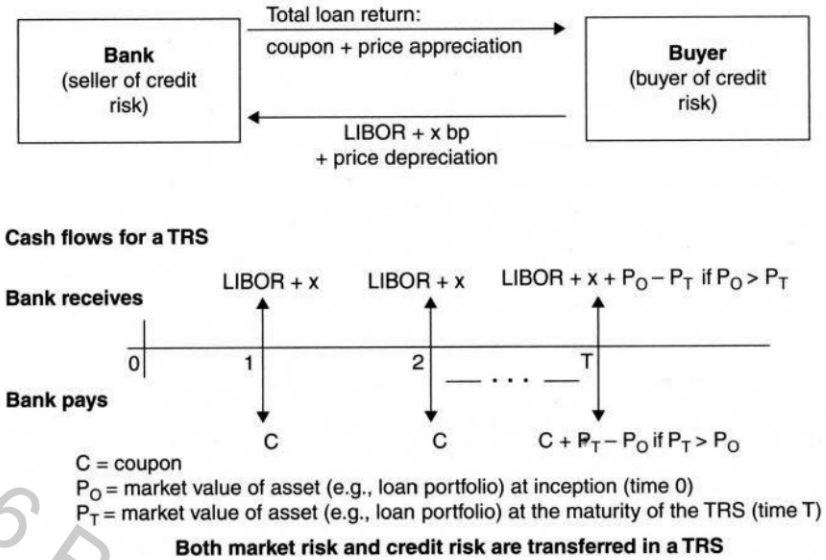


FIGURE 19-5 Generic Total Return Swap (TRS).

The first-to-default spread will lie between the spread of the worst individual credit and the sum of the spreads of all the credits—closer to the latter if correlation is low and closer to the former if correlation is high.

A generalization of the first-to-default structure is the *nth-to-default* credit swap, where protection is given only to the *nth* facility to default as the trigger credit event.

Total Return Swaps

Total return swaps (TRSs) mirror the return on some underlying instrument, such as a bond, a loan, or a portfolio of bonds and/or loans. The benefits of TRSs are similar to those of CDSs, except that for a TRS, in contrast to a CDS, both market and credit risk are transferred from the seller to the buyer.

TRSs can be applied to any type of security—for example, floating-rate notes, coupon bonds, stocks, or baskets of stocks. For most TRSs, the maturity of the swap is much shorter than the maturity of the underlying assets—e.g., 3 to 5 years as opposed to a maturity of 10 to 15 years.

The purchaser of a TRS (the total return receiver) receives the cash flows and benefits (pays the losses) if the value of the reference asset rises (falls). The purchaser is synthetically long the underlying asset during the life of the swap.

In a typical deal, shown in Figure 19-5, the purchaser of the TRS makes periodic floating payments, often tied to LIBOR. The party selling the risk makes periodic payments to the purchaser, and these are tied to the total return of some underlying asset (including both coupon payments and the change in value of the instruments). We've annotated these periodic payments in detail in the figure.

Since in most cases it is difficult to mark-to-market the underlying loans, the change in value is passed through at the maturity of the TRS. Even at this point, it may be difficult to estimate the economic value of the loans, which may still not be close to maturity. This is why in many deals the buyer is required to take delivery of the underlying loans at a price P_0, which is the initial value.

At time T, the buyer should receive $P_T - P_0$ if this amount is positive and pay $P_0 - P_T$ otherwise. By taking delivery of the loans at their market value P_T, the buyer makes a net payment to the bank of P_0 in exchange for the loans.

In some leveraged TRSs, the buyer holds the explicit option to default on its obligation if the loss in value $P_0 - P_T$ exceeds the collateral accumulated at the expiration of the TRS. In that case, the buyer can simply walk away from the deal, abandon the collateral to the counterparty, and leave the counterparty to bear any loss beyond the value of the collateral (Figure 19-6).

A total return swap is equivalent to a synthetic long position in the underlying asset for the buyer. It allows for any degree of leverage, and therefore it offers unlimited

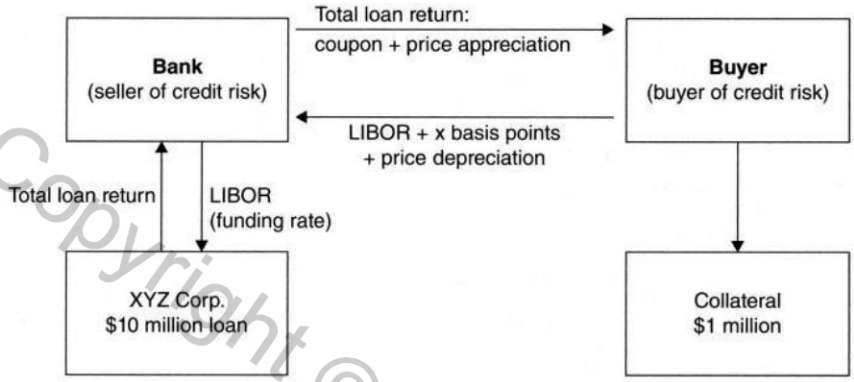


FIGURE 19-6 Leveraged Total Return Swap (TRS).

upside and downside potential. It involves no exchange of principal, no legal change of ownership, and no voting rights.

In order to hedge both the market risk and the credit risk of the underlying assets of the TRS, a bank that sells a TRS typically buys the underlying assets. The bank is then exposed only to the risk of default of the buyer in the total return swap transaction. This risk will itself depend on the degree of leverage adopted in the transaction. If the buyer fully collateralizes the underlying instrument, then there is no risk of default and the floating payment should correspond to the bank's funding cost. If, on the contrary, the buyer leverages its position, say, 10 times by putting aside 10 percent of the initial value of the underlying instrument as collateral, then the floating payment is the sum of the funding cost and a spread. This corresponds to the default premium and compensates the bank for its credit exposure with regard to the TRS purchaser.

Asset-Backed Credit-Linked Notes

An asset-backed credit-linked note (CLN) embeds a default swap in a security such as a medium-term note (MTN). Therefore, a CLN is a debt obligation with a coupon and redemption that are tied to the performance of a bond or loan, or to the performance of government debt. It is an on-balance-sheet instrument, with exchange of principal; there is no legal change of ownership of the underlying assets.

Unlike a TRS, a CLN is a tangible asset and may be leveraged by a multiple of 10. Since there are no margin calls, it offers its investors limited downside and unlimited upside. Some CLNs can obtain a rating that is consistent with an investment-grade rating from agencies such as Fitch, Moody's, or Standard & Poor's.

Figure 19-7 presents a typical CLN structure. The bank buys the assets and locks them into a trust. In the example, we assume that $105 million of non-investment-grade

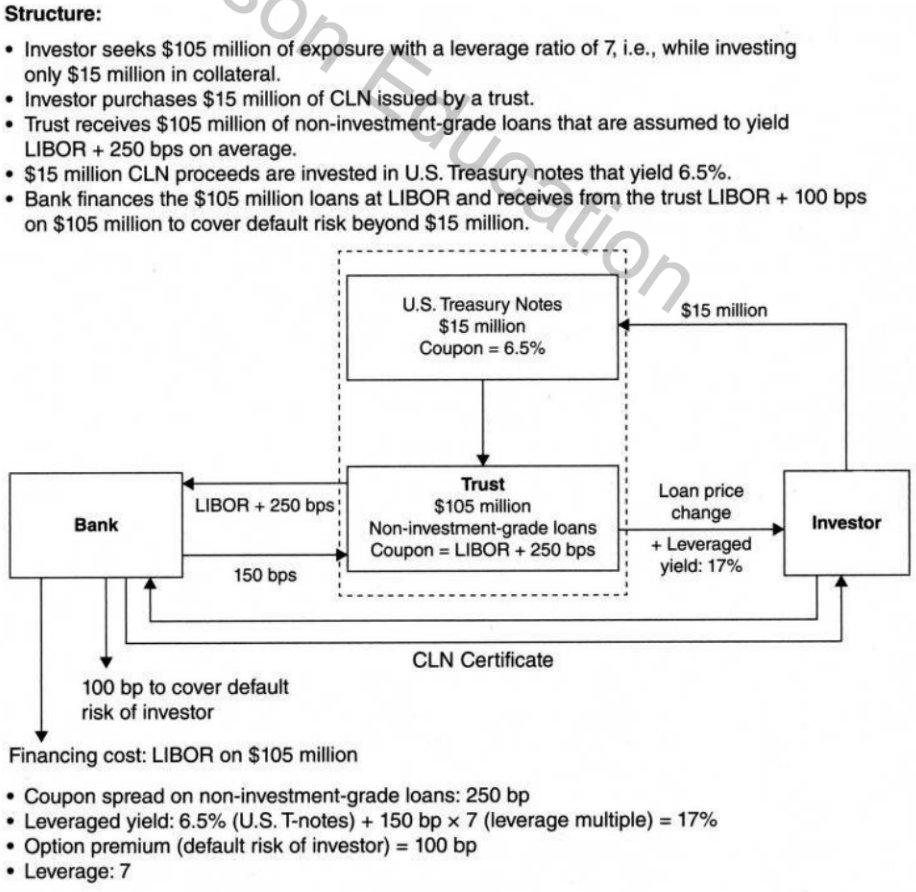


FIGURE 19-7 Asset-backed Credit-Linked Note (CLN).

loans with an average rating of B, yielding an aggregate LIBOR + 250 bp, are purchased at a cost of LIBOR, which is the funding rate for the bank. The trust issues an asset-backed note for $15 million, which is bought by the investor. The proceeds are invested in U.S. government securities, which are assumed to yield 6.5 percent and are used to collateralize the basket of loans. The collateral in our example is 15/105 = 14.3 percent of the initial value of the loan portfolio. This represents a leverage multiple of 7 (105/15 = 7).

The net cash flow for the bank is 100 bp—that is, LIBOR + 250 bp (produced by the assets in the trust) minus the LIBOR cost of funding the assets minus the 150 bp paid out by the bank to the trust. This 100 bp applies to a notional amount of $105 million and is the bank's compensation for retaining the risk of default of the asset portfolio above and beyond $15 million.

The investor receives a yield of 17 percent (i.e., 6.5 percent yield from the collateral of $15 million, plus 150 bp paid out by the bank on a notional amount of $105 million) on a notional amount of $15 million, in addition to any change in the value of the loan portfolio that is eventually passed through to the investor.

In this structure there are no margin calls, and the maximum downside for the investor is the initial investment of $15 million. If the fall in the value of the loan portfolio is greater than $15 million, then the investor defaults and the bank absorbs any additional loss beyond that limit. For the investor, this is the equivalent of being long a credit default swap written by the bank.

A CLN may constitute a natural hedge to a TRS in which the bank receives the total return on a loan portfolio. Different variations on the same theme can be proposed, such as compound credit-linked notes where the investor is exposed only to the first default in a loan portfolio.

Spread Options

Spread options are not pure credit derivatives, but they do have creditlike features. The underlying asset of a spread option is the yield spread between a specified corporate bond and a government bond of the same maturity. The striking price is the forward spread at the maturity of the option, and the payoff is the greater of zero or the difference between the spread at maturity and the striking price, times a multiplier that is usually the product of the duration of the underlying bond and the notional amount.

Investors use spread options to hedge price risk on specific bonds or bond portfolios. As credit spreads widen, bond prices decline (and vice versa).

CREDIT RISK SECURITIZATION

In this section, we offer a quick introduction to the basics of securitization and a recap on key themes in the ongoing attempts to reform and revitalize the securitization markets (Box 19-9).[16] Then we describe the different types of instruments, including some that are not used for securitizing at the present but that are still "in play" in the portfolios of financial institutions (and that remain of historical interest because of their role in provoking the 2007–2009 crisis).

Basics of Securitization

Securitization is a financing technique whereby a company, the *originator,* arranges for the issuance of securities whose cash flows are based on the revenues of a segregated pool of assets—e.g., corporate investment-grade loans, leveraged loans, mortgages, and other asset-backed securities (ABS) such as auto loans and credit card receivables.[17]

Assets are originated by the originator(s) and funded on the originator's balance sheet. Once a suitably large portfolio of assets has been originaled, the assets are analyzed as a portfolio and then sold or assigned to a bankruptcy-remote company—i.e., a special purpose vehicle (SPV) company formed for the specific purpose of funding the assets.[18] The pool of loans is therefore taken *off* the origi-

[16] The market for securitization is recovering faster in the United States than in Europe, where it is still depressed. According to a report by IOSCO (International Organization of Securities Commissions), in the United States, new issuance totaled $124 billion in 2011 and increased to reach $100 billion in the first half of 2012, down from a peak in 2006 of $753 billion. Half of these new issuances are backed by auto loans, while credit cards receivables account for almost 20 percent. In Europe, new Issuance totaled €228 billion in 2011, down from a peak of €700 billion in 2008. More than half of the new issuances are RMBS (residential mortgage-backed securities). See IOSCO, *Global Developments in Securitization Regulation*, November 16, 2012, pp. 11–12.

[17] The borrower may be unaware of this, as the lender normally continues to be the loan servicer.

[18] The SPVs are also known as SIVs (special investment vehicles).

BOX 19-9 Key Securitization Market Reforms: An Ongoing Process

Mending the failings of the securitization industry that helped provoke the 2007–2009 crisis is seen as crucial by both the industry and its regulators if key securitization markets are to be revived in a healthier form.[1]

Securitization markets are highly varied in terms of their jurisdiction, regulatory authorities, and underlying assets, and one of the challenges of the reform process has been to produce a reasonably consistent response (e.g., in Europe versus the United States) rather than a patchwork of local rules. The reform process has also been slow, beginning in 2009 and continuing through 2013 and beyond.

