

A Primer on  
Risk Management:

Applications to Latin America  
and the Caribbean

Jesse Wright

**Technical Study**

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Jesse Wright is a financial sector specialist in the Finance and Basic Infrastructure Division 2 of the Inter-American Development Bank. The opinions expressed herein are those of the author and should not be construed as the Inter-American Development's Bank endorsement or rejection of any of the conclusions reached. The purpose of this paper is to inform readers and elicit comments and suggestions.

## EXECUTIVE SUMMARY

Risk management is a work in progress. In just the last decade, the field has evolved from simple notions of risk to sophisticated mathematical and statistical models to measure risk. The “derivatives debacles” of the recent past increased the urgency of finding ways to control risk and had the salutary effect of making regulators and bank and corporate managers recognize their responsibilities to control these activities. Risk management units within banks and corporations use elaborate Value-at-Risk models, but only as a *guide* to management judgment and common sense. Many lessons have been learned in the last few years, and the field continues to evolve rapidly. This paper seeks to give the nonspecialist a sense of why risk management is so important in modern finance, how the area has evolved and what important obstacles have still to be overcome.

**Regulation of Derivatives:** In December 1995, the Basle Committee proposed to amend the 1988 Basle Capital Accord to include the measurement of market risk with the already required measurement of credit risk. Capital provisioning against market risks will be required when the amendments take effect, which is scheduled to be January 1, 1998. Over the last few years, the Basle Committee has increasingly moved away from imposition of its “standard regulatory model” in favor of allowing banks to use their proprietary internal models to measure market and credit risks. The Bank for International Settlements (BIS) recently found that “... growing public recognition of the benefits offered by derivatives markets and more prudent use of derivatives products reduced pressures during 1995 for restrictive regulatory action” (BIS, 1996). Regulators and industry participants are now concentrating on improving internal risk management, disclosure and the legal and institutional infrastructure of derivatives markets.

**Legal Issues:** A precondition to successful emerging derivatives markets is an adequate legal foundation for the derivatives industry. Some Latin American and Caribbean countries have gaming statutes that could be interpreted as prohibiting derivative transactions. In addition, the enforceability of counterparty risk reduction techniques such as industry “master agreements” and netting is unclear in the law of some jurisdictions. The legal competency or power of a counterparty to enter into a derivatives transaction has been questioned in some major market jurisdictions and likely will also be an issue in emerging derivatives markets.

**Disclosure Policy:** Recent surveys conducted by the Basle Committee have found an improving but still inadequate level of disclosure on the part of market professionals and corporate end-users in their financial statements, reports to investors and other published documents. Regulators argue that public disclosure, and the discipline of the marketplace, are valuable adjuncts to official supervision and that more disclosure should be encouraged. Private market participants have pointed to the difficulty in accurately portraying the risks of a derivatives position given current and proposed

accounting rules and the rising regulatory burden that increasing disclosure is bringing. This issue has only recently been joined and is far from being resolved.

**Counterparty Relationships:** The nature of the relationship between the parties to over-the-counter (OTC) derivatives has been the subject of controversy and one that has led to a number of lawsuits alleging abusive sales practices on the part of some derivatives professionals. In the United States, various trade organizations of professionals in the securities and derivatives markets have published voluntary principles and practices for regular participants in the wholesale financial markets that deal, among other things, with this relationship issue. Their presumption is that wholesale market transactions between regular participants—whether professionals or end-users—are entered into at “arm’s length” and that each party has a responsibility to inform itself of the nature and degree of risk involved. A recent Federal District Court ruling seems to have upheld this view in the facts involved in the case. The same presumption seems to apply in the wholesale financial markets in London and is embodied in the Bank of England’s London Code of Conduct for those markets. The “arms-length” concept seems also to have been endorsed in a recent English court decision involving OTC derivatives. Nonetheless, market professionals and regulators seem to agree that in some circumstances (such as those involving leverage or other very complex transactions) the professional should supply the end-user counterparty with pricing and other information. Some market professionals are now providing generic risk disclosure statements to their derivatives customers.

**Risk Measurement and Capital Adequacy:** Risk measurement started out with simple notions of equating market risk with notional value and has evolved rapidly to today’s highly sophisticated Value-at-Risk models that measure risk at the portfolio level for hundreds of positions. Since VaR provides, at best, a short-term snapshot of risk, these models also employ scenario analysis and “stress testing” to provide an indication of the portfolio’s value in extreme cases. These models are useful for giving management an indication of the portfolio’s exposure to certain market “events,” but the decision of how much capital is adequate to protect against losses still involves a considerable amount of judgment and common sense.

