III OTC Derivatives Markets: Size, Structure, and Business Practices

This section provides an overview of OTC derivatives markets, with particular emphasis on those aspects that are relevant to an assessment of systemic financial risks. It begins with a description of the size and global scope of derivatives markets and the major participants and counterparties in OTC derivatives markets. It then compares the structures of exchange-traded and OTC markets, and concludes with a discussion of the trading and back-office infrastructure and the middle-office risk management functions for OTC derivatives trading.

The Size, Global Scope, and Institutional Structure of Derivatives Markets

The global derivatives markets are large, both in absolute terms and compared with the size of the global economy and global financial markets (Tables 3.1 and 3.2). At end-June 2000, global notional principal (the reference amount for payments on a derivatives contract) of exchange-traded and OTC derivatives contracts combined totaled about $108 trillion. Turnover in global derivatives markets is similarly large. In 1998, the most recent year for which data on turnover in both OTC and exchange-traded markets is available, estimated average daily turnover amounted to about $2.7 trillion (equivalent to $675 trillion on an annualized basis). By comparison, in 1999, world GDP stood at about $31 trillion, and global net capital flows (the sum of all current account surpluses) totaled $394 billion.

OTC derivatives account for an increasing share of the global derivatives markets. During the 1990s, OTC derivatives markets grew from roughly equal to exchange-traded markets in size to several times as large as exchange-traded markets (Figure 3.1). This trend seems to have accelerated in the second half of the 1990s. Between June 1998 and June 2000, global notional principal in OTC derivatives markets rose from $72 trillion to $94 trillion, while notional principal in exchange-traded markets declined from $14.8 trillion to $13.9 trillion. Between April 1995 and April 1998, average daily turnover in OTC derivatives markets rose by about 50 percent to $1.3 trillion, while turnover on derivatives exchanges rose by only about 16 percent to $1.4 trillion. Because most contracts do not specify the exchange of principal amounts (foreign-exchange and currency swaps—described below—are among the exceptions), gross market value—an estimate of replacement cost, typically around 2 to 5 percent of notional principal—is a better indicator of current credit exposure than notional principal. At end-June 2000, global gross market value of contracts in OTC derivatives markets stood at $2.6 trillion, while credit exposure taking netting arrangements into account stood at about $0.9 trillion (comparable figures for exchange-traded markets are not available).

The bulk of OTC derivatives contracts are associated with interest rate and foreign exchange risks (Figure 3.2). Activity in interest rate derivatives is dominated by swaps, followed by Forward Rate Agreements (FRAs—forwards on interest rates) and options. Turnover in foreign exchange derivatives is dominated by foreign exchange swaps, followed by outright forwards, options, and currency swaps. The comparatively small forward market is oriented toward the retail trading and hedging needs of nonfinancial customers, who account for

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6 Turnover data are less timely than data on outstanding amounts.

7 Gross market value is the sum of the positive market value of all contracts held by the institutions included in the survey, and the negative market value of surveyed institutions' contracts with those not included in the survey. A portfolio of one contract worth $5 and one contract worth $2 (a negative market value) against a non-reporting institution thus has a gross market value of $7. The overall credit risk in a derivatives portfolio is more complicated to measure, as it includes potential future exposure (see below).

8 A foreign exchange swap is typically a short-term deal that combines a spot sale of currency and a forward purchase. A currency swap typically has a longer maturity and involves both a spot sale and forward purchase and the periodic exchange of interest in the two currencies.
about a third of turnover. Trading in OTC derivatives is denominated in the main international currencies. Overall, about half of OTC foreign exchange derivatives exposure involves the U.S. dollar; in 2000, in the interest rate segment, euro-denominated exposures were somewhat larger than dollar exposures.

OTC derivatives markets are global in scope. Trading is concentrated in the major financial centers: in 1998, London accounted for 35 percent of daily turnover, while New York accounted for 17 percent and Tokyo 7 percent (Table 3.3). A considerable share of trading—over half of currency swaps and single-currency interest-rate swaps—is cross-border. Much of this activity is accounted for by internationally active banks; for example, foreign-owned firms are major participants in the U.K. OTC derivatives markets. Similarly, in 1998, major U.S. banks earned larger revaluation gains on overseas derivatives activities than on domestic derivatives activities.

As the major internationally active banks and securities houses dominate the OTC derivatives markets, the market is highly concentrated: in the second quarter of 2000, seven U.S. banks held over 95 percent of turnover.

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9The average deal size of spot and forward transactions in the United States is approximately $4 million, whereas the average notional size of foreign exchange swaps is nearly eight times as large. Long-term transactions (one year and longer to maturity) account for less than 4 percent of traditional foreign currency derivatives turnover.

10Thom and Bousani (1998).

11See United States, Board of Governors of the Federal Reserve System (1999), Table 5.

(Billions of U.S. dollars)

<table>
<thead>
<tr>
<th>Notional Amounts</th>
<th>Gross Market Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>72,143</td>
</tr>
<tr>
<td>Foreign exchange</td>
<td>18,719</td>
</tr>
<tr>
<td>By counterparty</td>
<td></td>
</tr>
<tr>
<td>With other reporting dealers</td>
<td>7,406</td>
</tr>
<tr>
<td>With other financial institutions</td>
<td>7,048</td>
</tr>
<tr>
<td>With non-financial customers</td>
<td>4,264</td>
</tr>
<tr>
<td>By remaining maturity</td>
<td></td>
</tr>
<tr>
<td>Up to one year</td>
<td>16,292</td>
</tr>
<tr>
<td>One to five years</td>
<td>1,852</td>
</tr>
<tr>
<td>Over five years</td>
<td>595</td>
</tr>
<tr>
<td>By major currency</td>
<td></td>
</tr>
<tr>
<td>U.S. dollar</td>
<td>16,167</td>
</tr>
<tr>
<td>Euro3,4</td>
<td>8,168</td>
</tr>
<tr>
<td>Japanese yen1</td>
<td>5,579</td>
</tr>
<tr>
<td>Pound sterling1</td>
<td>2,391</td>
</tr>
<tr>
<td>Other3</td>
<td>5,133</td>
</tr>
</tbody>
</table>

Interest rate3

|                      | 42,368        | 50,015        | 54,072        | 60,091        | 64,125        | 1,160          | 1,675          | 1,357          | 1,304          | 1,230          |
| By counterparty      |               |               |               |               |               |                |                |                |                |                |
| With other reporting dealers | 18,244        | 24,442        | 27,059        | 30,518        | 32,208        | 463            | 748            | 634            | 602            | 560            |
| With other financial institutions | 18,694       | 19,790        | 21,149        | 24,012        | 25,771        | 515            | 683            | 559            | 548            | 518            |
| With non-financial customers | 5,430         | 5,783         | 5,863         | 5,562         | 6,146         | 182            | 244            | 164            | 154            | 152            |
| By remaining maturity |               |               |               |               |               |                |                |                |                |                |
| Up to one year | 17,422        | 18,185        | 20,287        | 24,874        | 25,809        | ...            | ...            | ...            | ...            | ...            |
| One to five years | 16,805        | 21,405        | 21,985        | 23,179        | 24,406        | ...            | ...            | ...            | ...            | ...            |
| Over five years | 8,141         | 10,420        | 11,800        | 12,038        | 13,910        | ...            | ...            | ...            | ...            | ...            |
| By major currency |               |               |               |               |               |                |                |                |                |                |
| U.S. dollar | 13,214        | 13,763        | 16,073        | 16,510        | 17,066        | 311            | 370            | 337            | 376            | 367            |
| Euro4       | 13,576        | 16,461        | 17,483        | 20,692        | 22,948        | 476            | 786            | 584            | 492            | 467            |
| Japanese yen | 7,164         | 9,763         | 10,207        | 12,291        | 12,763        | 194            | 212            | 192            | 232            | 207            |
| Pound sterling | 3,288         | 3,911         | 4,398         | 4,588         | 4,741         | 59             | 130            | 103            | 94             | 84             |
| Other4       | 5,126         | 6,117         | 5,911         | 5,910         | 6,068         | 120            | 177            | 141            | 110            | 105            |
| Equity-linked | 1,274         | 1,488         | 1,511         | 1,809         | 1,671         | 190            | 236            | 244            | 359            | 293            |
| Commodity | 451           | 415           | 441           | 548           | 584           | 38             | 43             | 44             | 59             | 80             |
| Other5       | 9,331         | 10,388        | 10,536        | 11,408        | 12,163        | 393            | 492            | 400            | 429            | 400            |


1 All figures are adjusted for double-counting. Notional amounts outstanding have been adjusted by halving positions vis-à-vis other reporting dealers.
2 Gross market values have been calculated as the sum of the total gross positive market value of contracts and the absolute value of the gross negative market value of contracts with nonreporting counterparties.
3 Residual maturity.
4 Counting both currency sides of each foreign exchange transaction means that the currency breakdown sums to twice the aggregate.
5 Data before end-June 1999 refer to legacy currencies of the euro.
6 Single-currency contracts only.
7 Adjustments for double-counting are estimated.
8 For end-June 1998: positions reported by institutions that only participated in the 1998 Triennial Survey of Foreign Exchange and Derivatives Market Activity, for subsequent periods: estimated positions of those institutions.
These participants in OTC derivatives markets play one (or more) of three roles. Brokers match buyers and sellers, but avoid market and counterparty risk exposures. Dealers make markets, hold inventory, and usually carry net exposure. End-users hedge, arbitrage, or speculate. These roles have evolved over time. For example, the swap market has developed in three stages: first, a brokered market in which banks strictly intermediated trades; second, a market in which banks temporarily "warehoused" swaps (sometimes hedging in futures markets) while they sought an offsetting exposure; and third, the current structure in which major banks and securities houses actively deal.