However, in the years since the crisis, both the industry and its regulators have begun changing industry practices in the following key areas:

- *Risk retention*. There is general agreement that originators (e.g., banks) need to retain an interest in each of their securitizations, to make sure they have some "skin in the game." Examples of reforms include rules in Europe preventing credit institutions from investing unless an originating party keeps 5 percent or more of the economic interest. The U.S. agencies require a similar level of retention, though the rules focus on the sponsor rather than the investor and there are important exemptions for securitizations based on assets of apparently higher credit quality.
- *Disclosure and transparency*. Disclosure requirements and proposed disclosures vary across regions and markets, but they cover issues such as the cash flow or "waterfall" structuring of the securitization, trigger events, collateral support, key risk factors, and so on. Two key post-crisis issues are the granularity (or level of detail) of information given to investors about the assets that underlie the securitization and the amount and kind of information that should be given to investors to allow them to understand (or independently analyze) what might happen in a stressed scenario.[2]
- *Rating agency role*. The main worries here are that investors rely too heavily on rating agencies, that agencies suffer from conflicts of interest, and also that securitizing banks "shop around" among the competing rating agencies to find the agency that offers the highest rating. A number of measures are being considered to reduce these issues, including obliging or pushing agencies to:
  - Publish details of their rating methodologies, procedures, and assumptions
  - Distinguish clearly between securitization ratings and other kinds of ratings
  - Make rating agencies more accountable (e.g., to the SEC in the United States)
  - Adopt mechanisms that discourage ratings shopping
  - Reduce the chance that conflicts of interest will affect rating decisions (e.g., keeping rating analysts away from fee discussions)
- *Capital and liquidity requirements*. Various aspects of Basel III reforms are intended to tighten up the treatment of securitization, and proposed revisions will substantially increase capital requirements. Resecuritizations, in particular, attract much higher capital charges, and securitization liquidity facilities are charged a higher credit conversion factor (CCF)—i.e., 50 percent instead of 20 percent in Basel II Standardized Approach.[3]

Sources: IOSCO, *Global Developments in Securitization Regulation*, Final Report. November 16, 2012; IMF, *Global Financial Stability Report*, October 2009, Chapter 2: "Restarting Securitization Markets: Policy Proposals and Pitfalls."

[1] For example, see Basel Committee, *Report an Asset Securitization Incentives*, July 2011.

[2] In the United States, the securitization industry has launched Project Restart to agree and promote improved standards of reporting on the composition of underlying asset pools and their ongoing performance.

[3] In December 2012, the Basel Committee launched a consultative paper that proposed a major overhaul of the regulatory treatment of securitization. (Basel Committee on Ranking Supervision, *Revisions to the Basel Securitization Framework,* Consultative Document, BIS, December 2012.)

nator's balance sheet. Alternatively, loans can be bought from other financial institutions.

The SPY issues tradable "securities" to fund the purchase of the assets. These securities are claims against the underlying pool of assets. The performance of these securities is directly linked to the performance of the assets and, in principle, there is no recourse back to the originator.

Tranching is the process of creating notes of various seniorities and risk profiles, including senior and mezzanine tranches and an equity (or first loss) piece. As a result of the prioritization scheme, also known as the "waterfall," used in the distribution of cash flows to the tranche holders, the most senior tranches are far safer than the average asset in the underlying pool. Senior tranches are insulated from default risk up to the point where credit losses deplete the more junior tranches. Losses on the mortgage loan pool are first applied to the most junior tranche until the principal balance of that tranche is completely exhausted. Then losses are allocated to the most junior tranche remaining, and so on.

This ability to repackage risks and create apparently "safe" assets from otherwise risky collateral led to a dramatic expansion in the issuance of structured securities, most of which were regarded by investors as virtually free of risk and certified as such by the rating agencies. Figure 19-8 gives a graphical representation of the securitization process.

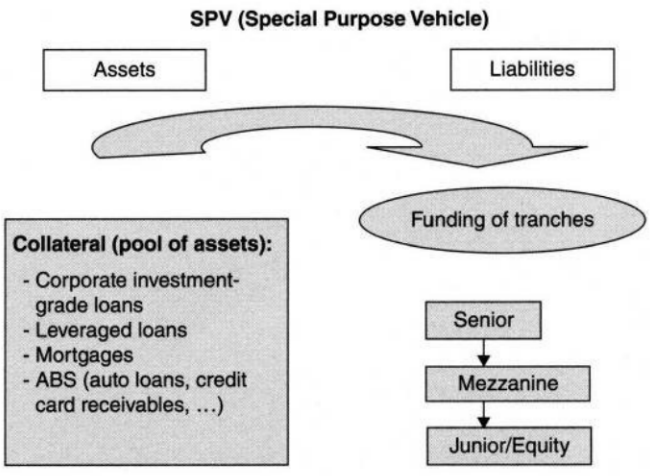


FIGURE 19-8 Securitization of financial assets.

Securitization of Corporate Loans and High-Yield Bonds

Collateralized loan obligations (CLOs) and collateralized bond obligations (CBOs) are simply securities that are collateralized by means of high-yield bank loans and corporate bonds. (CLOs and CBOs are also sometimes referred to generically as collateralized debt obligations, or CDOs.) Banks that use these instruments can free up regulatory capital and thus leverage their intermediation business.

A CLO (CBO) is potentially an efficient securitization structure because it allows the cash flows from a pool of loans (or bonds) rated at below investment grade to be pooled together and prioritized, so that some of the resulting securities can achieve an investment-grade rating. This is a big advantage because a wider range of investors, including insurance companies and pension funds, are able to invest in such a "senior class" of notes. The main differences between CLOs and CBOs are the assumed recovery values for, and the average life of, the underlying assets. Rating agencies generally assume a recovery rate of 30 to 40 percent for unsecured corporate bonds, while the rate is around 70 percent for well-secured bank loans. Also, since loans amortize, they have a shorter duration and thus present a lower risk than their high-yield bond counterparts. It is therefore easier to produce notes with investment-grade ratings from CLOs than it is from CBOs.[19]

Figure 19-9 illustrates the basic structure of a CLO. A special purpose vehicle (SPV) or trust is set up, which issues, say, three types of securities: senior secured class A notes, senior secured class B notes, and subordinated notes or an "equity tranche." The proceeds are used to buy high-yield notes that constitute the collateral. In practice, the asset pool for a CLO may also contain a small percentage of high-yield bonds (usually less than 10 percent). The reverse is true for CBOs: they may include up to 10 percent of high-yield loans.

[19] Despite some rating downgrades (then upgrades), CLO credit quality was relatively robust during and after the financial crisis of 2007–2009. The market was largely dormant immediately after the crisis, but volumes of new CLOs began to grow quite quickly through 2011 and 2012. Post-crisis CLOs tend to protect their senior tranches with higher levels of subordination and with generally stricter terms. See Standard & Poor's Rating Services, "CLO Issuance Is Surging, Even Though the Credit Crisis Has Changed Some of the Rules," *CDO Spotlight*, August 2012.

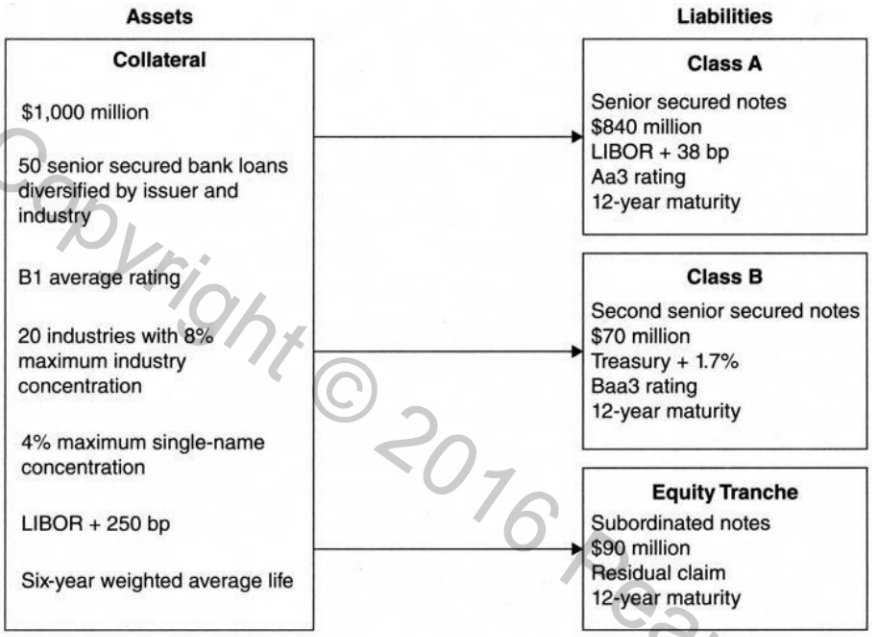


FIGURE 19-9 Typical Collateralized Loan Obligation (CLO) structure.

A typical CLO might consist of a pool of assets containing, say, 50 loans with an average rating of, say, B1 (by reference to Moody's rating system). These might have exposure to, say, 20 industries, with no industry concentration exceeding, say, 8 percent. The largest concentration by issuer might be kept to, say, under 4 percent of the portfolio's value. In our example, the weighted-average life of the loans is assumed to be six years, while the issued notes have a stated maturity of 12 years. The average yield on these floating-rate loans is assumed to be LIBOR + 250 bp.

The gap in maturities between the loans and the CLO structure requires active management of the loan portfolio. A qualified high-yield loan portfolio manager must be hired to actively manage the portfolio within constraints specified in the legal document. During the first six years, which is called the reinvestment or lockout period, the cash flows from loan amortization and the proceeds from maturing or defaulting loans are reinvested in new loans. (As the bank originating the loans typically remains responsible for servicing the loans, the investor in loan packages should be aware of the dangers of moral hazard and adverse selection for the performance of the underlying loans.) Thereafter, the three classes of notes are progressively redeemed as cash flows materialize.

The issued notes consist of three tranches: two senior secured classes with an investment-grade rating and an unrated subordinated class or equity tranche. The equity tranche is in the first-loss position and does not have any promised payment; the idea is that it will absorb default losses before they reach the senior investors.

In our example, the senior class A note is rated Aa3 and pays a coupon of LIBOR + 38 bp, which is more attractive than the sub-LIBOR coupon on an equivalent corporate bond with the same rating. The second senior secured class note, or mezzanine tranche, is rated Baa3 and pays a fixed coupon of Treasury + 1.7 percent for 12 years. Since the original loans pay LIBOR + 250 bp, the equity tranche offers an attractive return as long as most of the loans underlying the notes are fully paid.

The rating enhancement for the two senior classes is obtained by prioritizing the cash flows. Rating agencies such as Fitch, Moody's, and Standard & Poor's have developed their own methodologies for rating these senior class notes. (Appendix 19.1 discusses why agency ratings of CDOs in the run up to the 2007–2009 financial crisis were misleading.)

There is no such thing as a free lunch in the financial markets, and this has considerable risk management implications for banks issuing CLOs and CBOs. The credit enhancement of the senior secured class notes is obtained by simply shifting the default risk to the equity tranche. According to simulation results, the returns from investing in this equity tranche can vary widely: from −100 percent, with the investor losing everything, to more than 30 percent, depending on the actual rate of default on the loan portfolio. Sometimes the equity tranche is bought by investors with a strong appetite for risk, such as hedge funds, either outright or more often by means of a total return swap with a leverage multiple of 7 to 10. But most of the time, the bank issuing a CLO retains this risky first-loss equity tranche.

The main motivation for banks that issued CLOs in the period before the 2007–2009 crisis was thus to arbitrage regulatory capital: it was less costly in regulatory capital terms to hold the equity tranche than to hold the underlying loans. However, while the amount of regulatory capital

the bank has to put aside might fall, the economic risk borne by the bank was not necessarily reduced at all. Paradoxically, credit derivatives, which offer a more effective form of economic hedge, received little regulatory capital relief. This form of regulatory arbitrage won't be allowed under the new Basel Accord.

The Special Case of Subprime CDOs

While CDO collateral pools can consist of various forms of debt, such as bonds, loans, or synthetic exposures through CDS (credit default swaps), subprime CDOs were based on structured credit products such as tranches of subprime residential mortgage-backed securities (RMBS) or of other CDOs.[20]

A typical subprime trust is composed of several thousand individual subprime mortgages, typically around 3,000 to 5,000 mortgages, for a total amount of approximately $1 billion.[21] The distribution of losses in the mortgage pool is tranched into different classes of residential mortgage-backed securities (RMBS) from the equity tranche, typically created through overcollateralization, to the most senior tranche, rated triple-A. A subprime CDO is therefore a CDO-squared, with a pool of assets composed of RMBS bonds rated double-B to double-A, with an average rating of triple-B.[22] Figure 19-10 illustrates the difference between the securitization of asset-backed securities such as mortgages, taking the form of a CDO-squared, and the more straightforward securitization of corporate loans in the form of a CLO.

In a typical subprime CDO, approximately 75 percent of the tranches benefit from a triple-A rating. On average, the mezzanine part of the capital structure accounts for 20 percent of the securities issued by the SPY and is rated investment grade; the remaining 5 percent is the equity tranche (first loss) and remains unrated.

Re-Remics

Re-Remics are a by-product of the crisis. Many AAA-rated CDO tranches were downgraded during the subprime crisis; however, some investors can only retain these securities if the securities maintain their AAA rating. In addition, maintaining a AAA rating can save a substantial amount of regulatory capital. For example, the Basel 2.5 risk weighting of a BB-rated tranche is 350 percent under

[20] Issuance of these credit products increased dramatically after 2004, leading up to the financial crisis of 2007–2009. They represented 49 percent of the $560 billion worth of CDO issuance in 2006, up from 40 percent in 2004.

[21] "Subprime" mortgages are mortgages to less creditworthy borrowers. A rule of thumb is that a subprime mortgage is a home loan to someone with a credit FICO score of less than 620. Subprime borrowers have limited credit history or some other form of credit impairment. Some lenders classify a mortgage as subprime when the borrower has a credit score as high as 680 if the down payment is less than 5 percent. Alt-A borrowers fall between subprime and prime borrowers. They have credit scores sufficient to qualify for a conforming mortgage but do not have the necessary documentation to substantiate that their assets and income can support the requested loan amount.

Prior to 2005, subprime mortgage loans accounted for approximately 10 percent of outstanding mortgage loans. By 2006, subprime mortgages represented 13 percent of all outstanding mortgage loans, with origination of subprime mortgages totaling $420 billion (according to Standard & Poor's). This represented 20 percent of new residential mortgages, compared to the historical average of 8 percent. By July 2007, there was an estimated $1.4 trillion of subprime mortgages outstanding.