**Implications for Latin America and the Caribbean:** There are already several securities exchanges in the region that trade derivative contracts, and over-the-counter derivatives markets are emerging domestically. Commercial banks and corporations in the region are also increasing users of offshore derivative markets, and many cross-market links have already been established with exchanges outside the region. Latin American banking supervisors are gearing up to meet the new Basle standards and commercial banks and corporate end-users are also beginning to implement internal risk management programs. However, risk management techniques are not yet familiar tools throughout the region, and some of the legal, supervisory and institutional infrastructure does not exist in the region to permit the safe development of the derivatives markets. The Inter-American Development Bank has an opportunity to provide technical assistance to banking supervisors and the private sector in the region to help them avoid many of the mistakes seen recently in developed money centers and to begin with best practices.

## INTRODUCTION

Businesses exist to take risks. Capital is put at risk in order to earn a return on the firm's manufacturing, service, merchandising or research and development strategies. These may be thought of as the "core risks" that every business is organized to take. The act of going into business signals an intention to accept these business risks and to manage them successfully. However, there are other business risks, usually outside of the control of the firm, that may not be intrinsic or core to the operation of the business. These include the risks of changes in interest rates, currency parities, input prices and output prices as they affect the cash flows and values of the assets and liabilities of the firm. It is management's responsibility to decide what constitutes the firm's core business risks, and thus will be accepted and managed, and what constitutes non-core risk that is outside the competency or purpose of the firm to manage for which they will require some form of hedge or insurance.

Although basic hedging techniques have been used for hundreds of years, risk management, as a specialized activity, is a comparatively new field having begun in the late 1970s and early 1980s. "Risk management is the process of moving clients closer to their desired risk profiles by helping them to shed unwanted risk or acquire new risks that suit their portfolios. At times, this can be done simply by matching a client who wants to shed risk with one who wants to acquire that risk. More often, it involves unbundling, transforming and repackaging risks into bundles tailored to fit the particular needs of various clients" (Sanford, 1993). Markets now routinely enable an airline to remove its exposure to fuel prices, an exporter to eliminate exposure to a foreign currency or a pension plan to temporarily reduce its exposure to stock prices or interest rates. Derivatives are the

instruments through which this is accomplished. As the Group of Thirty has observed (G-30, July 1993), the introduction of these instruments has not resulted in risks not already present in financial markets. The *overall* level of risk in the economy has not increased, but rather is being distributed or transferred from one party to another. Perhaps, in a sense, derivatives can be thought of as reducing the *overall* level of risk in financial markets because, even though they do not make risks disappear, derivatives reallocate risks to the parties with the greatest capacity or appetite to bear them.

Because of this, derivatives have become indispensable to modern financial markets, and their economic benefits are by now widely recognized. "Derivatives markets are an integral part of the financial system in the world's leading economies. They play an increasingly important role in "...risk management, ...price discovery and ...transactional efficiency..." (Jorion and Da Silva, 1995). Firms should use "natural hedges" (see glossary) whenever possible without resorting to the use of derivatives, but this usually requires a long lead time to alter the firm's cash flows in its income statement or alter the assets and liabilities in its balance sheet. The transactional efficiency of derivatives to reduce currency or interest rate risks is unmatched in terms of speed of execution and cost. Furthermore, derivatives allow new information to be incorporated swiftly in markets, enhancing their price discovery function.

Bank involvement with derivative activities—both for risk management and as a line of business—is considerable, and supervisory authorities are paying heightened attention to

the risks that derivatives activities represent for the banks that engage in them. The Basle standards measuring market risk along with credit risk in assessing capital adequacy, are only one manifestation of this supervisory trend. This primer provides an overview of the changing nature of finance and how this evolution has caused bank supervisors to change the way they oversee their banking and

securities markets. The paper discusses the components of risk management in terms of legal, operational, credit and market risks, and identifies best practices in risk management. Finally, it suggests areas in which the Inter-American Development Bank may assist official regulators and the private sector to create the legal and institutional infrastructure for these markets and to instill best practices.

## THE CHANGING NATURE OF BANKING

Advances in financial theory and in computer and telecommunications technologies have combined to change the very nature of banking and finance. Financial institutions now sell information *about* money nearly as much as they sell money. Much of this information is produced in secondary trading markets and in derivative markets where valuable insights are gained about the expected direction and volatility of asset prices. Increasingly, banks must participate in these markets to keep themselves and their clients informed.