### Derivatives Contract Structures

Both exchange-traded and OTC contracts facilitate the unbundling and transformation of financial risks such as interest rate and currency risk in broadly similar ways (see Box 3.2: Motives for OTC Derivatives Transactions). However, exchange-traded contracts have rigid structures compared with OTC derivatives contracts. For example, the Chicago Board of Trade's treasury bond futures contract dictates (1) how many treasury bonds must be delivered on each futures contract; (2) the types of treasury bonds acceptable for delivery; (3) the way prices are quoted; (4) the minimum trade-to-trade price change; (5) the months in which contracts expire; and (6) how treasury bonds are delivered from the seller of the contract to the buyer. By contrast, OTC derivatives contracts can involve any underlying index, maturity, and payoff structure. OTC contracts can fill the gaps where exchange-traded contracts do not exist, including: exotic currencies and indices; customized structures (see Box 3.3: Exotic Options); and maturities that are tailored to other financial transactions. Nonetheless, some OTC derivatives instruments have become "commoditized," as market conventions and de facto standards for payments frequencies, maturities, and underlying indexes have emerged. About two-thirds of OTC derivatives' gross market value is accounted for by simple contract structures, many of which could be traded on an exchange except for minor differences in matu-
The limited flexibility of exchange-traded contracts may partly reflect the fact that such contracts are regulated, often by both a regulatory authority and an exchange’s self-regulatory organization. According to market participants, in the exchange environment, regulatory authorities evaluate proposed new contracts in a time-consuming and costly process. In the United States, the Securities and Exchange Commission (SEC) regulates exchange-traded derivatives that are legally “securities” (for example, certain options); the Commodity Futures Trading Commission (CFTC) regulates those that are legally “commodities” (for example, financial futures). Regulations promote investor protection, as exchange members act as agents for customers; market integrity, against the potential for manipulation when supplies of underlying goods, securities or commodities are limited; and efficient price discovery, an important function of exchange-traded derivatives. By contrast, OTC derivatives instruments are lightly and indirectly regulated, often because they fall between regulatory gaps. In the United States, for example, swaps contracts are classified neither as “securities” nor as “commodities,” and so are regulated neither by the SEC nor the CFTC. Many justifications for regulating exchange-traded derivatives contracts are not relevant for OTC derivatives. As was recognized by U.S. courts (Procter & Gamble v. Bankers Trust), they are principal-to-principal agreements between sophisticated counterparties, and investor protection is not regarded as an important issue. In addition, there is minimal risk of manipulation in OTC derivatives markets, since OTC derivatives contracts do not serve a price-discovery role as do exchange-traded derivatives contracts.¹⁷

¹⁶See United States, President’s Working Group on Financial Markets (1999b).
¹⁷See Greenspan (2000).
Table 3.3. Geographical Distribution of Reported Over-the-Counter (OTC) Derivatives Market Activity, April 1995 and April 1998
(Average daily turnover in billions of US. dollars)

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Foreign Exchange</th>
<th>Interest Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>351.2</td>
<td>292.4</td>
<td>58.8</td>
</tr>
<tr>
<td>United States</td>
<td>163.6</td>
<td>131.8</td>
<td>31.7</td>
</tr>
<tr>
<td>Japan</td>
<td>138.6</td>
<td>112.2</td>
<td>26.4</td>
</tr>
<tr>
<td>France</td>
<td>54.9</td>
<td>36.1</td>
<td>18.8</td>
</tr>
<tr>
<td>Singapore</td>
<td>79.2</td>
<td>63.0</td>
<td>16.3</td>
</tr>
<tr>
<td>Germany</td>
<td>56.0</td>
<td>45.1</td>
<td>10.9</td>
</tr>
<tr>
<td>Switzerland</td>
<td>46.7</td>
<td>44.2</td>
<td>2.4</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>59.9</td>
<td>56.4</td>
<td>3.5</td>
</tr>
<tr>
<td>Canada</td>
<td>23.1</td>
<td>18.7</td>
<td>4.4</td>
</tr>
<tr>
<td>Australia</td>
<td>25.7</td>
<td>22.9</td>
<td>2.8</td>
</tr>
<tr>
<td>Other</td>
<td>162.6</td>
<td>130.2</td>
<td>32.6</td>
</tr>
<tr>
<td>Total &quot;net-gross&quot; turnover</td>
<td>1,161.5</td>
<td>953.0</td>
<td>208.6</td>
</tr>
</tbody>
</table>


1Adjusted for local double-counting ("net-gross"). It is estimated that the survey covered from 73 percent to 100 percent of derivatives markets in individual countries.

2including outright forwards and foreign exchange swaps.

3Single-currency contracts only.

Derivatives contracts, whether exchange-traded or OTC, can be decomposed into portfolios of futures (or their OTC analog, forwards) and options. Forwards, like exchange-traded futures, convey a commitment to deliver a particular good or security at a future date at an agreed price (often settled in cash). Options (either OTC or exchange-traded) convey the right but not the obligation to buy or sell a particular good or security (often cash-settled as well). Swaps, which are an important part of the OTC derivatives markets, can be thought of as portfolios of forward contracts. Swaps exchange cashflows indexed to interest rates, foreign exchange rates, equity prices, credit instruments, or commodity prices; accordingly, swaps are often used to transform cashflows related to debt, by converting fixed-rate debt to floating-rate debt or converting yen debt to dollar debt. In addition, there are a variety of actively traded derivatives on swaps. Examples include swaptions, or options on swaps, that convey the right, but not the obligation, to enter into a swap; and forward swaps, or swaps that become activated after a certain amount of time has passed. Swaps sometimes include option-like features that allow them to be canceled or extended.

Swaps are as varied as the trading and hedging needs of market participants. Some swaps involve the exchange of payments in a single currency. In an interest rate swap, counterparties exchange interest payments on some notional amount. For example, a "vanilla" (standard) fixed-for-floating U.S. dollar interest rate swap might pay fixed interest at 6 percent and receive 6-month U.S. dollar LIBOR on a notional principal of $1 million, with the LIBOR rate reset at 6-month intervals. There are numerous variations on this basic theme.

two different currencies. Currency swaps provide the periodic exchange of interest payments in two currencies as well as initial and final exchange for the periodic exchange of interest payments in which link interest and principal to an index, and interest-rate payments in the two reference currencies. For example, consider flows are as varied as the hedging needs or risk ap-

while in cross-currency interest rate swaps, only in-

interest-rate payments in the two reference currencies are exchanged.

Other OTC derivatives include structured notes, which link interest and principal to an index, and credit derivatives. Structured notes have interest and principal payments that are linked to an underlying index. The index and its relationship to cashflows are as varied as the hedging needs or risk appetites of the counterparties. For example, consider a structured note involving the Mexican peso (with all cashflows in dollars). The note might pay an 85 percent coupon and principal that decreases by 5 percent for every 1 percent depreciation in the peso between inception and maturity. Such a note is equivalent to a dollar loan that is leveraged fourfold into a peso deposit. Although the note is effectively a highly-leveraged foreign-currency investment, under 1994 Mexican prudential regulations the transaction would have appeared for regulatory purposes as a peso investment. Such structures have been particularly popular for circumventing regulations, for example, on foreign-currency investment.