Subprime mortgages that required little or no down payment, as well as no documentation of the borrower's income, were known as "liar loans" because people could safely lie on their mortgage application, knowing there was little chance their statements would be checked. They accounted for 40 percent of the subprime mortgage issuance in 2006, up from 25 percent in 2001. (These loans were also called NINJA, with reference to applicants who had No Income, No Job, and no Assets.)

This phenomenon was aggravated by the incentive compensation system for mortgage brokers, which was based on the volume of loans originated rather than their performance, with few consequences for the broker if a loan defaulted within a short period. Originating brokers had little incentive to perform due diligence and monitor borrowers' creditworthiness, as most of the subprime loans originated by brokers were subsequently securitized. Fraud was also identified among some brokers—e.g., inflating the declarations of some applicants to make it possible for the applicant to obtain a loan. See M. Crouhy, "Risk Management Failures During the Financial Crisis," in D. Evanoff. P. Hartmann, and G. Kaufman, eds., *The First Credit Market Turmoil of the 2lst Century: Implications for Public Policy*, World Scientific Publishing, 2009, pp. 241–266.

[22] As discussed earlier, there was a huge demand for AAA-rated senior and super-senior tranches of CDOs from institutional investors because these tranches offered a higher yield than traditional securities with equivalent ratings—e.g., corporate and Treasury bonds. Hedge funds were the main buyers of the equity tranches. The high interest rate paid on these tranches meant they would pay a good return so long as defaults in the underlying asset pool occurred late in the life of the CDO. Mezzanine tranches, with an average rating of BBS, were harder to distribute, so banks securitized these tranches in new CDOs, referred to as "CDO-squareds."

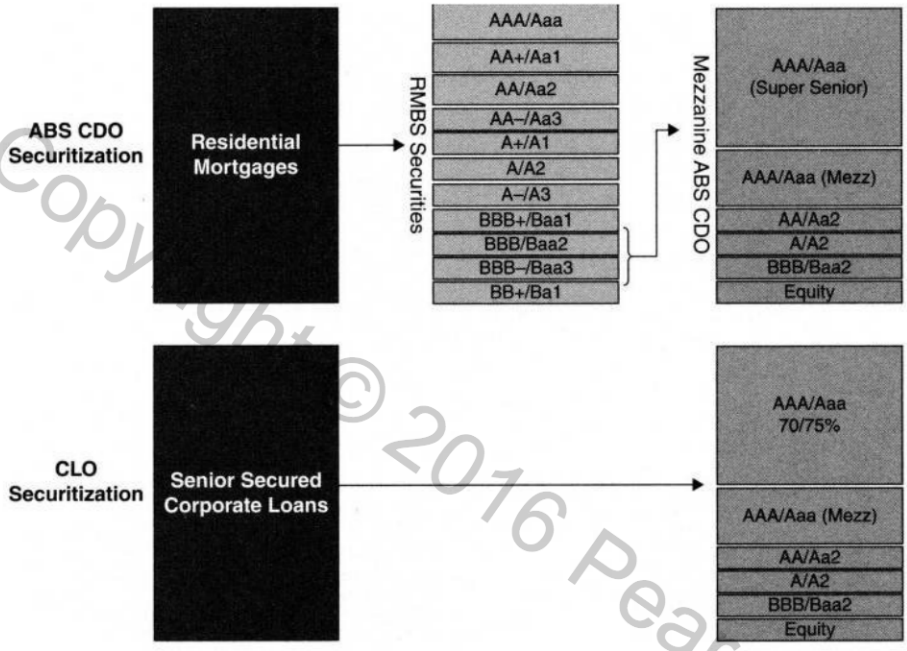


FIGURE 19-10 Securitization of asset-backed securities such as mortgages vs. securitization of corporate loans.

the standardized approach, while it is only 40 percent for a AAA-rated resecuritization.[23]

Re-Remics consist of resecuritizing senior mortgage-backed securities (MBS) tranches that have been downgraded from their initial AAA rating. Only two tranches are issued: a senior AAA tranche for approximately 70 percent of the nominal and an unrated mezzanine tranche for around 30 percent of the nominal.

Given the new regulatory capital regime, the total risk weight would decline from 350 percent (assuming the collateral is rated BB) to

$$70\% \times 40 + 30\% \times 650 = 223 \text{ percent}$$

where 70 percent and 30 percent are the size of the AAA and mezzanine tranches, respectively, and 40 and 650 are the risk weights for the resecuritization exposures rated AAA and unrated, respectively.

[23] Basel Committee on Banking Supervision, *Enhancements to the Basel II Framework*, Bank for International Settlements, July 2009.

Synthetic CDOs

In a traditional CDO, also called a "cash-CDO," the credit assets are fully cash funded using the proceeds of the debt and equity issued by the SPV; the repayment of obligations is tied directly to the cash flows arising from the assets. Figure 19-9 offers an example of this kind of structure—in this case the example of a CLO, one of the main types of CDO. A synthetic CDO, by contrast, transfers risk without affecting the legal ownership of the credit assets. This is accomplished through a series of CDSs.

The sponsoring institution transfers the credit risk of the portfolio of credit assets to the SPV by means of the CDSs, while the assets themselves remain on the balance sheet of the sponsor. In the example in Figure 19-11, the right-hand side is equivalent to the cash CDO structure presented in Figure 19-9, except that it applies to only 10 percent of the pool of reference assets. The left-hand side shows the credit protection in the form of a "super senior swap" provided by a highly rated institution (a role that used to be performed by monoline insurance companies before the subprime crisis).

The SPV typically provides credit protection for 10 percent or less of the losses on the reference portfolio. The SPV, in turn, issues notes in the capital markets to cash collateralize the portfolio default swap with the originating entity. The notes issued can include a nonrated equity

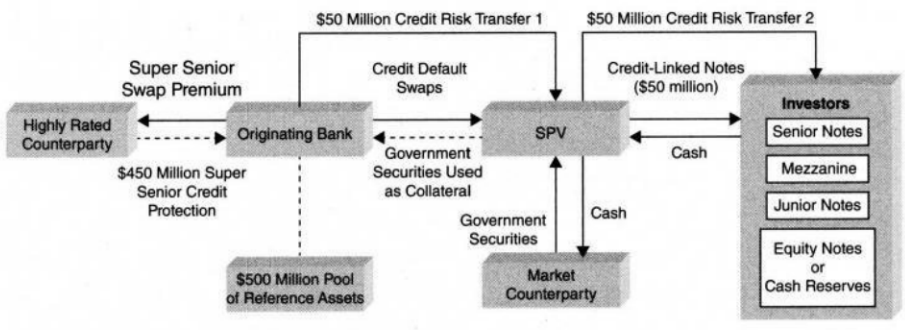


FIGURE 19-11 Capital structure of a synthetic CDO.

piece, mezzanine debt, and senior debt, creating cash liabilities. Most of the default risk is borne by the investors in these notes, with the same risk hierarchy as for cash CDOs—i.e., the equity tranche holders retain the risk of the first set of losses, and the mezzanine tranche holders are exposed to credit losses once the equity tranche has been wiped out. The remainder of the risk, 90 percent, is usually distributed to a highly rated counterparty via a senior swap.

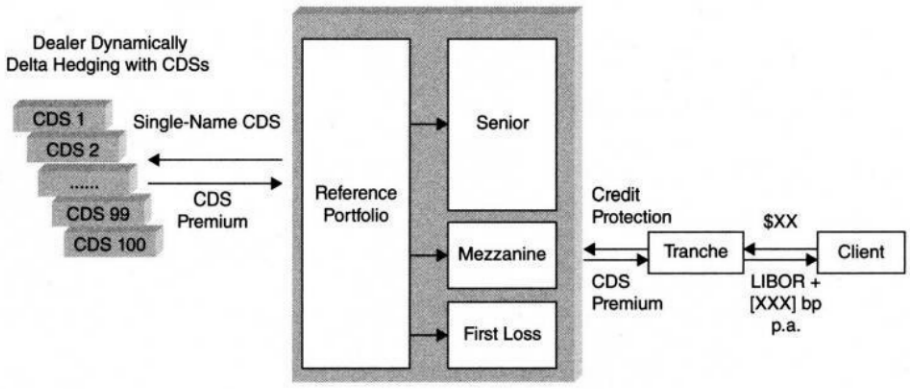


FIGURE 19-12 Single-tranche CDO.

Before the 2007–2009 financial crisis, reinsurers and insurance monoline companies, which typically had AAA credit ratings, exhibited a strong appetite for this type of senior risk, often referred to as super-senior AAAs. The initial proceeds of the equity and notes are invested in highly rated liquid assets.

If an obligor in the reference pool defaults, the trust liquidates investments in the trust and makes payments to the originating entity to cover the default losses. This payment is offset by a successive reduction in the equity tranche and then the mezzanine tranche; finally, the super-senior tranches are called on to make up the losses.

Single-Tranche CDOs

The terms of a single-tranche CDO are similar to those of a tranche of a traditional CDO. However, in a traditional CDO, the entire portfolio may be ramped up, and the entire capital structure may be distributed to multiple investors. In a single-tranche CDO, only a particular tranche, tailored to the client's needs,[24] is issued, and there is no need to build the actual portfolio, as the bank will hedge its exposure by buying or selling the underlying reference assets according to hedge ratios produced by its proprietary pricing model.

In the structure described in Figure 19-12, for example, the client has gained credit protection for a mezzanine or middle-ranking tranche of credit risk in its reference portfolio but continues to assume both the first-loss (equity) risk tranche and the most senior risk tranche. The biggest advantage of this kind of instrument is that it allows the client to tailor most of the terms of the transaction. The biggest disadvantage tends to be the limited liquidity of tailored deals. Dealers who create single-tranche CDOs have to dynamically hedge the tranche they have purchased or sold as the quality and correlation of the portfolio change.

Credit Derivatives on Credit Indices

Credit trading based on indices ("index trades") had become popular before the crisis and is still active, although there is less activity for index tranches. The indices are based on a large number of underlying credits, and portfolio managers can therefore use index trades to hedge the credit risk exposure of a diversified portfolio. Index trades are also popular with holders of CDO tranches and CLNs who need to hedge their credit risk exposure.

There are several families of credit default swap indices that cover loans as well as corporate, municipal, and sovereign debt across Europe, Asia, North America, and emerging markets. Markit, a financial information services company, owns and manages these credit indices, which are the only credit indices supported by all major dealer banks and buy-side investment firms (Figure 19-13).

The two major families of credit indices are CDX for North America and emerging markets and iTraxx for Europe and Asia. CDX indices are a family of indices covering multiple sectors. The main indices are CDX North American Investment Grade (CDX.NA.IG), with 125 equally weighted North American names; CDX North America Investment Grade High Volatility (30 names from CDX.NA.IG); and

[24] The client can be a buyer or a seller of credit protection. The bank is on the other side of the transaction.

Structured Finance		US	Markit ABX, CMBX, PrimeX, IOS, PO, MBX, TRX	
Synthetic Credit	**Loans**	US	Markit LCDX	
		Europe	MarkitiTraxx LevX	
	Sovereigns	Global	Markit CDX EM	Emerging Markets
				EM Diversified
			MarkitiTraxx SovX	Western Europe
				CEEMEA
				Asia Pacific
				Latin America
				G7
				Global Liquid Investment Grade
				BRIC
	Corporate Bonds	North America	Markit CDX NA	Investment Grade (IG, HVol)
				Crossover
				High Yield (HY, HY.B, HY.BB)
				Sectors
		Europe	MarkitiTraxx Europe	Europe (Investment Grade)
				HiVol
				Non-Financials
				Financials (Senior, Sub)
				Crossover
		Asia	MarkitiTraxx Asia	Japan
				Asia ex-Japan (IG, HY)
				Australia
	Municipal Bonds	US	Markit MCDX	

Key features of the indices

	Index	# Entities (1)	Roll Dates	Maturity in years (2)	Credit Events
CDX	IG	125	3/20–9/20	1,2,3,5,7,10	Bankruptcy, Failure to Pay
	HVOL	30	3/20–9/20	1,2,3,5,7,10	
	HY	100	3/27–9/27	3,5,7,10	
	XO	35	3/20–9/20	3,5,7,10	
	EM	15 (variable)	3/20–9/20	5	Bankruptcy, Failure to Pay, Restructuring,
	EM Diversified	40	3/20–9/20	5	
iTraxx Europe	Europe	125	3/20–9/20	3,5,7,10	Bankruptcy, Failure to Pay, Restructuring
	– Non financials	100	3/20–9/20	5,10	
	– Senior financials	25	3/20–9/20	5,10	
	– Sub financials	25	3/20–9/20	5,10	
	– High volatility	30	3/20–9/20	3,5,7,10	
	Crossover	40	3/20–9/20	3,5,7,10	
iTraxx Asia	Japan	50	3/20–9/20	5	Bankruptcy, Failure to Pay, Restructuring
	Asia ex-Japan IG	50	3/20–9/20	5	
	Asia ex-Japan HY	20	3/20–9/20	5	
	Australia	25	3/20–9/20	5	
iTraxx SovX	Western Europe	15	3/20–9/20	5,10	Failure to Pay, Restructuring, Repudiation/Moratorium
	CEEMEA	15	3/20–9/20	5,10	
	Asia Pacific	10	3/20–9/20	5,10	
	Latin America*	8	3/20–9/20	5,10	
	G7*	Up to 7	3/20–9/20	5,10	
	Global Liquid IG*	11 to 27	3/20–9/20	5,10	
	BRIC*	Up to 4	3/20–9/20	5,10	
MCDX	MCDX	50 credits	4/3–10/3	3,5,10	Failure to Pay, Restructuring
LCDX	LCDX	100	4/3–10/3	5	Bankruptcy, Failure to Pay
iTraxx LevX	LevX Senior	40	3/20–9/20	5	Bankruptcy, Failure to Pay, Restructuring

1. All indices are equally weighted, except for CDX.EM. and Traxx SovXCEEMEA.
2. Exact maturity is June 20th for the indices rolling on March 20th, March 27th and April 3rd and December 20th for indices rolling on September 20th, September 27th and October 3rd to coincide with IMM roll dates.
3. *Theoretical Indices.