Commercial banks in the United States had been losing market share as "...the share of credit assets intermediated by commercial banks has fallen from about 60 percent at the end of World War II to slightly over 20

percent today" (Goldstein and Folkerts-Landau, 1994). And, "... [M]utual funds have expanded their share of U.S. financial assets. The ratio of fund assets (excluding money market funds) to savings and small time deposits in banks grew from 21 percent in 1986 to 65 percent at the end of 1993" (Goldstein and Folkerts-Landau, 1994). Banks have reacted to these changing circumstances and are participating increasingly in equity and other securities-linked derivatives. They are also issuing hybrid deposit and other debt instruments with embedded derivatives linked to equity and securities-indexed returns as they strive to expand their role among consumers with a preference for equity and bond funds as investment vehicles.

TABLE 1

Markets for Selected Financial Derivative Instruments						
Instruments	Notional amounts outstanding					
	1990	1991	1992	1993	1994	1995
	in billions of US dollars					
Exchange-traded instruments	2,290.4	3,519.3	4,634.4	7,771.1	8,862.5	9,185.3
Interest rate futures	1,454.5	2,156.7	2,913.0	4,958.7	5,777.6	5,863.4
Interest rate options <sup>1</sup>	599.5	1,072.6	1,385.4	2,362.4	2,623.6	2,741.7
Currency futures	17.0	18.3	26.5	34.7	40.1	37.9
Currency options <sup>1</sup>	56.5	62.9	71.1	75.6	55.6	43.2
Stock market index futures	69.1	76.0	79.8	110.0	127.3	172.2
Stock market index options <sup>1</sup>	93.7	132.8	158.6	229.7	238.3	326.9
Over-the-counter instruments <sup>2</sup>	3,450.3	4,449.4	5,345.7	8,474.6	11,303.2	17,990.0
Interest rate swaps	2,311.5	3,065.1	3,850.8	6,177.3	8,815.6	--
Currency swaps <sup>3</sup>	577.5	807.2	860.4	899.6	914.8	--
Other swap-related derivatives <sup>4 1</sup>	561.3	577.2	634.5	1,397.6	1,572.8	--
Calls and puts.						

<sup>1</sup> Calls and puts. <sup>2</sup> Data collected by the International Swaps and Derivatives Association (ISDA) only; the two sides of contracts between ISDA members are reported once only. <sup>3</sup> Adjusted for reporting of both currencies; including cross-currency interest rate swaps. <sup>4</sup> Caps, collars, floors and swaptions.

**Source:** Futures Industry Association, various futures and options exchanges, ISDA and BIS calculations. BIS, 66th Annual Report, Basle, 10th June 1996.

These developments have significantly altered the source of bank earnings. Twenty years ago, the majority of the earnings of the world's largest banks, stemmed from credit or loan activities carried on the books of the bank. Today, for the largest banks, earnings from trading and off-balance sheet derivatives activities have replaced traditional credit activity as the most important source of earnings. As seen in Table 1, the notional value of exchange-traded derivatives outstanding reached \$9 *trillion* and that of over-the-counter derivatives reached nearly \$18 *trillion*.<sup>1</sup> This trend will likely spread to middle tier banks in developed banking markets and eventually to the banking systems of emerging markets. As indicated in Table 1, swaps are already the dominant instrument in OTC markets. A summary description of these markets and how value-at-risk models must price and value these instruments is presented in table 1.

## **The Swap**

Swaps can help a bank or business achieve its financing or risk management objectives. Swaps provide firms with an ability to obtain financing in currencies they would not normally have access to or effectively fix their costs of servicing floating rate debt and of purchasing the commodities they use in their businesses. Swaps are also increasingly being used for risk management purposes to hedge cash assets by swapping into the opposite exposure in the derivatives market. An interest rate swap, for example, could be used by an investor with a floating-rate note to "lock-in" a fixed return, by agreeing to pay the

floating-rate coupon on the investment for fixed-rate swap payments from the counterparty, or it could be used by a bond investor to exchange the fixed coupon stream for floating-rate swap payments, if the investor expected rates to rise. In either case, the conventional swap would not involve an exchange of principal.

The swaps market started becoming important in the early 1980s when banks and corporate treasurers noticed that "quality spreads" exist in the ability of borrowers to access different currencies or borrow at fixed interest rates. These quality spreads are thought to exist for a number of reasons, such as information asymmetries and agency costs, supply and demand factors for an issuer's debt, supply and demand factors for fixed or floating rate debt, market segmentation and tax or regulatory factors (see Alworth, 1993, Das, 1991 and Smithson, Smith and Wilford, 1995). Two parties to a swap can exploit their quality differentials and exchange the proceeds with each other reducing both of their borrowing costs through the swap transaction.