Credit derivatives are indexed to the total return of an underlying security, to a credit event, or to credit spreads. A total return swap exchanges fixed or floating interest (say, LIBOR plus a spread) for the total return on a reference security (interest or dividend payments plus price appreciation or depreciation). A credit default swap exchanges a fee for an agreement to cover the loss on a reference security if a predefined credit event occurs. A credit linked note pays interest and principal until a credit event occurs; its payment is then linked to the recovery value of a reference asset. The market for


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Derivatives Contract Structures

Box 3.1. Derivatives Products Companies

Concerns about counterparty risk have prompted some major financial institutions to set up special subsidiaries, known as Derivatives Products Companies (DPCs), to handle derivatives activities.1 DPCs are structured to obtain higher ratings than the parent company, so that they can serve as the parent’s vehicle for derivatives trading. A DPC is designed to insulate its counterparties from the credit risk associated with its parent: in the event of the parent’s default, the parent’s creditors cannot lay claim to the DPC’s assets. These vehicles pass the market risk in derivatives transactions to the parent company by entering offsetting “mirror transactions” with the parent. For example, when the DPC enters a swap to pay fixed interest and receive floating interest with a counterparty, it also enters a swap to receive fixed interest and pay floating interest with its parent.

DPCs have very simple financial structures. They typically hold derivatives, cash, treasury bills, and capital. Ratings agencies require them to hold substantial resources (including initial capital, surety bonds from monoline insurers, and receivables) to earn a high rating. In addition, they operate under predefined termination procedures in the event that, for example, the DPC or its parent is downgraded or the parent defaults. There are two such procedures: contingent manager (or continuation) structures, and early termination. Under the contingent manager or continuation structure, the DPC enters no new contracts after the termination event, but continues to service its current contracts under a prespecified contingent manager, until all its contracts mature. Under the early termination structure, the DPC accelerates its positions by unwinding them under prespecified terms. These structures—what Kroszner (1999) calls “prepackaged bankruptcy procedures”—relieve a significant degree of the uncertainty about the disposition of derivatives trades vis-à-vis such a counterparty in the event of default.

DPCs came into existence in the early 1990s, amid increasing concerns about counterparty credit risk stemming from the recession and the bankruptcy of Drexel Burnham Lambert. Since then, they have garnered only a relatively small share of the business. According to recent estimates, the major DPCs account for about $1.7 trillion in notional principal, only about 2 percent of global outstandings. Moreover, the popularity of DPCs has waned in more recent years (in fact, two institutions have recently closed their DPCs), as the credit ratings of many major banks and securities firms have improved and as more multiproduct collateral and netting agreements have been put in place. The vehicle remains attractive for lower-rated institutions; a major Japanese securities house recently considered establishing a DPC in order to make inroads into the global derivatives market.

1See Remolona, Bassett, and In Sun (1996) and Kroszner (1999).

19See Smithson and Hayt (1999), pp. 54-55. Credit events include default or a downgrade to sub-investment grade.
Box 3.2. Motives for OTC Derivatives Transactions

While OTC derivatives in the form of forward sales of agricultural goods date back to the 15th century, and perhaps earlier (the first options trade is attributed to the Greek philosopher Thales circa 600 B.C.), the modern forms of OTC derivatives originated in incentives from three sources: economic incentives, including the need to share and hedge risk; restrictions on financial activity, including regulation, investment restrictions, and taxation of financial transactions; and the internationalization of finance and the associated technological and methodological advances. Three historical examples illustrating the use of OTC derivatives show how these incentives shaped OTC derivatives markets.

First, the market for interest rate swaps grew out of a desire to exploit differential interest rate advantages for borrowing at fixed versus floating rates. For example, suppose a low-rated bank has to pay 100 basis points more than a high-rated bank when borrowing at fixed rates, while it has to pay only 10 basis points more than the high-rated bank when borrowing at floating rates. In this case, the two banks could profit from each bank's comparative advantage: the low-rated bank would borrow at floating rates; the top-rated bank would borrow at fixed rates, and both banks would exchange the cash flows. These types of transactions gave rise to the interest rate swap market. Initially, banks and other financial institutions served as brokers by matching buyers and sellers for a fee. But this activity ultimately evolved into the current OTC derivatives markets in which the internationally active commercial and investment banks actively trade and manage very large portfolios of swaps, including for their own proprietary accounts. Interest rate swaps presently account for about two-thirds of OTC derivatives markets activity in interest rate contracts.

Second, consider the market for currency swaps. These derivatives instruments arose from a need by credit derivatives is currently small—notional value was recently estimated at around $650 billion, compared with about $80 trillion for all OTC derivatives—but promises strong future growth. Credit derivatives are still in the early stages of the derivatives 'product cycle,' which is driven by client needs, technology, regulatory and tax considerations, and market conditions. As many of these factors become more favorable to the development of the market, and as banks seek to liquidify credit exposures on their balance sheets (blurring the distinction between securitization and the use of credit derivatives) and develop and make markets in credit risk, credit derivatives may come to play a central role in the management of credit risk. In the near term, challenges in documenting credit-derivatives trades, the inability to offset some kinds of risks for regulatory capital requirements, and concerns that banks may use their superior information about credit risk to the disadvantage of clients may work to limit growth in this nascent market segment of global derivative markets. There are also important legal uncertainties about the performance of credit derivatives in the event of counterparty bankruptcy, in part because credit derivatives are, under current law, junior to other claims. Meanwhile, the market
The flexibility of OTC derivatives contracts allows unusual contract structures to be traded, including in options. In a standard option, the buyer pays a fee (premium) up front, and receives an option to either buy (call option) or sell (put option) the underlying security at a specified price (strike price). This right may be exercisable only at maturity (European option) or at any time up until maturity (American option). At exercise, the payoff to the option is the difference between the strike price and the price of the underlying security (its intrinsic value). Options with simple structures such as these are known as “vanilla” options.

Exotic options can change any or all of these features:

- The option may be exercisable at several fixed points in time (Bermuda option).
- The premium can be paid at maturity, rather than at initiation (break forward, Boston option).
- The option can start with a delay (forward start option), as with some employee incentive stock options.
- The underlying can be another option, rather than an underlying security (compound options); for example, an option on an interest-rate cap (caption) or floor (floor option).
- The underlying may be another derivative, for example, a swap (swaption).
- The holder may pick at some point whether the option is a call or put option (chooser option).
- Barrier options are canceled (knockout) or activated (knock-in) when a price threshold is crossed.
- Binary options pay a fixed amount (cash or nothing option) or full asset value (asset or nothing option).
- The payoff may depend on the maximum or minimum price attained by the underlying (look back option) or on the average price of the underlying during the life of the option (Asian option).
- During the contract’s life, the holder may be able to pick a day, and at expiration receive the maximum of the intrinsic value on that day and the intrinsic value at maturity (shout option).
- The payoff may depend on the prices of several underlying securities (rainbow, basket, exchange options).
- The option may have a payoff that is nonlinear in the underlying price (power caps).
- The option’s payoff may be denominated in a different currency than the underlying (quanto).
- Many variations either combine one or more of these features, or amount to portfolios of options.

Exotic options raise a number of challenges for the financial institutions that trade them. They can be exceedingly challenging to price; options for which the payoff depends on the price history may not have a closed form solution for the price. In addition, they can be very challenging to hedge. Options are traditionally dynamically hedged by holding a quantity of the underlying security, which is periodically adjusted for changes in the price of the underlying security. How much of the underlying security is held depends upon how the option’s price responds to changes in the underlying; this response can change dramatically for exotic options. Suppose, for example, that when the price of the underlying security rises by one dollar, the price of an option on one unit of the underlying rises by 50 cents; in market parlance, the option’s delta (change with respect to the underlying) is 0.5. A portfolio of two options, and one unit of the underlying, is then perfectly hedged. However, the value of delta changes with the price of the underlying security. For knockout options, the value of delta declines sharply to zero as the barrier is approached. This has the potential to suddenly unbalance the hedged position and cause a sudden rush of sales or purchases of the underlying security to rebalance the portfolio.

1 See, for example, Hull (2000), Chapter 18. These “exotic” structures may be nonstandard and complex, but they are not necessarily rare, thinly traded, or especially risky.

2 Another approach is to hedge using a portfolio of other options constructed to automatically adjust for changes in the price of the underlying security (static hedging).
III OTC DERIVATIVES MARKETS: SIZE, STRUCTURE, AND BUSINESS PRACTICES

Exchange Versus Over-the-Counter Market Structures

A comparison of the market structures for OTC and exchange-traded derivatives can provide a useful perspective on important features of OTC derivatives markets. Compared with exchange-traded derivatives markets, OTC derivatives markets have the following features: management of counterparty (credit) risk is decentralized and located within individual institutions; there are no formal centralized limits on individual positions, leverage, or margining; there are no formal rules for risk and burden-sharing; and there are no formal rules or mechanisms for ensuring market stability and integrity, or for safeguarding the collective interests of market participants.

Organization of Derivatives Trading and Corresponding Frameworks for Promoting Market Stability

Apart from contract flexibility, the most salient differences between OTC and exchange-traded derivatives lie in the organization of trading and the corresponding frameworks for promoting market stability. Trading, clearing and settlement, risk management, and contingency management (handling a clearing-member default, for example) are highly formalized and centralized in exchange markets, but are informal, bilateral, and comparatively decentralized in OTC markets.