FIGURE 19-13 Markit credit indices and their key features.

Source: Markit.

CDX North America High Yield (100 names). Similarly, for Europe there is an iTraxx Investment Grade index, which comprises 125 equally weighted European names. The iTraxx Crossover index comprises the 40 most liquid sub-investment-grade European names.

These indices trade 3-, 5-, 7- and 10-year maturities, and a new series is launched every six months on the basis of liquidity.

Like CDOs, iTraxx and CDX are tranched, with each tranche absorbing losses in a predesignated order of priority. The tranching is influenced by the nature of the respective geographic markets. For example, CDX.NA.IG tranches have been broken down according to the following loss attachment points: 0–3 percent (equity tranche), 3–7 percent, 7–10 percent, 10–15 percent, 15–30 percent, and 30–100 percent (the most senior tranche), as illustrated in Figure 19-14. For iTraxx, the corresponding tranches are 0–3 percent, 3–6 percent, 6–9 percent, 9–12 percent, 12–22 percent, and 22–100 percent. The tranching of the European and U.S. indices is adjusted so that tranches of the same seniority in both indices receive the same rating. The tranches of the U.S. index are thicker because the names that compose the U.S. index are on average slightly more risky than the names in the European index.

There is currently a limited active broker market in tranches of both the iTraxx and the CDX.NA.IG, with 3- and 5-year tranches quoted on both indices. There is also activity in the 3- and 5-year tranches of the HY CDX.

The quotation of each tranche is made of two components: the "upfront" payment and a fixed "coupon" paid on a quarterly basis. These quotes are also converted in an equivalent "spread." At the end of August 2013, for example, the junior mezzanine tranche for the iTraxx index (tenor 5 years, Series 19, issued in March 2013) was quoted at an equivalent spread of 521 bp. The annualized cost for an investor who bought the junior mezzanine tranche of a $1 billion iTraxx portfolio at 521 bp would be 521 bp annually on $30 million (3 percent of $1 billion); in return, the investor would receive from the seller for any and all losses between $30 and $60 million of the $1 billion underlying iTraxx portfolio (representing the 3–6 percent tranche).

Options have been traded on iTraxx and CDX to meet the demand from hedge funds and proprietary trading desks looking to trade credit volatility and take views on the direction of credit using options.

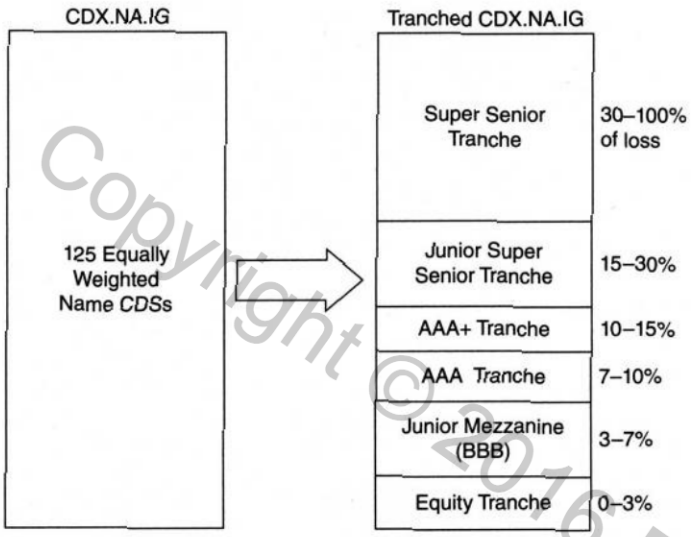


FIGURE 19-14 Tranched U.S. index of investment-grade names: CDX.NA.IG.

SECURITIZATION FOR FUNDING PURPOSES ONLY

For some years after the 2007–2009 financial crisis—triggered by problems in the subprime lending markets—investors remained wary about credit-linked investments. In the same period, funding became a major issue for banks because confidence in the financial system, and bank soundness, had also been severely damaged.

As securitization with credit risk transfer ground to a halt, banks began to use different kinds of funding vehicles in which all, or virtually all, of the credit risk remains with the bank. Below are two examples of such funding structures.

Covered Bonds

Covered bonds are debt obligations secured by a specific reference portfolio of assets. However, covered bonds are not true securitization instruments, as issuers are fully liable for all interest and principal payments; thus, investors have "double" protection against default, as they have recourse to both the issuer and the underlying loans. The "cover pool" of loans is legally ring-fenced on the issuer's balance sheet. Covered bonds are essentially a funding instrument, as no risk is transferred from the issuer to the investor.

In Europe, financial institutions have used covered bonds extensively to finance their mortgage lending activity—e.g., the German "Pfandbriefe," examined below, and the French "Obligations Foncières." According to the IMF, the covered mortgage bond market in Europe in 2009 constituted a $3 trillion market—i.e., 40 percent of European GOP.

While these instruments are not new, the 2007–2009 financial crisis reignited interest in this alternative source of capital market funding. In addition, the European Central Bank (ECB) launched a £60 billion covered bond purchase program in May 2009 (effective from July 2009 to July 2010), which had a strong positive impact on the volume of issuance and also led to narrower spreads.

Pfandbriefe[25]

A Pfandbrief bank is a German bank that issues covered bonds under the German Pfandbrief Act. These bonds, or Pfandbriefe, are AAA- or AA-rated bonds backed by a cover pool that includes long-term assets such as residential and commercial mortgages, ship loans, aircraft loans, and public sector loans.

Loans are reported in the Pfandbrief bank's balance sheet as assets in specific cover pools. Cover assets remain on the balance sheet and are supervised by an independent administrator. Pfandbriefe are collateralized by the cover assets and are subject to strict quality requirements—e.g., regional restrictions, senior loan tranches, and low loan-to-value ratios. The Pfandbrief Act ensures that the cover pools are available only to the relevant Pfandbrief creditor in the event of the bank's insolvency.

Several European banks have elected to create a German Pfandbrief subsidiary rather than a domestic covered bond program because the German Pfandbrief market is highly liquid and benefits from lower funding spreads than other covered bond markets in Europe.

Funding CLOs

Funding CLOs are balance sheet cash flow CLO transactions with only two tranches. The senior tranche, or funding tranche, is issued to investors. This tranche is rated by a rating agency and is structured so that it is given a AAA rating. The junior tranche, or subordinated note, is unrated, bears the first loss, and is kept by the bank.

[25] The origins of Pfandbrief banks lie in eighteenth-century Prussia; they now constitute the largest covered-bond market in the world.

CONCLUSION

Credit derivatives and securitization are key tools for the transfer and management of credit risk and for the provision of bank funding. However, for some years following the financial crisis, some of the key securitization markets were effectively closed for new issuance though others (e.g., auto loans) remained active. The process of agreeing how to reform and revitalize the markets has been slow, but there are signs that credit transfer markets, such as the CLO market, are once again reviving.

This may be timely. Basel III and the Dodd-Frank Act are likely to raise the cost of capital for banks. Banks may, in the longer term, have no alternative other than to adopt the originate-to-distribute business model and use credit derivatives and other risk transfer techniques to redistribute and repackage credit risk outside the banking system (notably to the insurance sector, investment funds, and hedge funds).

Up until recently, one of the main reasons for using the new credit instruments was regulatory arbitrage; it was this that led to the setting up of conduits and SIVs. Basel III should align regulatory capital requirements more closely to economic risk and provide more incentives to use credit instruments to manage the "real" underlying credit quality of a bank's portfolio.

Nevertheless, opportunities for regulatory arbitrage will remain. In the case of retail products such as mortgages, the very different regulatory capital treatment for Basel III compliant banks, compared to the treatment of banks that remain compliant with the current Basel I rules, will itself give rise to an arbitrage opportunity.

There is another kind of downside. The final paragraph of this chapter in the 2006 edition of this book, written well before the 2007–2009 financial crisis erupted, warned:

> Risks assumed by means of credit derivatives are largely unfunded and undisclosed, which could allow players to become leveraged in a way that is difficult for outsiders (or even senior management) to spot. So far, we've yet to see a major financial disaster caused by the complexities of credit derivatives and the new opportunities they bring for *both* transferring and assuming credit risk. But such a disaster will surely come, particularly if the boards and senior managers of banks do not invest the time to understand exactly how these new markets and instruments work—and how each major transaction affects their institutions risk profile.[26]

Despite attempts by regulators and the market to improve disclosure, this surely remains significantly true. Credit risk transfer is an enormously powerful tool for managing risk and for distributing risk to those most able to assume it. However, used without due care and attention, it can also devastate institutions and whole economies.

APPENDIX 19.1

Why the Rating of CDOs by Rating Agencies Was Misleading[27]

Investors in complex credit products were particularly reliant on rating agencies because they often had little information at their disposal to assess the underlying credit quality of the assets held in their portfolios.

In particular, investors tended to assume that the ratings for structured products were stable: no one expected triple-A assets to be downgraded to junk status within a few weeks or even a few days.[28] (However, the higher yields on these instruments, compared to the bonds of equivalently rated corporations, suggests that the market understood to some degree that the investments were not equivalent in terms of credit and/or liquidity risk.)

The sheer volume of downgrades of structured credit products focused attention on the nature of their ratings and how they might differ from the longer established ratings—e.g., those for corporate debt. Perhaps the most fundamental difference is that corporate bond ratings are largely based on firm-specific risk, whereas CDO tranches represent claims on cash flows from a portfolio of correlated assets. Thus, rating CDO tranches relies heavily on

[26] See pages 323–324 of the 2006 edItion.

[27] This appendix relies in part on an earlier work published by one of the authors. See M. Crouhy, "Risk Management Failures During the Financial Crisis," in D. Evanoff, P. Hartmann, and G. Kaufman, eds., *The First Credit Market Turmoil of the 21st Century; Implications for Public Policy*, World Scientific Publishing, 2009, pp. 241–266.

[28] Moody's first look rating action on 2006 vintage subprime loans in November 2006. In 2007, Moody's downgraded 31 percent of all tranches for CDOs of ABS that it had rated, including 14 percent of those initially rated AAA.

quantitative models, whereas corporate debt ratings rely essentially on the judgment of an analyst.

While the rating of a CDO tranche should exhibit the same expected loss as a corporate bond of the same rating, the volatility of loss—i.e., the unexpected loss—is quite different. It strongly depends on the correlation structure of the underlying assets in the pool of the CDO. This in itself warrants the use of different rating scales for corporate bonds and structured credit products.

For structured credit products, such as ABS collateralized debt obligations, it is necessary to model the cash flows and the loss distribution generated by the asset portfolio over the life of the CDO. This implies that it is necessary to model *prepayments* and *default dependence* (correlation) among the assets in the CDO and to estimate the parameters describing this dependence over time. In turn, this means modeling the evolution of the different factors that affect the default process and how these factors evolve together. It is critical to assess the sensitivity of tranche ratings to a significant deterioration in credit conditions that might drive default clustering. This relationship depends on the magnitude of the shocks and tends to be nonlinear.

If default occurs, it is necessary to estimate the resulting loss. Recovery rates depend on the state of the economy, the condition of the obligor, and the value of its assets. Loss rates and the frequency of default are dependent on each other: if the economy goes into recession, both the frequency of default and the loss rates increase. It is a major challenge to model this joint dependence.

Subprime lending on any scale is a relatively new industry, and the limited set of historical data available increased the model risk inherent in the rating process. In particular, historical data on the performance of U.S. subprime loans were largely drawn from a benign economic period with constantly rising house prices, making it difficult to estimate the correlation in defaults that would occur during a broad market downturn.

Many industry players misunderstood the nature of the risk involved in holding a AAA-rated super-senior tranche of a subprime CDO. Subprime CDOs are really CDO-squared because the underlying pool of assets of the CDO is not made up of individual mortgages. Instead, it is composed of subprime RMBS, or mortgage bonds, that are themselves tranches of individual subprime mortgages.

After the crisis, many commentators questioned whether the CRAs' poor ratings performance in structured credit products might be related to conflicts of interest. The CRAs were paid to rate the instruments by the issuer (not the investor), and these fees constituted a fast growing income stream for CRAs in the run-up to the crisis.