Suppose that Company A has mostly fixed rate debt outstanding and desires to swap some of this into floating rate debt while Company B has mostly floating rate debt and would like to swap some of it into fixed rate debt. Bank XYZ can act as a swap provider to companies A and B, assuming the counterparty credit risk that each of them may default. Bank XYZ will earn a spread between the fixed rate it receives and the fixed rate it pays as compensation for assuming these credit risks and for providing the service. Swap spreads are highly competitive and their size depends on the demand in the swap market to pay or receive fixed rates and to some extent on the credit

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<sup>1</sup> See section on notional value versus replacement value and the dangers of using notional value as a proxy of risk.

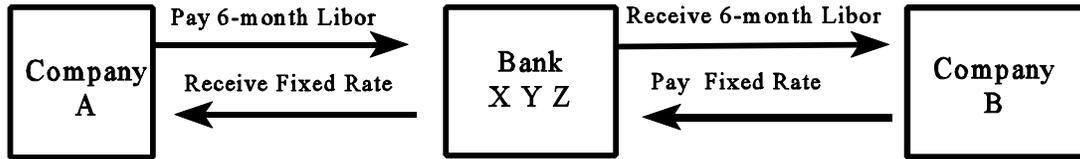
rating of the counterparties. (Generally, only rated companies and banks can participate in this market without having to provide collateral. The cost of supplying collateral must, of course, figure in calculating the cost of the swap to Company A and B).

### Pricing an Interest Rate Swap

The swaps market observes several conventions for pricing an interest rate swap. The first is that the price of a “generic” swap

and ask is the provider’s spread or fee to compensate for credit risk and services.

The basic valuation procedure is to treat a swap as a series of fixed and floating cash flows and to “...value the relative attractiveness of a swap’s floating index by bidding the accompanying fixed rate up or down” (Das, 1991). As an example, a simple two-period swap would be arranged in the following manner. Company A will pay a semiannual cash flow based on a floating 6-



is expressed in the fixed rates quoted. In a U.S. dollar interest rate swap, the fixed rate is quoted first and is based on a U.S. Government security with the same maturity as the swap. In short-term swaps, the fixed rate may be based on Eurodollar futures prices. The floating rate side of the swap is quoted in a floating rate index like the 6-month Libor and is quoted “flat,” that is without an add-on for credit quality. Once the generic swap price is determined, a tailored swap price can account for differences in credit quality, payment frequency, etc. For example, a two-year fixed for floating interest rate swap would be quoted “60-65 for two-year U.S. dollars” meaning that this provider is willing to pay 60 basis points over two-year Treasury notes to receive Libor flat. The offer is to receive 65 basis points over two-year Treasury notes and pay Libor flat. The difference between the bid

month Libor rate for one year with a notional amount of \$10 million. Assume that the *spot* 6-month Libor rate today is 5.75% and the 6 month *forward* 6-month rate is 6.25%. Company A, in the jargon of the industry, will “pay floating” and is therefore “short” the swap. Company B agrees to pay the cash flow at a fixed rate for one year on the same notional amount of \$10 million. The value of the swap, at origination, is set at zero by determining the fixed interest rate (6.15%) that Company B will pay, without requiring any additional fee, in exchange for its agreement to receive a known first period payment at a floating rate of 5.75% for the first six months, and an unknown payment for the second six-month period of the swap, at a time when the forward rate reflects market prospects that the second rate will be 6.25%, that expectations could prove wrong, and the floating Libor rate

for the second period will not actually be set until shortly before the beginning of the second period. (For calculations, see Annex 1.)

If interest rates all along the relevant portion of the yield curve rose 50 basis points after the

swap was entered into, but before the second reset date, Bank XYZ would mark-to-market the new value of the swap. Company A, the floating payer, would have to pay 6.75% in the second half of the swap's term while Company B would only be required to continue its fixed rate payments of 6.15%. Company B now has an "in-the-money" swap with a present value profit of \$21,921 (see Annex 1), which is also the loss to Company A. If Company A decided to terminate or reverse the swap, it would realize this loss. The new value of the swap is also called its *replacement value*.

## THE CHANGING NATURE OF BANK SUPERVISION

Bank supervisors and financial industry participants have made great strides in recent years in understanding and controlling the risks from burgeoning derivatives activity. Over the past few years, a number of proposals, from public and private sources, have surfaced to deal with credit, market, legal, and operational risks, systems for internal management control, analytic or computational risk models, and disclosure issues. The Basle Committee on Banking Supervision has issued several reports to help national bank supervisors formulate oversight programs, and many jurisdictions around the world are presently in the process of meeting the latest regulatory proposals. More recently, the Basle Committee has cooperated with the International Organization of Securities Commissions (IOSCO) to link bank and nonbank standards. The European Community has also joined the discussion with its Capital Adequacy Directive (CAD) and national authorities in the United States (the Federal Reserve Board, and the U.S. Securities and Exchange Commission, among others) and the United Kingdom (Bank of England) have also put forth proposals.