Organized Exchange Markets: Centralized, Formal, Regulated, Rule-Driven

Organized exchange trading has four main components: membership requirements; rules governing conduct (including risk management); centralized trading, clearing, and settlement; and rules that mutualize risk, including loss-sharing in case of defaults. These rules are designed to ensure market integrity, promote efficient price discovery, and safeguard the resources of the clearinghouse. A clearinghouse may be part of the exchange, or a separate legal entity. Exchange members normally commit capital or have an ownership interest in the clearinghouse.

In order to maintain market stability and financial integrity, exchanges impose soundness, disclosure, transparency, and prudential requirements on members. Typically, there are minimum capital requirements, protection of customer funds, reporting, and compliance with other rules and regulations. Exchanges closely monitor trading activity with a view to identifying large customer positions or concentrations of positions. They also promote transparency by reporting positions, turnover, and price data, and determining settlement prices, usually on a daily basis. Following the collapse of Barings, some clearinghouses share information and assess members’ net exposures across markets.21

The clearinghouse manages credit risk and is the central legal counterparty to every transaction; it has a matched market-risk position, but has current credit exposures. Credit risk arises because a change in the price of the underlying asset could cause one counterparty to owe a considerable amount on its position, particularly if the contract is highly leveraged. If an exchange member defaults, the clearinghouse normally has the right to liquidate the member’s positions, take the member’s security deposit, margin, and performance bonds, attach certain other member assets, and invoke any guarantee from the member’s parent company. If the defaulting member’s resources cannot cover the obligation, the exchange can normally turn to the resources of other clearing members by invoking loss-sharing rules. In the event of member default, most clearinghouses transfer the member’s client positions to another member; a few close out the client positions and liquidate the margin. Exchanges also have backup credit lines.22 Clearghouse defaults have been exceedingly rare.

Most importantly, exchanges formalize risk-management and loss-sharing rules designed to protect the exchange’s capital and the capital of its members. Members are usually, but not always, required to keep speculative positions within strictly defined limits, mark to market at least daily, and post initial and variation margin to limit the exchange’s net credit exposure to the member. Members are subject to surprise inspections and surveys of their financial condition, compliance with exchange rules, and risk-management abilities. Likewise, there are rules that protect the exchange and its members from trading activities of nonmembers, which must trade through members. For example, on some exchanges, members of the exchange need not be members of the clearinghouse, but trades must be cleared through clearinghouse members. Exchanges also dictate minimum margin requirements for member exposures to clients (often higher than the requirements for members), as well as client position limits. In addition, clearing members handling clients’ accounts may face more stringent capital requirements compared with those only trading on their own account.

22 See Kroszner (1999).
OTC Markets: Decentralized, Informal, Lightly Supervised and Regulated, Market-Discipline-Driven

By contrast, OTC derivatives markets lack a formal structure. There are no membership criteria, but counterparties prefer to deal only with highly rated and well-capitalized intermediaries to minimize counterparty risk. OTC derivatives markets are similar to interbank and interdealer markets. They comprise an informal network of bilateral relationships and there is no physical central trading place. Instead, the OTC derivatives markets exist on the collective trading floors of the major financial institutions. There is no central mechanism to limit individual or aggregate risk taking, leverage, and credit extension, and risk management is completely decentralized. Market participants individually perform risk management, in particular the management of the credit risk in the bilateral, principal-to-principal agreements, which is particularly challenging because exposures vary with the price of the underlying security and can rise very sharply.

The operational aspects of OTC derivatives markets are also decentralized. There is no centralized trading, clearing, or settlement mechanism in OTC markets. Transparency is generally limited as well. Except for semiannual central-bank surveys, market participants do not report outstanding positions or prices for aggregation or dissemination. Information about market concentration and who owns which risks is generally unavailable; at best, a trading desk might know that some institutions are building up positions. This lack of transparency enabled LTCM to build up outsized positions during 1997 and 1998.23

As discussed in more detail in Section IV, OTC instruments and trading are essentially unregulated, although they are affected indirectly by national legal systems, regulations, banking supervision, and market surveillance. None of the major financial centers has an “OTC derivatives regulator” similar to a banking or a securities regulator.24 Nor is the institutional coverage comprehensive, as hedge funds and unregulated securities affiliates are not regulated. Regulations are also highly fragmented, both nationally and internationally. In the United States, for example, there are at least three groups of regulators—securities, commodity futures, and banking—impeding on OTC derivatives activities. In addition, while the major market-making institutions flexibly book trades around the globe, supervision and regulation are nationally oriented. Nevertheless, despite its limited role, the current regulatory framework has had a visible impact on the market.

This light regulation and supervision exists alongside a set of private mechanisms that facilitate smoothly functioning OTC derivatives markets. Market discipline, provided by shareholders and creditors, promotes market stability by rewarding financial institutions based on their performance and creditworthiness. Recent research finds market discipline to be strong only during periods of banking sector stress and volatile financial markets.25

Market discipline is present when a firm’s private sector financial stakeholders (shareholders, creditors, and counterparties) are at risk of financial loss from the firm’s decisions and can take actions to “discipline” the firm and to influence its behavior. Market discipline may operate through share price movements, by constraining the supply of credit, or through the willingness to do business through counterparty relationships. Market discipline in financial markets therefore rests on two key elements: investors’ ability to accurately assess a firm’s financial condition (“monitoring”) and the responsiveness of the firm’s management to investor feedback (“influence”).26 Institutions mark their trading books to market daily so that unprofitable decisions and poor risk management can be reflected immediately in measured performance (profits and losses). This informs senior management and, through disclosure, financial stakeholders. These mechanisms have some influence, as demonstrated during the turbulence in 1998 when those institutions that appeared to manage well enjoyed the most buoyant stock prices, and creditors of institutions perceived to be less creditworthy refused to roll over credit lines or bond issues, and sold their credit instruments in the secondary market. The subsequent reductions in proprietary trading activity seem to have been largely motivated by financial stakeholders’ desire for less risky earnings.

In OTC derivatives markets, special obstacles for effective market discipline (both “monitoring” and “influence”) tend to be related to information disclosure—one of the fundamental preconditions for effective market discipline. For example, the off-balance-sheet character of derivatives makes it difficult for outside financial stakeholders to evaluate the financial health of an institution and its contingent liabilities. Data on individual exposures is proprietary, and disclosure could diminish potential

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23See International Monetary Fund (1999), Chapter IV.
24Among the exceptions, in Brazil all OTC derivatives transactions must be centrally registered. See United States, Commodity Futures Trading Commission (1999), pp. 64-65.
26See United States, Board of Governors of the Federal Reserve Board (1999).
profits. In addition, competitive pressures and the desire to see order flows can lead creditors to extend credit without insisting on adequate counterparty disclosure, as occurred, for example, with LTCM. Therefore, more emphasis may have to be placed on counterparty monitoring, as there may be significant limits to broader market discipline for complex institutions that are active in the OTC derivatives markets.

Supplementing these mechanisms, a number of industry groups are involved in initiatives designed to support well-functioning OTC derivatives markets, notably the International Swaps and Derivatives Association (ISDA), the Counterparty Risk Management Policy Group, the Group of 30, and the Derivatives Policy Group. Efforts include dissemination of best practices in risk management, standardization of documentation, identification of gaps in risk-management practices, and flaws in the operational infrastructure; assessments of legal and other operational risks; efforts to foster interindustry and public/private dialogues on key issues; and initiatives to voluntarily disclose information to regulatory authorities. The activities of these groups reflect the fact that market participants see it as in their best interest to encourage an orderly, effective, and efficient market, and also to discourage regulation.

Corporate governance monitoring by financial stakeholders and private initiatives imposes discipline on OTC derivatives activities and increases incentives to reflect the degree of counterparty risk in pricing, margins, or collateral. They also create benchmarks against which participants, end-users, and regulators can measure progress in dealing with the issues raised in public and private forums. Some of the same factors that complicate market discipline (such as the opacity of OTC derivatives) are also the very factors that make market discipline desirable from the standpoint of financial regulators.

To summarize, OTC derivatives markets and activities are highly decentralized and lightly regulated compared with exchange markets and activities. The decentralized and informal structure of OTC derivatives activities and the indirect impact of the regulatory environment are reflected in the day-to-day operational and risk management practices of its major participants. These practices are described next.

Trading and Back-Office Infrastructure for OTC Derivatives Dealing

Like other trades, OTC derivatives trades are initiated in the front-office trading function, then cleared, managed, and settled in the middle- and back-office functions (Figure 3.3 and Box 3.4: The Life of a Two-Year Interest-Rate Swap). Although market terminology does not always precisely distinguish back-office from middle-office functions, firms increasingly describe risk management as a "middle-office" function, distinct from "back-office" activities such as clearing and settlement (though back-office functions can have risk-management aspects as well, for example, by mitigating operational risk). That distinction is followed here.