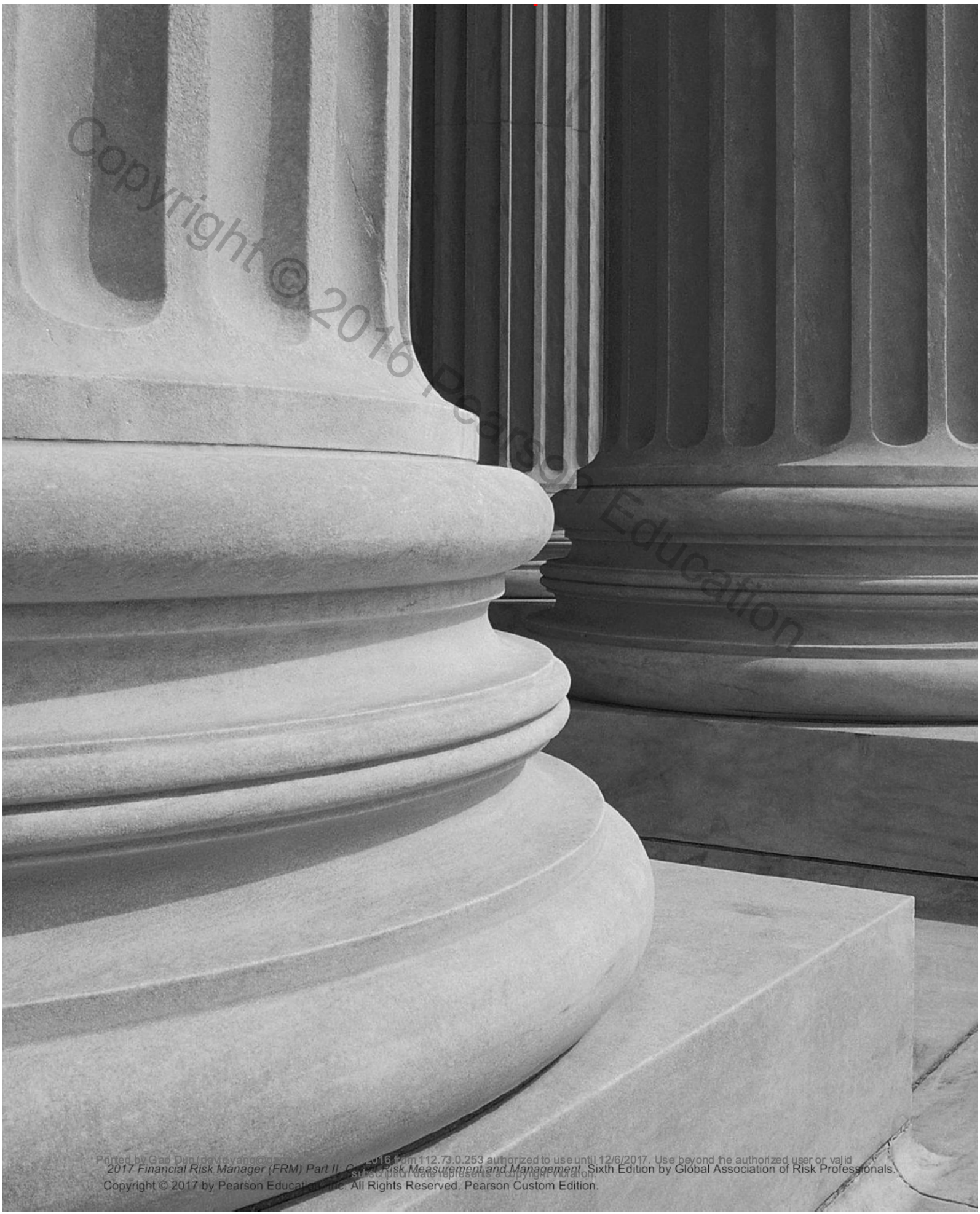
Another worry was the quality of the due diligence concerning the nature of the collateral pools underlying rated securities. Due diligence about the quality of the underlying data and the quality of the originators, issuers, or servicers could have helped to identify fraud in the loan files.

In addition, CRAs did not take into account the substantial weakening of underwriting standards for products associated with certain originators.

Commentators also questioned the degree of transparency about the assumptions, criteria, and methodologies used in rating structured credit products.

Since the crisis, regulators have tried to address the role that ratings played in the crisis in a variety of ways. For example, the Dodd-Frank Act explicitly calls for replacing the language of "investment-grade" and "non-investment-grade" and proposes that federal agencies undertake a review of their reliance on credit ratings and develop different standards of creditworthiness.[29] The aim is to encourage investors to perform their own due diligence and assess the risk of their investments, reducing the systemic risk that arises when too many investors rely too heavily on external risk assessment.

[29] This might require a review of the very foundations of the Standardized Approach in Basel II, which relies explicitly on the ratings awarded by rating agencies and other nationally recognized statistical rating organizations (NRSRO).



2017 Financial Risk Manager (FRM) Part II: Credit Risk Measurement and Management, Sixth Edition by Global Association of Risk Professionals.

An Introduction to Securitisation

20

Learning Objectives

After completing this reading you should be able to:

- Define securitization, describe the securitization process, and explain the role of participants in the process.
- Explain the terms *over-collateralization, first-loss piece, equity piece,* and *cash waterfall* within the securitization process.
- Analyze the differences in the mechanics of issuing securitized products using a trust versus a special purpose vehicle (SPV), and distinguish between the three main SPV structures: amortizing, revolving, and master trust.
- Explain the reasons for and the benefits of undertaking securitization.
- Describe and assess the various types of credit enhancements.
- Explain the various performance analysis tools for securitized structures, and identify the asset classes they are most applicable to.
- Define and calculate the delinquency ratio, default ratio, monthly payment rate (MPR), debt service coverage ratio (DSCR), the weighted average coupon (WAC), the weighted average maturity (WAM), and the weighted average life (WAL) for relevant securitized structures.
- Explain the prepayment forecasting methodologies, and calculate the constant prepayment rate (CPR) and the Public Securities Association (PSA) rate.
- Explain the decline in demand for new-issue securitized finance products following the 2007 financial crisis.

Excerpt is Chapter 12 of Structured Credit Products: Credit Derivatives and Synthetic Securitisation, *Second Edition, by Moorad Choudhry.*

The second part of this book examines *synthetic securitisation*. This is a generic term covering structured financial products that use credit derivatives in their construction. In fact another term for the products could be 'hybrid structured products'. However, because the economic impact of these products mirrors some of those of traditional securitisation instruments, we use the term 'synthetic securitisation'. To fully understand this, we need to be familiar with traditional or *cash flow* securitisation as a concept, and this is what we discuss now.

The motivations behind the origination of synthetic structured products sometimes differ from those of cash flow ones, although sometimes they are straight alternatives. Both product types are aimed at institutional investors, who may or may not be interested in the motivation behind their origination (although they will—as prudent portfolio managers—be interested in the name and quality of the originating institution). Both techniques aim to create disintermediation and bring the seekers of capital, and/or risk exposure, together with providers of capital and risk exposure.

In this chapter we introduce the basic concepts of securitisation and look at the motivation behind their use, as well as their economic impact. We illustrate the process with a brief hypothetical case study. We then move on to discuss a more advanced synthetic repackaging structure.

THE CONCEPT OF SECURITISATION

Securitisation is a well-established practice in the global debt capital markets. It refers to the sale of assets, which generate cash flows from the institution that owns the assets, to another company that has been specifically set up for the purpose of acquiring them, and the issuing of notes by this second company. These notes are hacked by the cash flows from the original assets. The technique was introduced initially as a means of funding for US mortgage banks. Subsequently, the technique was applied to other assets such as credit card payments and equipment leasing receivables. It has also been employed as part of asset/liability management, as a means of managing balance sheet risk.

Securitisation allows institutions such as banks and corporations to convert assets that are not readily marketable—such as residential mortgages or car loans—into rated securities that are tradable in the secondary market. The investors that buy these securities gain exposure to these types of original assets that they would not otherwise have access to. The technique is well established and was first introduced by mortgage banks in the United States during the 1970s. The synthetic securitisation market was established much more recently, dating from 1997. The key difference between cash and synthetic securitisation is that in the former market, as we have already noted, the assets in question are actually sold to a separate legal company known as a special purpose vehicle (SPV). This does not occur in a synthetic transaction, as we shall see.

Sundaresan (1997, p. 359) defines securitisation as

> . . . a framework in which some illiquid assets of a corporation or a financial institution are transformed into a package of securities backed by these assets, through careful packaging, credit enhancements, liquidity enhancements and structuring.

The process of securitisation creates *asset-backed securities*. These are debt instruments that have been created from a package of loan assets on which interest is payable, usually on a floating basis. The asset-backed market was developed in the US and is a large, diverse market containing a wide range of instruments. Techniques employed by investment banks today enable an entity to create a bond structure from virtually any type of cash flow. Assets that have been securitised include loans such as residential mortgages, car loans and credit card loans. The loans form assets on a bank or finance house balance sheet, which are packaged together and used as backing for an issue of bonds. The interest payments on the original loans form the cash flows used to service the new bond issue. Traditionally, mortgage-backed bonds are grouped in their own right as mortgage-backed securities (MBS), while all other securitisation issues are known as asset-backed bonds or ABS.

Example 20.1 Special Purpose Vehicles

The key to undertaking securitisation is the special purpose vehicle or SPV. They are also known as special purpose entities (SPE) or special purpose companies (SPC). They are distinct legal entities that are the 'company' through which a securitisation is undertaken. They act as a form of repackaging vehicle, used to transform, convert or create risk structures that can be accessed by a wider range of investors. Essentially they are the legal entity to which assets such as mortgages, credit card debt or synthetic assets such as credit derivatives are transferred,

and from which the original credit risk/reward profile is transformed and made available to investors. An originator will use SPVs to increase liquidity and to make liquid risks that cannot otherwise be traded in any secondary market.

An SPV is a legal trust or company that is not, for legal purposes, linked in any way to the originator of the securitisation. As such it is *bankruptcy-remote* from the sponsor. If the sponsor suffers financial difficulty or is declared bankrupt, this will have no impact on the SPV, and hence no impact on the liabilities of the SPV with respect to the notes it has issued in the market. Investors have credit risk exposure only to the underlying assets of the SPV.[1]

To secure favourable tax treatment SPVs are frequently incorporated in offshore business centres such as Jersey or the Cayman Islands, or in areas that have set up SPV-friendly business legislation such as Dublin or the Netherlands. The choice of location for an SPV is dependent on a number of factors as well as taxation concerns, such as operating costs, legal requirements and investor considerations.[2] The key issue is taxation; however, the sponsor will wish all cash flows both received and paid out by the SPV to attract low or no tax. This includes withholding tax on coupons paid on notes issued by the SPV.

SPVs are used in a wide variety of applications and are an important element of the market in structured credit products. An established application is in conjunction with an asset swap, when an SPV is used to securitise the asset swap so that it becomes available to investors who cannot otherwise access it. Essentially the SPV will purchase the asset swap and then issue notes to the investor, who gain an exposure to the original asset swap albeit indirectly. This is illustrated in Figure 20-1.

The most common purpose for which an SPV is set up is a cash flow securitisation, in which the sponsoring company sells assets off its balance sheet to the SPV, which funds

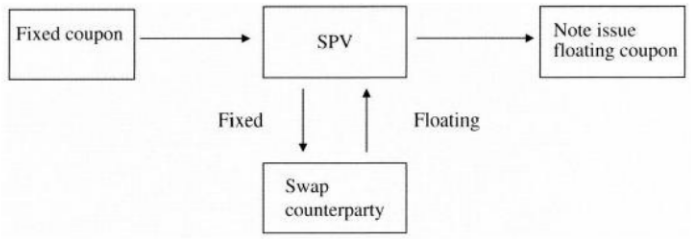


FIGURE 20-1 Asset swap package securitised and economic effect sold on by SPV.

the purchase of these assets by issuing notes. The revenues received by the assets are used to pay the liability of the issued overlying notes. Of course, the process itself has transformed previously untradable assets such as residential mortgages into tradable ones, and freed up the balance sheet of the originator.

SPVs are also used for the following applications:

- converting the currency of underlying assets into another currency more acceptable to investors, by means of a currency swap;
- issuing credit-linked notes (CLNs). Unlike CLNs issued by originators direct, CLNs issued by SPVs do not have any credit-linkage to the sponsoring entity. The note is linked instead to assets that have been sold to the SPV, and its performance is dependent on the performance of these assets. Another type of credit-linked SPV is when investors select the assets that (effectively) collateralise the CLN and are held by the SPV. The SPV then sells credit protection to a swap counterparty, and on occurrence of a credit event the underlying securities are sold and used to pay the SPV liabilities;
- they are used to transform illiquid into liquid ones. Certain assets such as trade receivables, equipment lease receivables or even more exotic assets such as museum entry-fee receipts are not tradable in any form, but can be made into tradeable notes via securitisation.

For legal purposes an SPV is categorised as either a Company or a Trust. The latter is more common in the US market, and its interests are represented by a Trustee, which is usually the Agency services department of a bank such as Deutsche Bank or Citibank, or a specialist Trust company such as Wilmington Trust. In the Euromarkets SPVs are often incorporated as companies instead of Trusts.

[1] In some securitisations, the currency or interest-payment basis of the underlying assets differs from that of the overlying notes, and so the SPV will enter into currency and/or interest rate swaps with a (bank) counterparty. The SPV would then have counterparty risk exposure.

[2] For instance, investors in some European Union countries will only consider notes issued by an SPV based in the EU, so that would exclude many offshore centres.

REASONS FOR UNDERTAKING SECURITISATION

The driving force behind securitisation has been the need for banks to realise value from the assets on their balance sheet. Typically these assets are residential mortgages, corporate loans and retail loans such as credit card debt. Let us consider the factors that might lead a financial institution to securitise part of its balance sheet. These might be the following:

- if revenues received from assets remain roughly unchanged but the size of assets has decreased, there will be an increase in the return on equity ratio;
- the level of capital required to support the balance sheet will be reduced, which again can lead to cost savings or allow the institution to allocate the capital to other, perhaps more profitable, business;
- to obtain cheaper funding: frequently the interest payable on asset-backed securities is considerably below the level payable on the underlying loans. This creates a cash surplus for the originating entity.

In other words, the main reasons that a bank securitises part of its balance sheet is for one or all of the following reasons:

- funding the assets it owns;
- balance sheet capital management;
- risk management and credit risk transfer.

We shall now consider each of these in turn.

Funding

Banks can use securitisation to: (i) support rapid asset growth; (ii) diversify their funding mix and reduce cost of funding; and (iii) reduce maturity mismatches.

The market for asset-hacked securities (ABS) is large, with an estimated size of $1,000 billion invested in ABS issues worldwide.[3] Access to this source of funding enables a bank to grow its loan books at a faster pace than if they were reliant on traditional funding sources alone. For example, in the UK a former building society-turned-bank, Northern Rock plc, has taken advantage of securitisation to back its growing share of the UK residential mortgage market. Unfortunately, it developed an over-reliance on securitised funding to the detriment of its retail deposit funding base, with disastrous consequences during the 2007 crash.

Securitising assets also allows a bank to diversify its funding mix. Banks generally do not wish to be reliant on a single or a few sources of funding, as this can be high-risk in times of market difficulty. Banks aim to optimise their funding between a mix of retail, inter-bank and wholesale sources. Securitisation has a key role to play in this mix. It also enables a bank to reduce its funding costs. This is because the securitisation process de-links the credit rating of the originating institution from the credit rating of the issued notes. Typically, most of the notes issued by SPVs will be higher rated than the bonds issued directly by the originating bank itself. While the liquidity of the secondary market in ABS is frequently lower than that of the corporate bond market, and this adds to the yield payable by an ABS, it is frequently the case that the cost to the originating institution of issuing debt is still lower in the ABS market because of the latter's higher rating.