Private industry groups such as the International Swaps and Derivatives Association, the Derivatives Policy Group, the Group of Thirty, the Institute of International Finance and the Financial Standards Accounting Board have also made significant contributions to the policy dialogue. The objective of all groups, public and private, is to strike a delicate balance between encouragement and control and to limit the regulatory burden. National regulators rightly worry that excessive or prohibitive regulation of these markets would cause domestic derivatives activity to migrate offshore which

would be counterproductive to protecting the domestic financial system because risks would remain within domestic bank portfolios but could be managed only through access to off-shore derivatives markets, probably at a higher cost. It is beyond the scope of this paper to treat exhaustively all of the issues put forward in the various proposals, but below is a brief review of the salient features of the various recommendations of public and private groups over the last decade.

### **Basle Committee Reports: A Chronicle**

The Basle Committee on Banking Supervision is comprised of banking supervisors from the Group of Ten countries, which actually consists of twelve large industrial countries. The Basle Committee first began to think systemically about derivatives activity in 1984 when it surveyed regulatory authorities in money center countries on the comprehensiveness of off-balance sheet exposure reporting and their computation of capital adequacy rules. The Committee found reporting very uneven or nonexistent. As a result of this work, the Committee, in the next two years, published a series of reports (Basle Committee, 1985) discussing the extent and nature of off-balance sheet exposures and the risks these posed to capital adequacy regimes then in effect.

In July 1988, the Basle Committee approved the "International Convergence of Capital Measurement and Capital Standards," the so-called "Basle Capital Accord." The Capital Accord represented a major evolutionary step in risk supervision and it has since been adopted by most banking authorities around the world. The Capital Accord addresses

principally minimum capital standards for *credit risks* of on- and off-balance sheet credit activities. Its innovation was to use credit conversion factors to convert off-balance sheet contingent liabilities into credit equivalent risk. Off-balance sheet derivatives exposure was treated differently. To measure the credit risk of derivatives, the Capital Accord permits a choice of either the “original exposure” or “current exposure” methods.

The original exposure method expresses risk as a fraction of the “notional value” (see Box 3) of a contract, depending upon the type of derivative contract and its maturity. Due to the inaccuracy of this method, conservative credit conversion factors are used. The second, and more common method, for measuring the credit risks of derivatives is the current exposure method where risk is calculated by marking the position to market and adding an “add-on” factor to reflect future or potential risk in the remaining life of the contract. The add-ons are based on notional principal and depend on the type of derivative contract (foreign exchange or interest rate) and the maturity of the contract.

#### **Notional Value versus Replacement Value**

A few years ago, at the height of the scandals over significant losses associated with derivatives, the financial press frequently ranked banks by the ratio of the notional value of their derivatives portfolio to the bank’s capital. This approach implies that somehow a bank will be responsible for exchanging the entire principal value of its derivatives portfolio. Since the notional or principal value of a swap or similar derivative is the amount on which the exchange of cash flows will be based, this is a large number and gives a misleading impression of the extent of risk in a swap. For example, in the one-year interest rate swap as described above, Company A agreed to pay a floating rate on \$10 million to Bank XYZ, and Company B agreed to pay a fixed rate on \$10 million; the face amount of \$10 million is the *notional amount* of the swap. The notional amount of a swap is not principal to be repaid as in a loan or bond. (An exception is in a currency swap where the partners exchange notional amounts in different currencies at maturity. There is always the settlement risk of having made a payment in one currency and not having received payment in the other currency of the swap.)

The *replacement value* of a swap, which is a better measure of its risk, as we saw above in connection with the hypothetical rate swap was the \$21,921 amount of loss Company A would realize if it wished to terminate the swap agreement. This loss is just .02% of the notional amount of \$10 million, although this example is artificially low because of the simple two-period model used. In longer maturity swaps, duration increases (the sensitivity of the swap price to changes in interest rates) and gains and losses become more important. As indicated in Table 2, the replacement value of swaps varies by derivative product, with a high of 18% for currency swaps (reflecting the final exchange at maturity and because historically higher volatility has been experienced in currency rates), but the overall replacement value for outstanding OTC derivatives was 4% at the end of last year (\$1.8 trillion based on \$40.6 trillion of notional value). Even this value is overstated because it is a *gross* replacement value and does not take netting or collateral arrangements into account. Finally, Tables 1 and 2 point to another disadvantage in using notional value as a measure of derivatives risk because of the widely varying estimates given for OTC derivatives activity. Industry estimates put the level of OTC derivatives activity at about \$18 trillion at the end of 1995, while a survey of central banks put the same activity level at \$40.6 trillion, or more than double. A reconciliation process is underway (see BIS, 1996).