The Trading Function

The first step of an OTC derivatives trade is soliciting a price. Prices are normally quoted bilaterally within an informal network of familiar counterparties, usually over the telephone or over electronic quoting or broking systems. Screen-based prices are prevalent in "vanilla" segments such as interest-rate swaps and options and foreign-exchange forwards, though market participants may not be able to readily transact at these prices (owing in part to CFTC restrictions described in Section IV). Even when bid and offer prices are posted—as in the swaps market—these are generally indications for "vanilla" deals with the highest-rated counterparties. "Non-vanilla" or off-market swaps that involve amortizing or accreting principal, a nonstandard fixed-rate coupon or floating rate index, or other adjustments often require a customized quote. Nonetheless, trading arrangements are becoming more formalized in a few segments of the OTC derivatives market. In 1999, Derivatives Net Inc. announced a new system for swaps trading ("Blackbird"); three brokers began to set up an electronic broking systems for swaps and other fixed-income derivatives; and the CreditTrade system for credit derivatives began operation (Creditex, another electronic trading system for credit derivatives, began operation in March 2000).

Since a trade implies a current or potential increase in counterparty risk exposure, most firms check credit limits and other risk controls before finalizing the trade. The trader may check an internal reporting system or consult a risk or relationship manager. Once the trade has been checked for consistency with risk limits and confirmed informally,
more formal confirmation and clearing usually takes place in the back office.  

Back-Office Infrastructure

The back office provides five critical functions: issuing and monitoring confirmations; recording transactions; settling transactions; ensuring that legal documentation is completed; and producing information for management and control purposes, including reports on positions that are subject to trading and counterparty limits, reports on profitability, and reports on exceptions that require action (unsigned confirmations and breaches of limits, for example).

Clearing is a particularly important back-office function. Trade confirmations form a critical part of this process. Interbank counterparties normally exchange, by fax or telex, confirmation letters detailing the economic terms of the trade and other particulars within one to five days of the trade. When counterparties have not yet signed a master agreemen (described below), the confirmation letter often describes closeout netting arrangements; these are called long-form confirmations. In brokered trades, the broker may issue confirmations to both parties. In transactions with nonbank end-users, it is common that only the bank counterparty sends a confirmation. The back office checks the terms of the confirmation to ensure that both parties agree to the same terms; discrepancies crop up in 5 to 10 percent of trades.

Trade capture, in which the details of the trade are entered in management information systems, can be cumbersome for OTC derivatives dealers. First, large dealers—and even active end-users—have many counterparties and positions: for example, LTCM had some 50 counterparties in the OTC derivatives markets, and was counterparty to tens of thousands of transactions in all markets. Second, some OTC derivatives products have complex terms. While a cash instrument may be described by two or three parameters or a simple security identifier, a complex derivative instrument requires pages of documentation. Trade capture takes seconds for foreign exchange and cash trades, compared with up to two hours for complex trades. As a result of these complexities, traders frequently record the wrong interest rate, term, or counterparty in trade information systems. Errors early in the process can compound later; the trade information system may fail to inform the trader that an in-the-money option is expiring, or that a counterparty has missed several payments. For this reason, risk managers see it as critical to detect and fix errors early in the process, and see managing the first day of the trade as key. Errors are usually caught and corrected early in the trade capture cycle and they are therefore not generally viewed as “life-threatening.”

The back office also tracks and records the value of OTC derivatives transactions and positions. First, it checks and corrects the price data submitted by the trading desk. Once the data have been “scrubbed,” they are used to value the firm’s positions, and to calculate profit, loss, and exposures. The precise way that OTC derivatives transactions and exposures translate into gains, losses, and exposures on the income statement and balance sheet depends on a number of factors, including the jurisdiction and whether the derivatives are used for hedging or trading.

Valuation of OTC derivatives raises special challenges for the back office. Following Statement 133 by the Financial Accounting Standards Board (FASB) and IASC International Accounting Standard 39, OTC derivatives are often recorded at fair value, which the FASB has defined as “the amount at which
Suppose that a company owns a $100 million, two-year bond that pays semiannual fixed interest at 10 percent, but would prefer a floating-rate bond. Instead of selling the fixed-rate bond and buying a floating-rate bond, it can convert the fixed-rate bond’s cashflows from fixed to floating by entering with an intermediary into a two-year interest-rate swap in which it pays a fixed rate of interest and receives a floating rate (for dollar-denominated interest-rate swaps, the floating-rate index is often LIBOR, or the rate on Treasury bills, commercial paper, or federal funds). In this case, the company will be the “fixed-rate payer” and the intermediary will be the “fixed-rate receiver.”

The company phones an intermediary to obtain a quote on such a swap. Swap rates are normally quoted by reference to the interest rate on the fixed leg of the transaction and expressed as a spread over Treasury rates. The intermediary offers to pay LIBOR flat in return for 8 percent fixed interest. The rate of 8 percent is then the swap rate or swap coupon on this two-year swap. The swap rate is normally expressed as the semiannual yield to maturity on the fixed rate leg against a flat floating rate. It is typically quoted in terms of a spread to Treasury rates of the same maturity. Suppose that the two-year Treasury note yields 7.75 percent. The swap spread quoted to the company is then 25 basis points. Swap rates may be either on market—that is, calculated using prevailing interest rates and with a standard payment frequency, notional amount, and floating-rate index—or off market, with one or more of these aspects customized (standardized swaps are also known as “plain vanilla” swaps). For short-dated, U.S. dollar interest rate swaps, on-market swap rates are calculated from eurodollar futures rates. For this two-year swap, the intermediary would first compound the yields on eight successive three-month eurodollar contracts to arrive at the swap rate. The intermediary would then add and subtract small amounts (perhaps a few basis points) to reflect credit risk and the cost of doing business to arrive at the fixed rates that it would be willing to receive and pay on swaps; the difference between the intermediary’s “receive” and “pay” rates is the bid-ask spread.

If the company accepts the swap arrangement, the intermediary fills out and sends a confirmation form that spells out the details of the swap, including the floating-rate index, the frequency of payment, and any arrangement for collateral. The company checks, signs, and returns the confirmation. If the intermediary and company have a master agreement between them, the swap may be encompassed by that agreement; if not, the intermediary may use a more detailed confirmation (a long-form confirmation) that sets out many of the considerations that are normally covered in the master agreement. The date that the deal is agreed is known as the trade date; interest begins to accrue on the effective date (perhaps 5 business days later), and any initial cashflows are exchanged on the settlement date (often the same as the effective date).

The company has now in effect converted the fixed-rate bond that pays 10 percent to a floating-rate bond that pays LIBOR plus 2 percent: the company receives 10 percent from the bond, pays 8 percent on the swap, and receives LIBOR (see figure). The intermediary now may have an open exposure to interest rates, depending on the configuration of swaps and other instruments on its books. The intermediary may choose to hold the position, enter an offsetting swap (paying fixed rates and receiving floating), or hedge the position using U.S. Treasury securities or eurodollar futures.

The intermediary also enters the details of the swap into the data management system, capturing the important details in the firm’s risk-management system, which would calculate the exposure to the company net of any other positions. In a standard, on-market swap, the expected present value of the swap is zero, so no cash changes hands up front. However, both the intermediary and the company have potential future exposure (PFE) liquid derivatives (for example, the value of a foreign exchange barrier option may be estimated from the value of a replicating portfolio of vanilla foreign exchange options). When models are used to mark positions, model valuations are sometimes periodically checked against market quotations.

The back-office function is also responsible for settling OTC derivatives transactions. Most OTC derivatives are cash settled or allow for it. Payments change hands during the contract’s life (for interest-rate and cross-currency interest rate swaps, periodic exchange of interest, and for foreign ex-

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**Box 3.4. The Life of a Two-Year Interest-Rate Swap**


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See Kawaller (1999).
Anatomy of a Fixed-for-FloatLng
Interest-Rate Swap

Company
“Fixed-Rate
Payer”

Intermediary
“Fixed-Rate
Receiver”

Fixed-Rate
Bond

(see Box 3.5). Accordingly, one or both may have the
right to take collateral up front (in arrangements like
the one described, normally only the intermediary has
the right to take collateral). Moreover, as market rates
change, and PFE fluctuates, both current exposure
and PFE may rise, and the intermediary may make
collateral calls (as well as rehedging market risk
exposure).

After 6 months, the first “reset” period is reached,
and the first payment is due. The size of the gross and
net payments depends upon the 6-month LIBOR at
the beginning of the period when the deal was struck
(say, December 2000). Suppose that the 6-month
LIBOR was 6 percent. The company is obligated to
pay 8 percent of $100 million; the intermediary is ob-
ligated to pay 6 percent of $100 million; net, then,
the company is obligated to pay the intermediary 2
percent of $100 million, or $2 million (see table).
Note that the gross and net flows are considerably
smaller than the notional value of $100 million. The
market value of the swap would likewise be small
compared with the notional value (perhaps 5 percent
of the notional).