Finally, there is the issue of maturity mismatches. The business of bank asset-liability management (ALM) is inherently one of maturity mismatch, since a bank often funds long-term assets such as residential mortgages, with short-term asset liabilities such as bank account deposits or inter-bank funding. This can be reduced via securitisation, as the originating bank receives funding from the sale of the assets, and the economic maturity of the issued notes frequently matches that of the assets.

Balance Sheet Capital Management

Banks use securitisation to improve balance sheet capital management. This provides: (i) regulatory capital relief; (ii) economic capital relief; and (iii) diversified sources of capital.

As stipulated in the Bank for International Settlements (BIS) capital rules,[4] also known as the Basel rules, banks must maintain a minimum capital level for their assets, in relation to the risk of these assets. Under Basel I, for every $100 of risk-weighted assets, a bank must hold at least $8 of capital; however, the designation of each asset's risk-weighting is restrictive. For example, with the exception of mortgages, customer loans are 100% risk-weighted regardless of the underlying rating of the borrower or the

[3] Sourcc: CSFB, *Credit Risk Transfer*, 2 May 2003.

[4] For further information see Choudhry (2007).

quality of the security held. The anomalies that this raises, which need not concern us here, are being addressed by the Basel II rules that became effective from 2008. However, the Basel I rules, which have been in place since 1988 (and effective from 1992), were a key driver of securitisation. As an SPV is not a bank, it is not subject to Basel rules and it therefore only needs such capital that is economically required by the nature of the assets they contain. This is not a set amount, but is significantly below the 8% level required by banks in all cases. Although an originating bank does not obtain 100% regulatory capital relief when it sells assets off its balance sheet to an SPV, because it will have retained a 'first-loss' piece out of the issued notes, its regulatory capital charge will be significantly reduced after the securitisation.[5]

To the extent that securitisation provides regulatory capital relief, it can be thought of as an alternative to capital raising, compared with the traditional sources of Tier 1 (equity), preferred shares, and perpetual loan notes with step-up coupon features. By reducing the amount of capital that has to be used to support the asset pool, a bank can also improve its return-on-equity (ROE) value. This is received favourably by shareholders.

Of course, under accounting consolidation rules, it is harder to obtain capital relief under most securitisation transactions. We must look to other benefits of this process.

Risk Management

Once assets have been securitised, the credit risk exposure on these assets for the originating bank is reduced considerably and, if the bank does not retain a first-loss capital piece (the most junior of the issued notes), it is removed entirely. This is because assets have been sold to the SPV. Securitisation can also be used to remove non-performing assets from banks' balance sheets. This has the dual advantage of removing credit risk and removing a potentially negative sentiment from the balance sheet, as well as freeing up regulatory capital. Further, there is a potential upside from securitising such assets, if any of them start performing again, or there is a recovery value obtained from defaulted assets, the originator will receive any surplus profit made by the SPV.

[5] We discuss first-loss later on.

Benefits of Securitisation to Investors

Investor interest in the ABS market has been considerable from the market's inception. This is because investors perceive ABSs as possessing a number of benefits. Investors can:

- diversify sectors of interest;
- access different (and sometimes superior) risk-reward profiles;
- access sectors that are otherwise not open to them.

A key benefit of securitisation notes is the ability to tailor risk-return profiles. For example, if there is a lack of assets of any specific credit rating, these can be created via securitisation. Securitised notes frequently offer better risk-reward performance than corporate bonds of the same rating and maturity. While this might seem peculiar (why should one AA-rated bond perform better in terms of credit performance than another just because it is asset-backed?), this often occurs because the originator holds the first-loss piece in the structure.

A holding in an ABS also diversifies the risk exposure. For example, rather than invest $100 million in an AA-rated corporate bond and be exposed to 'event risk' associated with the issuer, investors can gain exposure to, say, 100 pooled assets. These pooled assets will have lower concentration risk. That, at least, was the theory. As the 2007–08 crash showed, in some cases diversification actually increased concentration risk.

THE PROCESS OF SECURITISATION

We now look at the process of securitisation, the nature of the SPV structure and issues such as credit enhancements and thc cash flow 'waterfall'.

The securitisation process involves a number of participants. In the first instance there is the *originator*, the firm whose assets are being securitised. The most common process involves an *issuer* acquiring the assets from the originator. The issuer is usually a company that has been specially set up for the purpose of the securitisation, which is the SPV and is usually domiciled offshore. The creation of an SPV ensures that the underlying asset pool is held separate from the other assets of the originator. This is done so that in the event that the originator is declared bankrupt or insolvent, the assets that have been transferred to the SPV will not be affected. This is known

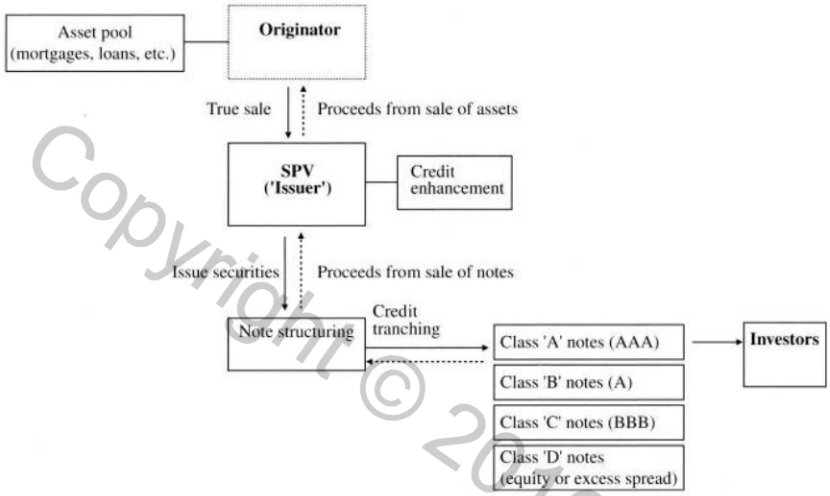


FIGURE 20-2 The securitisation process.

as being bankruptcy-remote. Conversely, if the underlying assets begin to deteriorate in quality and are subject to a ratings downgrade, investors have no recourse to the originator.

By holding the assets within an SPV framework, defined in formal legal terms, the financial status and credit rating of the originator becomes almost irrelevant to the bondholders. The process of securitisation often involves *credit enhancements*, in which a third-party guarantee of credit quality is obtained, so that notes issued under the securitisation are often rated at investment grade and up to AAA-grade.

The process of structuring a securitisation deal ensures that the liability side of the SPV—the issued notes—carries a lower cost than the asset side of the SPV. This enables the originator to secure lower cost funding that it would not otherwise be able to obtain in the unsecured market. This is a tremendous benefit for institutions with lower credit ratings.

Figure 20-2 illustrates the process of securitisation in simple fashion.

Mechanics of Securitisation

Securitisation involves a 'true sale' of the underlying assets from the balance sheet of the originator. This is why a separate legal entity, the SPV, is created to act as the issuer of the notes. The assets begin securitised are sold on to the balance sheet of the SPV. The process involves:

- undertaking 'due diligence' on the quality and future prospects of the assets;
- setting up the SPV and then effecting the transfer of assets to it;
- underwriting of loans for credit quality and servicing;
- determining the structure of the notes, including how many tranches are to be issued, in accordance with originator and investor requirements;
- the rating of notes by one or more credit rating agencies;
- placing of notes in the capital markets.

The sale of assets to the SPV needs to be undertaken so that it is recognised as a true legal transfer. The originator obtains legal counsel to advise it in such matters. The credit rating process considers the character and quality of the assets, and also whether any enhancements have been made to the assets that will raise their credit quality. This can include *over-collateralisation*, which is when the principal value of notes issued is lower than the principal value of assets, and a liquidity facility provided by a bank.

A key consideration for the originator is the choice of the underwriting bank, which structures the deal and places the notes. The originator awards the mandate for its deal to an investment bank on the basis of fee levels, marketing ability and track record with assets being securitised.

SPV Structures

There are essentially two main securitisation structures, amortising (pass-through) and revolving. A third type, the master trust, is used by frequent issuers.

Amortising Structures

Amortising structures pay principal and interest to investors on a coupon-by-coupon basis throughout the life of the security, as illustrated in Figure 20-3. They are priced and traded based on expected maturity and weighted-average life (WAL), which is the time-weighted period during which principal is outstanding. A WAL approach incorporates various pre-payment assumptions, and any change in this pre-payment speed will increase or decrease the rate at which principal is repaid to investors. Pass-through structures are commonly used in residential

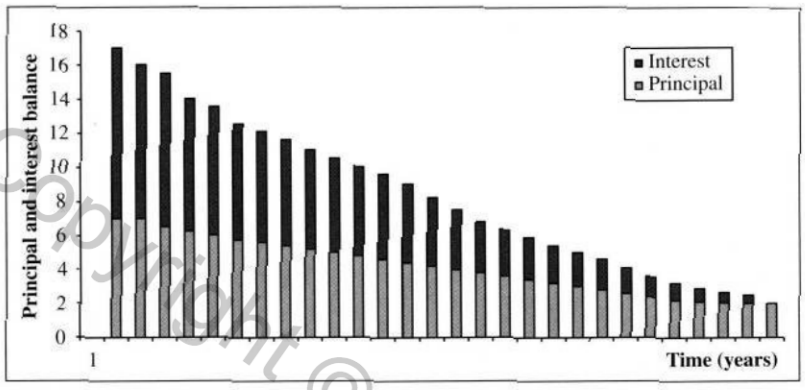


FIGURE 20-3 Amoritising cash flow structure.

and commercial mortgage-backed deals (MBS), and consumer loan ABS.

Revolving Structures

Revolving structures revolve the principal of the assets; that is, during the revolving period, principal collections are used to purchase new receivables that fulfil the necessary criteria. The structure is used for short-dated assets with a relatively high pre-payment speed, such as credit card debt and auto-loans. During the amortisation period, principal payments are paid to investors either in a series of equal instalments (*controlled amortisation*) or the principal is "trapped' in a separate account until the expected maturity date and then paid in a single lump sum to investors (*soft bullet*).

Master Trust

Frequent issuers under US and UK law use *master trust* structures, which allow multiple securitisations to be issued from the same SPV. Under such schemes, the originator transfers assets to the master trust SPV. Notes are then issued out of the asset pool based on investor demand. Master trusts are used by MBS and credit card ABS originators.

Securitisation Note Tranching

As illustrated in Figure 20-2, in a securitisation the issued notes are structured to reflect specified risk areas of the asset pool, and thus are rated differently. The senior tranche is usually rated AAA. The lower rated notes usually have an element of *over-collateralisation* and are thus capable of absorbing losses. The most junior note is the lowest rated or non-rated. It is often referred to as the *first-loss piece*, because it is impacted by losses in the underlying asset pool first. The first-loss piece is sometimes called the *equity piece* or equity note (even though it is a bond) and is usually held by the originator.

Credit Enhancement

Credit enhancement refers to the group of measures that can be instituted as part of the securitisation process for ABS and MBS issues so that the credit rating of the issued notes meets investor requirements. The lower the quality of the assets being securitised, the greater the need for credit enhancement. This is usually by some or all of the following methods:

- *Over-collateralisation:* where the nominal value of the assets in the pool are in excess of the nominal value of issued securities.
- *Pool insurance:* an insurance policy provided by a composite insurance company to cover the risk of principal loss in the collateral pool. The claims paying rating of the insurance company is important in determining the overall rating of the issue.
- *Senior/Junior note classes:* credit enhancement is provided by subordinating a class of notes ('class B' notes) to the senior class notes ('class A' notes). The class B note's right to its proportional share of cash flows is subordinated to the rights of the senior note holders. Class B notes do not receive payments of principal until certain rating agency requirements have been met, specifically satisfactory performance of the collateral pool over a predetermined period, or in many cases until all of the senior note classes have been redeemed in full.
- *Margin step-up:* a number of ABS issues incorporate a step-up feature in the coupon structure, which typically coincides with a call date. Although the issuer is usually under no obligation to redeem the notes at this point, the step-up feature was introduced as an added incentive for investors, to convince them from the outset that the economic cost of paying a higher coupon is unacceptable and that the issuer would seek to refinance by exercising its call option.
- *Excess spread:* this is the difference between the return on the underlying assets and the interest rate payable on the issued notes (liabilities). The monthly excess spread is used to cover expenses and any losses. If

any surplus is left over, it is held in a reserve account to cover against future losses or (if not required for that), as a benefit to the originator. In the meantime the reserve account is a credit enhancement for investors.

All securitisation structures incorporate a *cash waterfall* process, whereby all the cash that is generated by the asset pool is paid in order of payment priority. Only when senior obligations have been met can more junior obligations be paid. An independent third party agent is usually employed to run 'tests' on the vehicle to confirm that there is sufficient cash available to pay all obligations. If a test is failed, then the vehicle will start to pay off the notes, starting from the senior notes. The waterfall process is illustrated in Figure 20-4.