**TABLE 2**

<b>The Over-the-Counter Derivatives Market at end-March 1995<sup>1</sup></b>					
Market risk category and instrument type	Notional amounts outstanding		Gross market values		Gross market values as a percentage of notional amounts outstanding
	in billions of US dollars	per-cent-age share <sup>2</sup>	in billions of US dollars	per-cent-age share <sup>2</sup>	
Foreign exchange	13,095	100	1,048	100	8
Forwards and foreign exchange swaps <sup>3</sup>	8,699	72	622	71	7
Currency swaps <sup>4</sup>	1,957	11	346	22	18
Options <sup>5</sup>	2,379	17	71	7	3
Other products	61	0	10	0	16
Interest rates	26,645	100	647	100	2
Forward rate agreements	4,597	17	18	3	0
Swaps	18,283	69	562	87	3
Options	3,548	13	60	9	2
Other products	216	1	7	1	3
Equity and stock indices	579	100	50	100	9
Forward and swaps	52	9	7	14	13
Options	527	91	43	86	8
Commodities	318	100	28	100	9
Forward and swaps	208	66	21	78	10
Options	109	34	6	22	6
<b>Total</b>	<b>40,637</b>		<b>1,773</b>		<b>4</b>

<sup>1</sup> Adjusted for local and cross-border double-counting. <sup>2</sup> To put the shares accounted for by different foreign exchange instruments on a comparable basis, percentages have been calculated on data that exclude figures for currency swaps and options reported by dealers in the United Kingdom. <sup>3</sup> Data are incomplete because they do not include outstanding forward and foreign exchange swap positions of market participants in the United Kingdom. <sup>4</sup> Notional amounts excluding data from reporting dealers in the United Kingdom amounted to \$1,307 billion. <sup>5</sup> Notional amounts excluding data from reporting dealers in the United Kingdom amounted to \$1,995 billion.  
**SOURCE:** BIS, 66th Annual Report, Basle, 10th June 1996.

As financial institutions have learned more about credit and market risks arising from a derivatives portfolio, the market has begun to differentiate between banks' ability to manage these risks. Although the size of the derivatives portfolio is not unimportant, a number of other questions also need to be asked: Is the purpose of the portfolio hedging or speculation? What is the credit quality of

the counterparties in a bank's portfolio? Are the OTC swaps "plain vanilla" or exotic and complex instruments that are difficult to trade out of? And how careful are the bank's internal controls? Dealers or end-users that allowed their portfolios to become unbalanced in any of these areas or permitted a lapse of management control have seen their share prices punished by the market.

The Capital Accord also recognized that exchange-traded derivatives, which are marked-to-market daily and subject to margin deliveries, are virtually free of credit risk and therefore exempt from additional capital requirements. The Capital Accord also recognized the superior credit quality of private participants in the over-the-counter derivatives market and caps their risk weights at 50% of exposure. Finally, the Capital Accord has recognized the risk reduction benefits of netting in derivatives portfolios. Originally only “bilateral netting by novation” was recognized for Basle Accord capital adequacy purposes. This is a narrow method of netting generally used only in currency forward and spot transactions.

Because of the legal uncertainty then surrounding “closeout netting” (discussed further below), the Basle Committee did not recognize closeout netting benefits in the calculation of a bank’s regulatory capital. In November 1990, the Basle Committee commissioned the “Lamfalussy” report on “Interbank Netting Schemes” which urged the Committee to widen its recognition of netting under the 1988 Capital Accord as a means to reduce cost and increase the safety of interbank settlements. The 1988 Capital Accord was subsequently revised, in July 1994, to permit bilateral netting in jurisdictions where the national authorities believe bilateral netting and closeout netting are legal (Matthews, Fall 1995).

In October 1992, the Basle Committee issued a report entitled “Recent Developments in International Interbank Relations,” known as the “Promisel Report,” which raised concerns over commercial banks’ internal control of their derivatives activities and the state of regulatory surveillance of derivatives transactions. The Basle Committee concluded

that capital requirements alone are not sufficient to control risks, but that commercial banks also need sound internal risk management systems. The Committee defined these risk management principles, by seeking comment from supervisors and industry participants, and in July 1994 issued its recommendations in a document entitled “Risk Management Guidelines for Derivatives.” These guidelines describe the main elements of what constitutes appropriate oversight by boards of directors and senior management; an adequate risk management system in terms of prudential limits, risk measurement and information systems; and a set of comprehensive controls and audit procedures.