This process continues through the end of the life
of the swap, at the end of the second year. At that point,
the swap agreement expires, and any excess collateral
is returned (in a “plain vanilla” interest rate swap, the
two counterparties do not exchange principal).

<table>
<thead>
<tr>
<th>Period Ending</th>
<th>6-month LIBOR</th>
<th>Fixed interest payment (from company)</th>
<th>Floating-rate payment (from intermediary)</th>
<th>Net payment (from intermediary to company)</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 2000</td>
<td>6 percent</td>
<td>$8 million</td>
<td>$6 million</td>
<td>$2 million</td>
</tr>
<tr>
<td>June 2001</td>
<td>7 percent</td>
<td>$8 million</td>
<td>$7 million</td>
<td>$1 million</td>
</tr>
<tr>
<td>December 2001</td>
<td>6 percent</td>
<td>$8 million</td>
<td>$8 million</td>
<td>$1 million</td>
</tr>
<tr>
<td>June 2002</td>
<td>9 percent</td>
<td>$8 million</td>
<td>$8 million</td>
<td>$1 million</td>
</tr>
<tr>
<td>December 2002</td>
<td>...</td>
<td>$8 million</td>
<td>$9 million</td>
<td>$1 million</td>
</tr>
</tbody>
</table>

Some dealers also manage settlement risks in two-
way payments by specifying that counterparties
pay first, before the dealer pays. Overall, except
when principal is at risk (as in foreign exchange
transactions), most market participants see settle-
ment risk in OTC derivatives transactions as no
greater than in cash transactions, where manage-
ment of settlement risk is well developed and un-
derstood. In addition, because netting practices are
widely accepted, payments associated with OTC
derivatives transactions are a relatively small frac-
tion of total gross obligations for most institutions.

33Data from the U.S. Office of the Comptroller of the Currency
show that bilateral netting reduces credit exposure on derivatives
among all U.S. banks by about 60 percent, and that this percentage
has increased over time.
usually around five percent and no more than 15 percent of total payments.

Increasing competition and declining spreads create pressure to rationalize middle- and back-office costs. Some small to medium-sized market participants find it more economical to subcontract middle- and back-office functions to another firm, rather than perform them in-house. For example, hedge funds often employ a prime broker that handles financing, custody, recordkeeping, and clearing. For larger institutions, pressures to lower costs will likely mean increased automation of back-office functions, which is limited outside the more commoditized segments. In 1999, a new electronic system for checking and matching OTC derivatives confirmations (Londex) was introduced, and major market participants have signed up. There are also suggestions that SWIFT may be used more extensively for electronic exchange of OTC derivatives confirmations, although SWIFT membership is limited and the SWIFT system apparently cannot handle some structured transactions.

Once the trade is confirmed, initially settled, checked, and recorded, the first part of its “life cycle” is ended. At that point, middle-office risk managers take responsibility for managing its market, credit, and operational risks.

**Middle Office: Managing the Risks Associated with OTC Derivatives Positions**

The principles of prudent risk management are the same in OTC derivatives as in other areas: avoid concentration, know your counterparty, manage maturity, and mark-to-market. Similarly, some of the same risk-management tools used for other types of exposures can be used for OTC derivatives as well. This section provides a general overview of the risk management considerations surrounding OTC derivatives, including those that are particular to OTC derivatives positions.

**Market Risks**

Market risks in OTC derivatives are managed using familiar tools such as the value-at-risk (VaR) model, which measures how much of the firm’s capital could be lost owing to swings in the value of its portfolio, given a host of simplifying assumptions. Recent bouts of turbulence have revealed the limitations of these simplifying assumptions. For example, standard VaR models ignore the confluence of credit and market risk, which is a key consideration for OTC derivatives exposures. Counterparty credit exposure rises when market moves put a derivatives exposure into the money (so-called “wrong-way risk”—see below). When the exposure is highly leveraged, even small market moves can give rise to large changes in credit exposure. In a five-year interest-rate swap, a 100 basis point change in rates can increase credit exposure by 400 basis points of notional principal. The confluence of credit and market risk can be particularly complicated for options, as option credit exposure varies nonlinearly with the price of the underlying security.

**Credit Risk**

Modeling of market risks is more advanced than modeling of credit exposures (including counterparty exposures) in OTC derivatives. Market risk is reasonably well approximated by means, standard deviations, and correlations, but credit risk—particularly the risk of “tail events”—requires a more refined approach, and a portfolio approach to counterparty credit risk remains elusive. Instead, counterparty credit risk is more often managed like other types of credit risk—that is, “one name at a time,” using internal ratings, models of rating migration, estimates of default probabilities and expected loss from spreads on other senior unsecured claims (such as corporate bonds), and scenario analyses. A few dealers also explicitly mark to market the credit risk in their swap books, and some use instruments such as corporate bonds or credit derivatives to hedge counterparty risk in OTC derivatives exposures. As the market for credit derivatives develops further, it may provide timely market estimates of credit risk for these purposes.

One of the key concepts of counterparty credit risk in a derivatives contract is potential future exposure (PFE), or the amount potentially at risk if a counterparty defaults (see Box 3.5: Measuring Potential Future Exposure in a Swap Contract). Consider a German securities firm that buys a put option on a U.S. stock (currently trading at $300) from a U.S. bank, giving the German securities firm the right to sell the stock at $300 (the strike price). If the U.S. stock falls

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34Major banks are among the providers of prime brokerage services. In March 2000, J.P. Morgan announced plans to set up a separate company (Arcordia) to offer post-trade operations associated with derivatives.

35See Trant (1999).

36SWIFT is a banking industry-owned payment and settlement messaging network that is operated by the Society for Worldwide Interbank Financial Telecommunications.

37See International Monetary Fund (1999), pp. 69–70.

38White (1997).

to $100, the option will be worth about $200 to the German securities firm, since it could buy the stock for $100 in the spot market, then exercise the option and sell it to the U.S. bank for $300. From a market-risk perspective, the trade has worked out well so far for the German securities firm, but from a credit-risk perspective, it has become riskier. If the U.S. bank defaults on its obligation, the German securities firm stands to lose a lot more than it did at the inception of the trade. Moreover, if the drop in the price of the U.S. stock coincides with a deterioration in the U.S. bank’s ability to pay—as it well might—the chance of default and the loss given default both rise sharply. This adverse confluence between market and credit risk is known as “wrong-way” risk, and caused sharp losses during recent crises.

Risk managers mitigate counterparty credit risk exposure using a variety of techniques, including: collateral; netting; concentration limits by industry and counterparty (sometimes with additional limits by maturity); periodic recoupment (resetting swap terms to return its mark-to-market value to zero); and credit triggers that give the option to force cash settlement if the counterparty’s credit rating deteriorates. Payments may be made more frequently on riskier exposures (for example, monthly or quarterly rather than semiannually). Market participants pay close attention to the maturity of their exposures, in part because exchange-traded hedging instruments generally have short maturities. Exposures tend to be concentrated at short maturities (see Table 3.2), and long-dated (for example, 20-year) swaps sometimes have an optional or mandatory unwind after 5 or 10 years.

Collateral is a particularly important tool for managing counterparty risks in OTC derivatives markets. In 1999, some $175 billion to $200 billion in collateral covered credit exposures in derivatives and foreign exchange positions. Large institutions averaged over 1,000 collateral arrangements and collateralized just over half of OTC derivatives trades, while midsized institutions averaged about 140 agreements and collateralized about one-third of their OTC derivatives trades. Dealers indicated that 45 percent of collateral arrangements involved other banks and broker dealers; 20 percent involved hedge funds; another 20 percent involved corporations (usually end users); 8 percent involved central banks and supranational agencies; and the remaining 7 percent involved counterparties such as private individuals. In general, collateral is used much more intensively in some countries (particularly the United States) than others. Dealers’ willingness to take collateral depends in part on whether they can reuse it (for example, through repo) and in part on their operational capabilities to track collateral. Collateral is operationally demanding; an active dealer might mark-to-market 100,000 transactions every day.

Collateral positions are usually marked-to-market daily, though dealers do not always make daily collateral calls. Other terms that vary are the use of one-way versus two-way collateral (whether only one party, or both, potentially posts collateral) and rehypothecation (the reuse of collateral). ISDA credit support annexes (CSAs) are frequently used to spell out the terms of collateral arrangements, including the threshold for uncollateralized exposure and acceptable collateral instruments (normally cash and developed-country sovereign and agency debt, though some dealers accept equities and corporate debt). At present, three such CSAs are in use (corresponding to English, Japanese, and U.S. law). ISDA plans to consolidate these into a single core document that addresses the operational and economic aspects, with annexes that cover purely legal aspects.