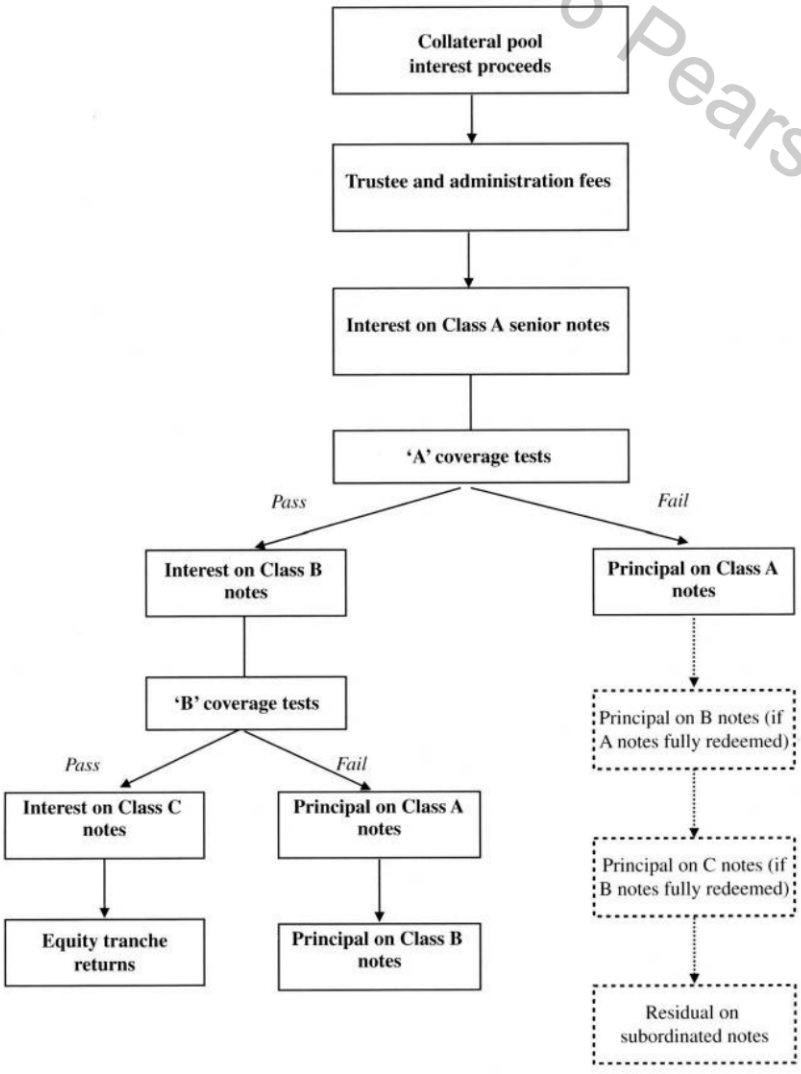


FIGURE 20-4 Cash flow waterfall (priority of payments).

Impact on Balance Sheet

Figure 20-5 on page 439 illustrates, by way of a hypothetical example, the effect of a securitisation transaction on the liability side of an originating bank's balance sheet. Following the process, selected assets have been removed from the balance sheet, although the originating bank will usually have retained the first-loss piece. With regard to the regulatory capital impact, this first-loss amount is deducted from the bank's total capital position. For example, assume a bank has $100 million of risk-weighted assets and a target Basel ratio of 12%,[6] and it securitises all $100 million of these assets. It retains the first-loss tranche that forms 1.5% of the total issue. The remaining 98.5% will be sold on to the market. The bank will still have to set aside 1.5% of capital as a buffer against future losses, but it has been able to free itself of the remaining 10.5% of capital.

ILLUSTRATING THE PROCESS OF SECURITISATION

To illustrate the process of securitisation, we consider a hypothetical airline ticket receivables transaction, originated by a fictitious company called ABC Airways plc and arranged by the equally fictitious XYZ Securities Limited. The following illustrates the kind of issues that are considered by the investment bank that is structuring the deal.

Note that our example is far from a conventional or 'plain vanilla' securitisation, and is a good illustration of the adaptability of the technique and how it was extended to ever more exotic asset classes. However, one of the immediate impacts of the 2007–08 financial crisis was that transactions such as these were no longer closed, as investors became risk averse, and transactions after the crisis were limited to more conventional asset classes.

[6] The minimum is 8%, but many banks prefer to set aside an amount well in excess of this minimum required level. The norm is 12%–15% or higher.

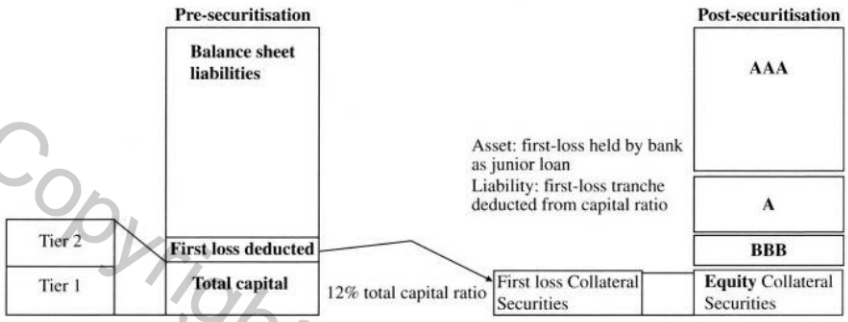


FIGURE 20-5 Regulatory capital impact of securitisation, original Basel I rules.

Originator	ABC Airways plc
Issuer	'Airways No 1 Ltd'
Transaction	Ticker receivables airline future flow securitisation bonds 200m 3-tranche floating-rate notes, legal maturity 2010 Average life 4.1 years
Tranches	Class 'A' note (AA), LIBOR plus [] bps[7]
	Class 'B' note (A), LIBOR plus [] bps
	Class 'E' note (BBB), LIBOR plus [] bps
Arranger	XYZ Securities plc

Due Diligence

XYZ Securities undertakes due diligence on the assets to be securitised. In this case, it examines the airline performance figures over the last five years, as well as modelling future projected figures, including:

- total passenger sales;
- total ticket sales;
- total credit card receivables;
- geographical split of ticket sales.

It is the future flow of receivables, in this case credit card purchases of airline tickets, that is being securitised. This is a higher risk asset class than say, residential mortgages, because the airline industry has a tradition of greater volatility of earnings than mortgage banks.

Marketing Approach

The present and all future credit card ticket receivables generated by the airline are transferred to an SPV. The investment bank's syndication desk seeks to place the notes with institutional investors across Europe. The notes are first given an indicative pricing ahead of the issue, to gauge investor sentiment. Given the nature of the asset class, during November 2002 the notes are marketed at around 3-month LIBOR plus 70–80 bps (AA note), 120–130 bps (A note) and 260–270 bps (BBB note).[8] The notes are 'benchmarked' against recent issues with similar asset classes, as well as the spread level in the unsecured market of comparable issuer names.

Deal Structure

The deal structure is shown at Figure 20-6. The process leading to the issue of notes is as follows:

- ABC Airways plc sells its future flow ticket receivables to an offshore SPV set up for this deal, incorporated as Airways No 1 Ltd;
- the SPV issues notes in order to fund its purchase of the receivables;
- the SPV pledges its right to the receivables to a fiduciary agent, the Security Trustee, for the benefit of the bondholders;
- the Trustee accumulates funds as they are received by the SPV;
- the bondholders receive interest and principal payments, in the order of priority of the notes, on a quarterly basis.

In the event of default, the Trustee will act on behalf of the bondholders to safeguard their interests.

Financial Guarantors

The investment bank decides whether or not an insurance company, known as a mono-line insurer, should be

[7] The price spread is determined during the marketing stage, when the notes are offered to investors during a 'roadshow'.

[8] Plainly, these are pre-2007 crisis spreads!

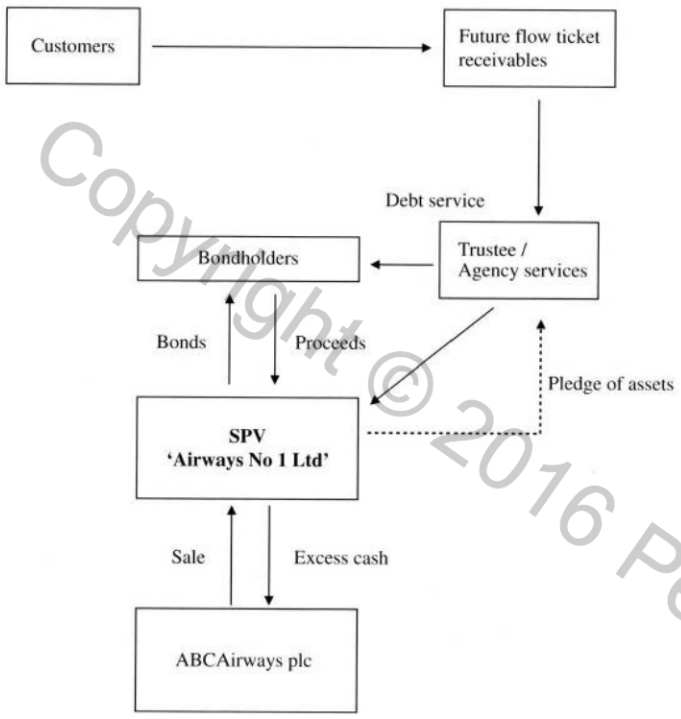


FIGURE 20-6 Airways No. 1 limited deal structure.

approached to 'wrap' the deal by providing a guarantee of backing for the SPV in the event of default. This insurance is provided in return for a fee.

Financial Modelling

XYZ Securities constructs a cash flow model to estimate the size of the issued notes. The model considers historical sales values, any seasonal factors in sales, credit card cash flows and so on. Certain assumptions are made when constructing the model; for example, growth projections, inflation levels and tax levels. The model considers a number of different scenarios, and also calculates the minimum asset coverage levels required to service the issued debt. A key indicator in the model is the debt service coverage ratio (DSCR). The more conservative the DSCR, the more comfort there is for investors in the notes. For a residential mortgage deal, this ratio may be approximately 2.5–3.0; however, for an airline ticket receivables deal, the DSCR is unlikely to be lower than 4.0. The model therefore calculates the amount of notes that can be issued against the assets, while maintaining the minimum DSCR.

Credit Rating

It is common for securitisation deals to be rated by one or more of the formal credit ratings agencies Moody's, Fitch or Standand & Poor's. A formal credit rating makes it easier for XYZ Securities to place the notes with investors. The methodology employed by the ratings agencies takes into account both qualitative and quantitative factors, and differs according to the asset class being securitised. The main issues in a deal such as our hypothetical Airways No. 1 deal would be expected to include:

- corporate credit quality: these are risks associated with the originator, and are factors that affect its ability to continue operations, meet its financial obligations, and provide a stable foundation for generating future receivables. This might be analysed according to the following:
  1. ABC Airways' historical financial performance, including its liquidity and debt structure;
  2. its status within its domicile country; for example, whether or not it is state-owned;
  3. the general economic conditions for industry and for airlines;
  4. the historical record and current state of the airline; for instance, its safety record and age of its aeroplanes;
- the competition and industry trends: ABC Airways' market share, the competition on its network;
- regulatory issues, such as the need for ABC Airways to comply with forthcoming legislation that will impact its cash flows;
- legal structure of the SPV and transfer of assets;
- cash flow analysis.

Based on the findings of the ratings agency, the arranger may re-design some aspect of the deal structure so that the issued notes are rated at the required level.

This is a selection of the key issues involved in the process of securitisation. Depending on investor sentiment, market conditions and legal issues, the process from inception to closure of the deal may take anything from three to 12 months or more. After the notes have been issued, the arranging bank no longer has anything to do with the issue; however, the bonds themselves require a number of agency services for their remaining life until they mature or are paid off (see Procter and Leedham 2004). These agency services include paying the agent, cash manager and custodian.

ABS STRUCTURES: A PRIMER ON PERFORMANCE METRICS AND TEST MEASURES[9]

This section is an introduction to the performance measures on the underlying collateral of the ABS and MBS product.

Growth of ABS/MBS

The MBS market first appeared when the US government-chartered mortgage agencies began issuing pass-through securities collateralised by residential mortgages to promote the availability of cheap mortgage funding for US home buyers. The pass-through market inevitably grew as it provided investors in the secondary mortgage market with a liquid instrument and the lenders an opportunity to move interest rate risk off their balance sheet. Consequently, the ABS market came about as US finance companies began applying similar securitisation techniques to non-mortgage assets with expected payment streams. However, while MBS investors had, through the 'Ginnie Mae' government issues, benefitted from implicit Treasury guarantees, the ABS market offered investors, in addition to a differing portfolio dynamic, an exposure to more diversified credit classes.

During 2002–2007 the low interest rate environment and increasing number of downgrades in the corporate bond market made the rating-resilient ABS/MBS issuance an attractive source of investment for investors. Like all securitisation products, during this time ABS/MBS traded at yields that compared favourably to similar rated unsecured debt and as investors have sought alternatives to the volatile equity market. In 2003, issuance for the European securitisation market exceeded €157.7 billion.

While in the US it is auto-loan and credit card ABS that remain the prominent asset classes, alongside US-Agency MBS, in the European market the predominant asset class is Residential Mortgages (RMBS). RMBS accounted for over 55% of total issuance and over 90% of MBS in the European securitisation market in 2003. A buoyant housing market, particularly in the UK, drove high RMBS issuance. The Commercial MBS market benefited from the introduction of favourable insolvency coupled with the introduction of the euro, eliminating currency concerns among investors.

Collateral Types

ABS performance is largely dependent on consumer credit performance, and so, typical ABS structures include trigger mechanisms (to accelerate amortisation) and reserve accounts (to cover interest shortfalls) to safeguard against poor portfolio performance. Though there is no basic difference in terms of the essential structure between CDO and ABS/MBS, some differences arise by the very nature of the collateral and the motives of the issuer. The key difference arises from the underlying; a CDO portfolio will have 100–200 loans, for example, whereas ABS portfolios will often have thousands of obligors thus providing the necessary diversity in the pool of consumers.

We now discuss briefly some prominent asset classes.

Auto Loan

Auto loan pools were some of the earliest to be securitised in the ABS market. Investors had been attracted to the high asset quality involved and the fact that the vehicle offers an easily sellable, tangible asset in the case of obligor default. In addition, since a car is seen as an 'essential purchase' and a short loan exposure (3–5 years) provides a disincentive to finance, no real pre-payment culture exists. Prepayment speed is extremely stable and losses are relatively low, particularly in the prime sector. This is an attractive feature for investors.

Performance Analysis

The main indicators are Loss curves, which show expected cumulative loss through the life of a pool and so, when compared to actual losses, give a good measure of performance. In addition, the resulting loss forecasts can be useful to investors buying subordinated note classes. Generally, prime obligors will have losses more evenly distributed, while non-prime and sub-prime lenders will have losses recognised earlier and so show a steeper curve. In both instances, losses typically decline in the latter years of the loan.