Beginning in April 1993 and continuing for the next two years, the Basle Committee issued a series of proposals to amend the 1988 Capital Accord to create a capital adequacy framework for dealing with the *market risk* posed by bank trading and derivatives activities. The inadequacies of the 1988 Accord were becoming increasingly apparent as trading and derivative products were overtaking traditional credit activities and market risk was assuming an increasing importance. In its April 1993 “Market Risk Proposal,” the Basle Committee dealt with netting, market risk models, interest rate risks and assessing capital adequacy on the basis of measured market risk (discussed below). To assess market or price risk, the proposal offers a choice between a “standard regulatory model,” use of the banks’ own “internal model,” or both methods.

Basle divides market risk into “specific” and “general” components. Specific risks are price changes that could occur due to a change in the creditworthiness of the issuer of a security or counterparty in a derivatives contract. General risks are factors that are unrelated to

a particular security but affect all securities in the market. For example, interest rate changes in debt markets and stock index moves in equity markets are general risks. The standard model converts derivative positions into notional value and assigns risk factors according to the type of instrument involved (i.e. foreign exchange, equity or interest rate product), the maturity of the derivatives contract and the credit rating of the counterparty in OTC transactions. The two types of risks are summed and converted into a notional amount to which a flat 8% capital charge is applied; an additional capital charge is assessed on debt and equity securities not netted; and a special additional charge is made for foreign exchange exposure (Basle, 1993). This approach has been criticized by industry participants as akin to applying an across-the-board tax to the notional value of derivatives activity without regard to the underlying risk. The simplicity of the method is defeated by its arbitrariness (Derivatives Policy Group, 1995).

The second approach considered by the Committee was to allow commercial banks, *under strict guidelines*, to use their proprietary internal models as an alternative to the standard regulatory model. The strict guidelines, however, have been criticized by derivatives professionals as too narrow. Thirty-five commercial and investment banks formed a working group headed by the Institute of International Finance which in July 1995, issued a "Response to the Planned Supplement to the Capital Accord to Incorporate Market Risks." The working group is in basic agreement with Basle's objectives and framework, but suggested the following recommendations for improving the Basle proposal.

The first recommendation of the working group, which is called "model integrity," argues that by requiring proprietary models to use specific parameters, Basle weakens the models' distinctive characteristics and therefore their ability to predict accurately. Secondly, Value-at-Risk models predict short-term risk under carefully specified parameters to yield an estimate of portfolio risk. These are imperfect estimates, and management must use its judgment in determining how much capital is adequate to cover the bank's risk. Thirdly, Basle proposes to link the short-term VaR estimates of risk to required regulatory capital by multiplying VaR estimates by a "capital adjustment factor" or "multiplier" of three. In addition, they would apply a "plus factor" to cover any risk unique to specific banks. The working group argues that this produces an overly conservative estimate of risk and requires an excessive regulatory capital charge. Fourthly, Basle's standard regulatory model permits the use of correlations only within asset classes, but not between asset classes, because of the volatility of correlations in time of market stress. The working group argues that this penalizes banks that have diversified portfolios across asset classes and that this kind of diversification should be taken into account to reduce capital charges. Moreover, Basle proposes that VaR models use a ten-day holding period to produce price changes sufficiently large to encompass "nonlinear" price changes. The working group argues that nonlinear price changes have more to do with liquidity considerations and the structure of the portfolio and recommends that banks be permitted more flexibility in setting their VaR holding period. Finally, because of the extensive testing of the model being undertaken within banks and regulatory agencies and the need to harmonize the significant number of national and international

regulatory proposals outstanding, the working group recommends that Basle delay implementation of its proposals until these issues are clarified.

The internal models approach is becoming increasingly popular among national bank supervisors, especially in the United States. The Office of the Comptroller of the Currency and the Federal Reserve Board encourage banks to develop and use internal models that are commensurate with the size and complexity of their derivatives businesses (OCC Banking Circular 277, October 1993 and Federal Reserve System Letter SR 93-69, December 1993). Basle, too, has recently demonstrated more flexibility in its acceptance of proprietary internal models and may, over the course of time, relax the qualifications on their use.

### **Supervision of Nonbanks**

Over the past decade, nearly all Basle Committee reports treated the derivatives supervisory problem within the context of credit risk in lending activities by deposit-taking institutions. Derivatives were not addressed as market instruments nor were nonbank derivative activities considered. An important change in the Committee's supervisory thinking about derivatives occurred in December 1994, when the Basle Committee released a report entitled "Prudential Supervision of Banks' Derivatives Activities." For the first time the risks associated with derivatives were dealt with exclusively and the Committee also began a dialogue with regulators of securities houses to coordinate international standards to preserve the competitive equilibrium between banks and nonbanks.