### Operational Risks

The complexity of OTC derivatives contracts gives rise to operational risks, including the aforementioned clearing and settlement risks and a variety of others. Models of derivatives prices may be misspecified, may be miscoded in management information systems, or may break down unexpectedly; this is model risk. The relationship of the price of the derivative to the underlying security and to related hedging instruments can be quite complicated, and major dealers employ teams of highly skilled quantitative analysts to study and manage these relationships. Nonetheless, even sophisticated institutions and well-developed and liquid markets are subject to model risk. For example, the relationships among sterling interest-rate swaps, interest-rate options, and swaptions broke down in 1999, owing to structural developments that the models did not capture.

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40If the option still has some time to go before it expires, it will be worth a bit more than $200. Part of an option’s value derives from the fact that one can wait to exercise it.

41Greater sensitivity to credit risk at the longer end of the maturity spectrum may also be reflected in wider swap spreads for longer-dated swaps (Kolb (1996), pp. 146–47).


43In 1993, about half the end-users and all the dealers surveyed by the CFTC reported the use of collateral to manage credit exposures (United States, Commodity Futures Trading Commission, 1993b, p. 77).

44United States, General Accounting Office (1999), p. 42, notes that LTCM used rehypothecation to achieve high leverage.

45See, for example, Global Derivatives Study Group (1993).

46Dunbar (1999).
Sharp losses during periods of market turbulence have led to an increased focus on counterparty credit risk in OTC derivatives. This credit risk includes current and potential exposure. Potential future exposure (PFE) is the maximum, the average, or some percentile (for example, the 95th percentile) of the distribution of exposure that might be attained in the future. This distribution (based on simulated future paths for the price of the underlying asset) is known as an exposure profile.

The exposure profile and PFE depend importantly upon the key characteristics of the underlying cashflows, particularly their maturity. For example, exposure tends to rise with maturity because the potential drift in the price of the underlying security also increases with maturity (the diffusion effect). At the same time, the remaining maturity of the contract, and the number of future payments that might be at risk, decrease with the passage of time (the amortization effect). When the diffusion effect is stronger (typically in the early days of the contract’s life), the exposure profile rises with time; when the amortization effect is stronger, the exposure profile falls with time. For contracts where principal is exchanged, the exposure profile usually rises continuously until maturity; for others, such as interest rate swaps, the exposure profile is usually hump-shaped.

A simple example can illustrate the principle of exposure profiles and PFE. Consider a very simple interest rate swap where the holder pays a floating rate and receives a fixed rate of interest (12 percent) once a year on a notional principal of $100 million over 5 years. In practice, calculating the PFE on even this simple swap is complicated, because changes in both the level and shape of the yield curve can give rise to large changes in the value of the swap, and because the yield curve evolves over time in a complicated way. To simplify, suppose that (1) the yield curve is initially flat, and remains flat—short-term and long-term interest rates are always exactly the same; (2) interest rates follow a simple process: they start at 12 percent; thereafter, every year, interest rates either increase by one percentage point, decline by one percentage point, or remain unchanged. The valuation of the swap is then very simple; at each point in time, the floating-rate leg is priced at par, and the fixed-rate leg is priced as if it were a fixed-rate bond with a 12 percent coupon. At inception and expiration, the swap is worth zero, since the interest rates on the floating (paying) and fixed (receiving) legs are the same and the cashflows are identical.

The table shows the evolution of interest rates and the value of the swap. If interest rates fall, the value of the swap to the fixed-rate receiver rises (for the same reason that the price of a fixed-rate bond rises), creating credit exposure to the counterparty. If interest rates decline to 11 percent in the first year, for example, the value of the swap to the fixed-rate receiver rises to $3.1 million. If they decline further to 10 percent in the second year, the value of the swap rises further to about $5 million. The maximum exposure is at the lowest level of interest rates that can be attained; the diffusion effect means that interest rates can fall further in years that are farther from inception. As the figure shows, at three years, exposure peaks at about $5.3 million, at which point the amortization effect begins to dominate the diffusion effect. Measuring PFE by maximum exposure, the PFE for the five-year swap is $5.3 million. Comparing a ten-year swap gives a perspective on the importance of maturity (see the second panel of the table). Maximum exposure on the ten-year swap peaks at six years at almost $21 million, about four times the maximum exposure on the five-year swap.

Operational risks are difficult to quantify and manage using tools like the ones used for other risks. In practice, most operational risks are managed by limiting and reserving against exposures that seem vulnerable to operational risks, and by strengthening back-office systems and automating the trade-capture process. As noted above, operational risks associated with the early part of the trade-capture cycle are viewed as manageable by major market participants. As a result, much of the focus has turned to other operational risks that crop up later—particularly legal risks (see Box 3.6: Legal Risks in OTC Derivatives Markets).47

### Potential Exposure Paths for Two $100 Million Notional Fixed-for-Floating Interest Rate Swaps

#### Five-year swap:

<table>
<thead>
<tr>
<th>Interest Rate</th>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>17%</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>16%</td>
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<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>15%</td>
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<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>14%</td>
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<td>$1,754,386</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
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<tr>
<td>13%</td>
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<td>$1,069,852</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
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<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
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</tr>
<tr>
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<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>7%</td>
<td>($12,481,259)</td>
<td>$2,443,715</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Max.</td>
<td>$3,102,446</td>
<td>$2,443,715</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
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</tr>
</tbody>
</table>

#### Ten-year swap:

<table>
<thead>
<tr>
<th>Interest Rate</th>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
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<td>$0</td>
<td>$0</td>
<td>$0</td>
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</tr>
<tr>
<td>20%</td>
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<td>($6,666,667)</td>
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<td>$0</td>
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<tr>
<td>19%</td>
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<td>($10,825,507)</td>
<td>($5,882,353)</td>
<td>$0</td>
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<tr>
<td>18%</td>
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</tr>
<tr>
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<td>($11,047,925)</td>
<td>($7,926,072)</td>
<td>($4,273,504)</td>
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<td>$0</td>
<td>$0</td>
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<tr>
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</tr>
<tr>
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<td>($3,997,550)</td>
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<td>$0</td>
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<tr>
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<td>$7,581,574</td>
<td>$6,339,731</td>
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<td>$0</td>
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<tr>
<td>9%</td>
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<td>$7,593,884</td>
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<td>$2,732,294</td>
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<td>$0</td>
<td>$0</td>
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<td>$0</td>
</tr>
<tr>
<td>8%</td>
<td>$18,491,519</td>
<td>$16,970,840</td>
<td>$15,348,507</td>
<td>$13,208,888</td>
<td>$11,000,854</td>
<td>$8,793,017</td>
<td>$5,277,334</td>
<td>$2,732,294</td>
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</tr>
<tr>
<td>7%</td>
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<td>$18,936,056</td>
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<td>5%</td>
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<td>$15,348,507</td>
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</tr>
<tr>
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<td>$4,973,704</td>
<td>$3,471,074</td>
<td>$2,181,182</td>
<td>$0</td>
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</tr>
<tr>
<td>2%</td>
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<td>$0</td>
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<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Max.</td>
<td>$5,537,048</td>
<td>$10,669,852</td>
<td>$15,099,859</td>
<td>$18,491,519</td>
<td>$20,500,987</td>
<td>$20,790,634</td>
<td>$19,082,736</td>
<td>$15,088,757</td>
<td>$8,737,864</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
</tbody>
</table>

1. Both swaps have annual resets and payment dates and 12 percent (fixed-rate leg) coupons. For simplicity, analysis assumes a flat yield curve and that interest rates can either decline by 1 percent, increase by 1 percent, or stay the same every year. Parentheses indicate negative values.

The legal risks associated with the use of collateral have been the subject of much recent discussion. Collateral offers substantial protection for swap transactions that are subject to U.S. law since such collateral is specifically recognized in the Financial Institutions Reform Recovery and Enforcement Act of 1989; in addition, swaps counterparties are exempt from the automatic stay provision of the U.S. bankruptcy code. In other segments and jurisdictions, however, collateral can give rise to legal risks at the same time that it alleviates coun-

Box 3.6. Legal Risks in OTC Derivatives Markets

OTC derivatives are more lightly regulated than exchange-traded derivatives, so it is not surprising that OTC derivatives transactions have given rise to a number of legal disputes. A recent study found that 76 percent of derivatives cases filed in U.S. federal courts involved OTC derivatives. A number of high-profile cases have illustrated the legal risks in OTC derivatives markets:

Fiduciary Duty in Swap Agreements, and the Legal Environment for Swaps: Procter & Gamble vs. Bankers Trust (United States, 1996): This is often viewed as among the first decisions bearing on the OTC derivatives markets, though the judge who ruled made clear that his decision was meant to apply only to the specific arrangements at hand. Procter & Gamble (P&G) had entered a number of swaps with Bankers Trust (BT), including several highly leveraged swaps linked to interest rates and currencies. In the event, P&G lost some $150 million on the swaps, and claimed (among other things) that: (1) owing to its longstanding relationship with BT, BT owed it a fiduciary duty under those arrangements, and that BT had failed to perform this duty in the context of these swaps; (2) the agreements violated various provisions of, among other things, the Commodity Exchange Act (CEA) and Ohio law. The court ruled that the bilateral, principal-to-principal relationship between P&G and BT did not give rise to a fiduciary duty on BT’s part. It also ruled that the swap agreements were exempt from the CEA and that the choice of law provision in the swap agreements (which specified that New York law would govern the agreements) precluded claims under Ohio law.