[9] This section was written by Suleman Baig, Structured Finance Department, Deutsche Bank AG, London. This section represents the views, thoughts and opinions of Suleman Baig in his individual private capacity. It should not be taken to represent the views of Deutsche Bank AG, or of Suleman Baig as a representative, officer or employee of Deutsche Bank AG.

The *absolute prepayment speed* (ABS)[10] is a standard measure for prepayments, comparing actual period prepayments as a proportion to the whole pool balance. As with all prepayment metrics, this measure provides an indication of the expected maturity of the issued ABS and essentially, the value of the implicit call option on the issued ABS at any time.

Credit Card

For specialised credit card banks, particularly in the US, the ABS market became the primary vehicle to fund the substantial volume of unsecured credit loans to consumers. Credit card pools are differentiated from other types of ABS in that loans have no predetermined term. A single obligor's credit card debt is often no more than six months and so the structure has to differ from other ABS in that repayment speed needs to be controlled, either through scheduled amortisation or the inclusion of a revolving period (where principal collections are used to purchase additional receivables).

Since 1991, the Stand-alone Trust has been replaced with a Master Trust as the preferred structuring vehicle for credit card ABS. The Master Trust structure allows an issuer to sell multiple issues from a single trust and from a single, albeit changing, pool of receivables. Each series can draw on the cash flows from the entire pool of securitised assets with income allocated to each pro rata based on the invested amount in the Master Trust.

Consider the example structure represented by Figure 20-7. An important feature is excess spread, reflecting the high yield on credit card debt compared to the card issuer's funding costs. In addition, a financial guaranty is included as a form of credit enhancement given the low rate of recoveries and the absence of security on the collateral. Excess spread released from the trust can be shared with other series suffering interest shortfalls.

Performance Analysis for Credit Card ABS

The *delinquency ratio* is measured as the value of credit card receivables overdue for more than 90 days as a percentage of total credit card receivables. The ratio provides an early indication of the quality of the credit card portfolio.

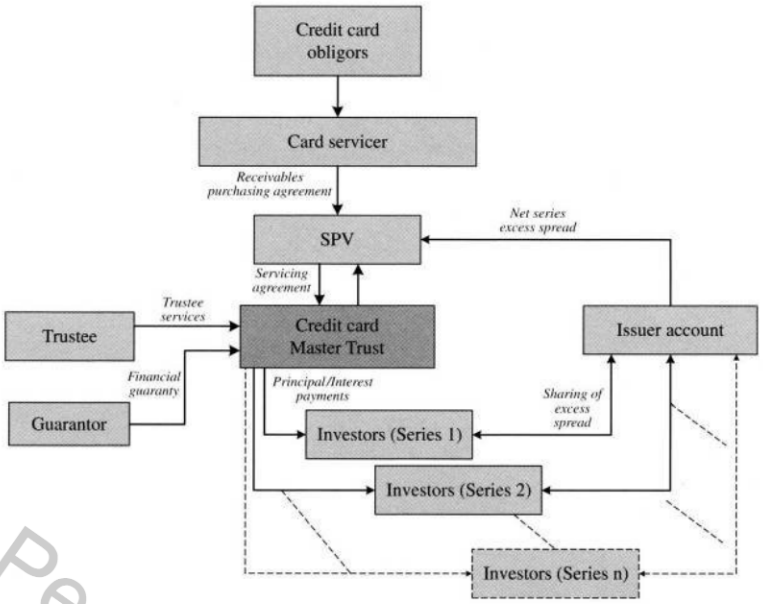


FIGURE 20-7 Master trust structure.

The *default ratio* refers to the total amount of credit card receivables written off during a period as a percentage of the total credit card receivables at the end of that period. Together, these two ratios provide an assessment of the credit loss on the pool and are normally tied to triggers for early amortisation and so require reporting through the life of the transaction.

The *monthly payment rate (MPR)*[11] reflects the proportion of the principal and interest on the pool that is repaid in a particular period. The ratings agencies require every non-amortising ABS to establish a minimum as an early amortisation trigger.

Mortgages

The MBS sector is notable for the diversity of mortgage pools that are offered to investors. Portfolios can offer varying duration as well as both fixed- and floating-rate debt. The most common structure for agency-MBS is pass-through, where investors are simply purchasing a share in the cash flow of the underlying loans. Conversely, non-agency MBS (including CMBS), has a senior

[10] First developed by Credit Suisse First Boston.

[11] This is not a prepayment measure since credit cards are non-amortising assets.

and a tranched subordinated class with principal losses absorbed in reverse order.

The other notable difference between RMBS and CMBS is that the CMBS is a non-recourse loan to the issuer as it is fully secured by the underlying property asset. Consequently, the debt service coverage ratio (DSCR) becomes crucial to evaluating credit risk.

Performance Analysis for MBS *Debt service coverage ratio (DSCR)*, which is Net operating income/Debt payments and so indicates a borrower's ability to repay a loan. A DSCR of less than 1.0 means that there is insufficient cash flow generated by the property to cover required debt payments.

The *weighted average coupon (WAC)* is the weighted coupon of the pool that is obtained by multiplying the mortgage rate on each loan by its balance. The WAC will therefore change as loans are repaid, but at any point in time when compared to the net coupon payable to investors, gives us an indication of the pool's ability to pay.

The *weighted average maturity (WAM)* is the average weighted (weighted by loan balance) of the remaining terms to maturity (expressed in months) of the underlying pool of mortgage loans in the MBS. Longer securities are by nature more volatile and so a WAM calculated on the stated maturity date avoids the subjective call of whether the MBS will mature and recognises the potential liquidity risk for each security in the portfolio. Conversely, a WAM calculated using the reset date will show the shortening effect of prepayments on the term of the loan.

The *weighted average life (WAL)* of the notes at any point in time is:

$$s = \sum t.PF(s)$$

where

PF(s) = Pool factor at s

t = actual/365.

We illustrate this measure below at Table 20-1 on page 444; PF refers to 'pool factor', which is assumed and is the repayment weighting adjustment to the notional value outstanding (O/S). The column 'IPD' is coupon payment date.

EXAMPLE 20.2 Forecasting Prepayment Levels

It is the time-weighted maturity of the cash flows that allows potential investors to compare the MBS with other investments with similar maturity. These tests apply uniquely to MBS since the principal is returned through the life of the investment on such transactions.

Forecasting prepayments is crucial to computing the cash flows of MBS. Though, the underlying payment remains unchanged, prepayments, for a given price, reduce the yield on the MBS. There are a number of methods used to estimate prepayments, two commonly used ones are the constant prepayment rate (CPR) and the Public Securities Association (PSA) method.

The CPR approach is:

$$CPR = 1 - (1 - SMM)^{12}$$

where *single monthly mortality (SMM)* is the single-month proportional prepayment.

A SMM of 0.65% means that approximately 0.65% of the remaining mortgage balance at the beginning of the month, less the scheduled principal payment, will prepay that month.

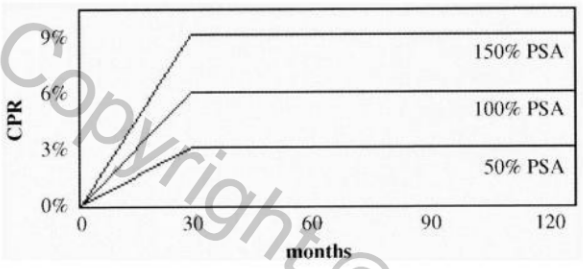
The CPR is based on the characteristics of the pool and the current expected economic environment as it measures prepayment during a given month in relation to the outstanding pool balance.

The PSA (since merged and now part of the Securities Industry and Financial Markets Association or SIFMA), has a metric for projecting prepayment that incorporates the rise in prepayments as a pool seasons.

A pool of mortgages is said to have 100%- PSA if its CPR starts at 0 and increases by 0.2 % each month until it reaches 6% in month 30. It is a constant 6% after that. Other prepayment scenarios can be specified as multiples

[12] The entire business model of a large number of banks as well as 'shadow banks' such as structured investment vehicles (SIVs) had depended on available liquidity from the inter-bank market, which was rolled over on a short-term basis such as weekly or monthly and used to fund long-dated assets such as RMBS securities that had much longer maturities and which themselves could not be realised in a liquid secondary market (once the 2007 credit crunch took hold). This business model unravelled after the credit crunch, with its most notable casualties being Northern Rock plc and the SIVs themselves, which collapsed virtually overnight. Regulatory authorities responded by requiring banks to take liquidity risk more seriously, with emphasis on longer term average tenor of liabilities and greater diversity on funding sources (for example, see the UK FSA's CP 08/22 document, at www.fsa.org). The author discusses bank liquidity management in *Bank Asset and Liability Management* (Wiley Asia 2007) and *The Principles of Banking* (Wiley Asia 2010).

of 100% PSA. This calculation helps derive an implied prepayment speed assuming mortgages prepay slower during their first 30 months of seasoning.



For reference, PSA = [CPR/(.2)(m)] * 100

where

m = number of months since origination.

Summary of Performance Metrics

Table 20-2 lists the various performance measures we have introduced in this chapter, and the asset classes to which they apply.

TABLE 20-1 Example of Weighted Average Life (WAL) Calculation

IPD	Dates	Actual Days (a)	PF(t)	Principal Paid	O/S	a/365	PF(t)*(a/365)
0	21/11/2003	66	1.00		89,529,500.00	0.18082192	0.18082192
1	26/01/2004	91	0.94	5,058,824.00	84,470,588.00	0.24931507	0.23522739
2	26/04/2004	91	0.89	4,941,176.00	79,529,412.00	0.24931507	0.22146757
3	26/07/2004	91	0.83	4,823,529.00	74,705,882.00	0.24931507	0.20803536
4	25/10/2004	91	0.78	4,705,882.00	70,000,000.00	0.24931507	0.19493077
5	24/01/2005	91	0.73	4,588,235.00	65,411,765.00	0.24931507	0.18215380
6	25/04/2005	91	0.68	4,470,588.00	60,941,176.00	0.24931507	0.16970444
7	25/07/2005	91	0.63	4,352,941.00	56,588,235.00	0.24931507	0.15758269
8	24/10/2005	92	0.58	4,235,294.00	52,352,941.00	0.25205479	0.14739063
9	24/01/2006	90	0.54	4,117,647.00	48,235,294.00	0.24657534	0.13284598
10	24/04/2006	91	0.49	4,000,000.00	44,235,294.00	0.24931507	0.12318314
11	24/07/2006	92	0.45	3,882,353.00	40,352,941.00	0.25205479	0.11360671
12	24/10/2006	92	0.41	3,764,706.00	36,588,235.00	0.25205479	0.10300784
13	24/01/2007	90	0.37	3,647,059.00	32,941,176.00	0.24657534	0.09072408
14	24/04/2007	91	0.33	3,529,412.00	29,411,765.00	0.24931507	0.08190369
15	24/07/2007	92	0.29	3,411,765.00	26,000,000.00	0.25205479	0.07319849
16	24/10/2007	92	0.25	3,294,118.00	22,705,882.00	0.25205479	0.06392448
17	24/01/2008	91	0.22	3,176,471.00	19,529,412.00	0.24931507	0.05438405
18	24/04/2008	91	0.18	3,058,824.00	16,470,588.00	0.24931507	0.04586606
19	24/07/2008		—	16,470,588.00	—	—	—
						WAL	2.57995911

TABLE 20-2 Summary of Performance Measures

Performance Measure	Calculation	Typical Asset Class
Public Securities Association (PSA)	PSA = [CPR/(.2)(months)]*100	mortgages, home-equity, student loans
Constant prepayment rate (CPR)	$1 - (1 - SMM)^{12}$	mortgages, home-equity. student loans
Single monthly mortality (SMM)	Prepayment/Outstanding pool balance	mortgages, home-equity, student loans
Weighted average life (WAL)	Σ (a/365).PF(s) Where PF(s)	mortgages
Weighted average maturity (WAM)	Weighted maturity of the pool	mortgages
Weighted average coupon (WAC)	Weighted coupon of the pool	mortgages
Debt service coverage ratio (DSCR)	Net operating income/Debt payments	commercial mortgages
Monthly payment rate (MPR)	Collections/Outstanding pool balance	all non-amortising asset classes
Default ratio	Defaults/Outstanding pool balance	credit cards
Delinquency ratio	Delinquents/Outstanding pool balance	credit cards
Absolute prepayment speed (ABS)	Prepayments/Outstanding pool balance	auto loans, truck loans
Loss curves	Show expected cumulative loss	auto loans, truck loans

SECURITISATION POST-CREDIT CRUNCH

Following the July–August 2007 implosion of the asset-backed commercial paper market, investor interest in ABS product dried up virtually completely. The growing illiquidity in the inter-bank market, which resulted in even large AA-rated banks finding it difficult to raise funds for tenors longer than one month, became acute following the collapse of Lehman Brothers in September 2008. To assist banks in raising funds, central banks starting with the US Federal Reserve and European Central Bank (ECB), and then the Bank of England (BoE), began to relax the criteria under which they accepted collateral from banks that raised terms funds from them. In summary, the central banks announced that ABS including MBS and other securitised products would now be eligible as collateral at the daily liquidity window.

As originally conceived, the purpose of these moves was to enable banks to raise funds, from their respective central bank, using existing ABS on their balance sheet as collateral. Very quickly, however, the banks began to originate new securitisation transactions, using illiquid assets held on their balance sheet (such as residential mortgages or corporate loans) as collateral in the deal. The issued notes would be purchased by the bank itself, making the deal completely in-house. These new purchased ABS tranches would then be used as collateral at the central bank repo window. We discuss these 'ECB-led' deals in this section.

Structuring Considerations

Essentially an ECB-deal is like any other deal, except that one has a minimum requirement to be ECB eligible. There are also haircut considerations and the opportunity to structure it without consideration for investors. To be eligible for repo at the ECB, deals had to fulfil certain criteria. These included:

(i) minimum requirements:
- public rating of triple-A or higher at first issue;
- only the senior tranche can be repo'd;
- no exposure to synthetic securities. The ECB rules stated that the cash flow in generating assets backing the ABSs must not consist in whole or in part, actually or potentially, of credit-linked notes