Ultra Vires: Hazell vs. Hammersmith and Fulham LBC (United Kingdom, 1991). During 1987–89, the local authorities of the London borough of Hammersmith and Fulham entered about 600 swaps and swap derivatives transactions totalling some £6 billion in notional amounts, almost all speculative rather than hedging transactions. After the swaps and swap derivatives went out of the money (by some hundreds of millions of pounds), the authority’s auditor asked to have the transactions declared void, claiming that Hammersmith and Fulham did not have the authority to enter them (that is, that the swaps were ultra vires). The U.K. court agreed, notwithstanding some prior legal opinions obtained by some counterparties that local authorities did have the power to enter such transactions for risk-management purposes. The decision effectively voided numerous other transactions undertaken by U.K. local authorities, triggering a rash of litigation (however, the court noted that the rights of the authorities and their counterparties to recover payments would have to be determined on a case-by-case basis).

Contract Terms Governing Collateral: High Risk Opportunities vs. Société Générale SA and Crédit Lyonnais SA (ongoing). The High-Risk Opportunities Fund (HRO), run by the III Offshore Advisors hedge fund located in West Palm Beach, Florida, made leveraged investments in Russian GKOs and hedged its ruble risk with forwards entered with Société Générale (SG) and Crédit Lyonnais (CL). HRO claimed that, after Russia’s devaluation and default on GKOs, SG and CL refused to make margin payments on the forwards, intentionally forcing HRO into bankruptcy. Counsel for SG insisted that the crisis in Russia relieved them of their obligations. As of mid-2000, the case had not yet been concluded.

Definition of “Credit Event”: Deutsche Bank AG vs. ANZ Banking Group Ltd., (1999). A credit default swap between Deutsche Bank and ANZ provided that ANZ would buy City of Moscow bonds from Deutsche Bank if Deutsche Bank notified it that a “credit event” (a “failure to pay” by the City of Moscow) had occurred, based on publicly available information. Deutsche Bank sent ANZ a notice that the City of Moscow had made payments on a loan from Daiwa Bank one day late, providing as evidence an article from International Financing Review and noting that the terms of the loan from Daiwa included no grace period. ANZ alleged, among other things, that a credit event had not occurred, because the delay in payment was “technical” rather than “substantial,” and moreover claimed that Daiwa had arranged to have the article published in order to collect on payments under one of its own agreements. The court concluded that ANZ was bound to the letter of the agreement and found in favor of Deutsche Bank.

Valuation of Swaps Against a Defaulting Counterparty: Robinson Department Stores vs. Peregrine Fixed Income (2000). Robinson Department Stores Plc, a Thai corporation, owed money to Peregrine Fixed Income (PFI) on derivatives transactions it entered before Peregrine’s collapse during the Asian crisis. Robinson claimed that the amount it owed should have been reduced because its (Robinson’s) credit-worthiness has decreased; hence, the value of Peregrine’s claim on Robinson had decreased as well. At issue was whether language in ISDA documentation should be interpreted as specifying that the credit standing of the nondefaulting counterparty should be taken into account in valuing terminated swaps. PricewaterhouseCoopers, PFI’s liquidator, asked the U.K. court for an interpretation of ISDA documentation in this regard. Some legal experts considered that, if the court found that the amount Robinson owed PFI should be reduced, numerous other ISDA-documented swaps transactions could have been sharply revalued. In May 2000, the U.K. court sided with Peregrine’s liquidator; Robinson and other swap creditors will be required to pay in full.

terparty risk. For example, there are important questions about the enforceability of collateral arrangements in some jurisdictions.\(^5\) The legal environment for collateral is particularly murky in cross-border deals. The geographic diversity of counterparties, collateral instruments, and custodial entities gives rise to significant uncertainty about which country’s law governs collateral arrangements.\(^5\) At least three sets of law are relevant: the law of the jurisdiction governing the collateral arrangement; the law of the jurisdiction where the collateral is located; and the law of the jurisdiction where the counterparty is located. In addition, procedural slippages such as failing to perfect security interest in overseas collateral are commonplace, leading one legal counsel to suggest that “security of collateral is not widely respected in international finance.” Awareness of these issues is improving, and market leaders are making strong efforts to manage the associated risks and ensure that procedures are followed.

Market participants have taken a number of steps to address these operational risks. Considerable effort has been devoted to formalizing and standardizing (or commoditizing) the framework for OTC derivatives transactions, so that traders and back-office personnel correctly document the terms of each trade and both counterparties understand their rights and obligations. The master agreement is a key element of this framework. Various national organizations and business groups, such as the British Bankers Association and ISDA, have promulgated master agreements that are either used verbatim or modified.\(^5\) The most widely used master agreements are the two main ISDA agreements promulgated in 1992: one for transactions in local currency within a single jurisdiction and another for cross-border transactions in multiple currencies.\(^5\) The latter spells out (1) each party’s obligations, including making payments as specified in confirmation agreements; (2) representations of each party, for example, that it has the power to execute the agreement; (3) agreements that each party will, among other things, supply relevant information to the other and comply with applicable laws; (4) the definition of default or early termination (for example, if changes in law make the agreement illegal, or if relevant taxes change); (5) the right to terminate in case of a termination event; (6) terms for transfer of the agreement to other parties; (7) the currency used for payments; and (8) miscellaneous other provisions, such as the law governing the transaction (commonly English or New York law).\(^5\) Once a master agreement has been put in place between two parties, they may enter OTC derivatives transactions in the context of that agreement (transactions are treated as supplements to the master agreement).

Closeout netting—the settlement of net outstanding obligations by a single payment in the event of default—is a key part of the master agreement, as it limits the risk that the counterparty or trustee will “cherry pick” its obligations. The closeout process can itself be the source of difficulties in stressed markets, however. Under standard agreements, closeout valuations require 4 or 5 market quotes for each contract, and a major derivatives desk may have thousands of contracts with a large counterparty.\(^5\) In addition, the default of Peregrine Fixed Income underlined important unresolved questions about whether counterparty credit risk should be reflected in closeout valuation of swaps.\(^5\) The present industry consensus is that the standard “first” and “second” valuation methods—market quotation and the loss method—do not work well under stress, and that alternatives (such as taking fewer quotes from a wider universe of participants, and lengthening the period of time for obtaining closeout valuations) should be considered.

Legal risks are often reflected in risk management practices. For example, there may be limits on exposures to countries where legal risks are pronounced. If there are concerns that netting may not be enforceable in a particular jurisdiction, or that enforcement may be time-consuming, exposures may be calcu-

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\(^6\)In the EU, the implementation of the Settlement Finality Directive may clarify these issues ("Collateral Calculations," pp. 44-47).

\(^7\)A recent "master master" cross-product netting agreement permits the netting of counterparty exposures across existing master agreements including for swaps, options, foreign exchange, and repos (see Cass, 2000, p. 17).

\(^8\)German and French counterparties often prefer master agreements written by domestic banking associations to those written by ISDA. The use of different documents for different positions can give rise to "documentation basis risk"; for example, ISDA and Bond Market Association documents might imply different valuations for the same underlying asset (Counterparty Risk Management Policy Group, 1999, p. 42).

\(^9\)Default is distinct from termination. Default indicates a credit problem and entitles the nondefaulting counterparty to terminate all swaps under a master agreement. Termination indicates an event other than a credit problem (say, a change in relevant law) and terminates only those swaps that are directly affected (Marshall and Kapner, 1993, pp. 198-99).

\(^10\)Once these valuations are obtained, the process for making a claim against the counterparty in court is the same as for any other senior claim.

\(^11\)For a description of Peregrine’s demise see International Monetary Fund (1998a), Box 2.10, p. 45.
lated on a gross basis. Dealers may also require counterparties to own assets or post collateral in the dealer's home country; for example, U.S. dealers may require counterparties to have U.S. treasury collateral in the United States.

The risks and market practices described in this part of the paper are importantly influenced by the supervisory and regulatory environment that impinges on OTC derivatives markets. The next section describes that environment.