In May 1995, the Basle Committee continued its cooperation with securities firms' supervisors and released a report jointly with the International Organization of Securities Commissions that presented "... a framework for supervisors to assess the information about derivatives activities of banks and securities firms" (Basle and IOSCO, 1995). The report discusses minimum information standards in terms of comprehensiveness, timeliness and coverage across all legal entities and jurisdictions for banks and securities firms with *significant* derivatives activity.<sup>2</sup> The Basle Committee and IOSCO noted their awareness of the regulatory burden in providing this information and encouraged bank and security supervisors to draw on information that banks and securities firms already generate internally. They also noted that multiple jurisdictions were preparing reporting requirements and will seek to coordinate the information requests of banking and securities supervisors and their central banks.

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<sup>2</sup> As an aside, the Basle Committee recommends that banks or firms without a significant derivatives portfolio measure their risk simply through an "add-on" that calculates risk as a fraction [the credit conversion factor] of the notional value.

## PUBLIC DISCLOSURE

In November 1995, the Basle Committee and IOSCO issued another joint report that surveyed public disclosure by major derivatives dealers as published in their annual reports (Basle and ISOCO, 1995). Public disclosure, they argued, is eagerly sought by investors and depositors who impose a strong market discipline on banks and securities houses to manage their derivatives positions prudently. Private market scrutiny is a valuable supplement to supervisory efforts and should be encouraged. The report found, however, that there are significant gaps in the quantity and quality of information provided in annual reports and urged banks and securities firms to draw more information from their "...internal risk management and management systems and enable financial statement users to assess a firm's performance in managing material exposures to credit risk, market risk, [and] liquidity risk, as well as the impact of trading and derivatives activities on earnings" (Basle and ISOCO, November 1995).

The use of market discipline to encourage prudent derivatives policies through public disclosure of derivatives activities also surfaced in an interesting proposal by the U.S. Federal Reserve Board. Owing to the size and complexity of some derivatives transactions and the speed with which exposures change, the Board reasoned that only a dealer can know his/her own positions and risks at any time and regulators will always be at a disadvantage in terms of current information. Given this situation, it may be better for each derivatives dealer, using proprietary internal models, to publish estimates of derivatives losses over some period and let the market judge how carefully dealers control their

exposures. Alternatively, the supervisory authorities could impose on those dealers with losses outside some allowable limit. This approach has come to be known as the "Pre-Commitment Approach."

In the United States, industry participants recently indicated that some of the new information requirements are burdensome and perhaps counterproductive to their intended purpose. The Financial Accounting Standards Board (FASB), the Securities and Exchange Commission and the Commodity Futures Trading Commission recently issued proposals for derivatives accounting conventions and enhanced public disclosure that raised these concerns. The proposals raised issues about who "owns" private financial information, what controls over this information are allowable and how much information investors and regulators need, and at what cost. These issues illustrate the constant tug and pull between encouraging financial innovation and safeguarding the financial system.

The European Community began to revise its bank supervisory standards about the same time that the Basle Committee began to revise its 1988 Capital Accord. In March 1993 the EC published its Capital Adequacy Directive (CAD). The directive is similar to the Basle Capital Accord with the important exception that it does not allow banks to use their own internal models. Moreover, the CAD established a capital adequacy framework for nonbanks as well as banks. Finally, a number of national banking authorities have or are in the process of issuing derivatives and trading guidelines including, the Bank of England's

“London Code of Conduct,” the New York Federal Reserve’s “Principles and

Practices for Wholesale Financial Market Transactions,”<sup>3</sup> the Bank of Mexico and the Central Bank of Argentina (Gooch and Klein, 1996).

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<sup>3</sup> Although the New York Federal Reserve does not consider this an official document, but rather a derivatives industry document.

## THE COMPONENTS OF A COMPREHENSIVE RISK MANAGEMENT SYSTEM

Below we set out the major components of risk management that should be addressed by a country's bank and securities market regulators at the national level, and by bank and corporate boards of directors at the level of the bank and firm. These include components legal risk, operational risk, credit and market risks.

### Legal Risks

Several preconditions should exist in order to ensure the successful operation of exchange-traded or over-the-counter derivatives markets. Among these is the need for legal certainty of contracts and clear and enforceable rules for the valuation of positions. Derivatives are created when two parties enter into a contract either on an organized exchange or in the OTC markets. As a means of reducing counterparty credit and legal risks, the exchange's clearinghouse takes the other side of the trade, requires margin to be posted, and uses "multilateral netting" to reduce thousands of payments among many participants to a single payment per clearing member per trading session (see glossary). Organized exchanges in Latin America for decades have used these well-known risk reduction measures in counterparty risk.

However, attempts to reduce credit and legal risk in OTC markets are more recent and their enforceability in situations involving insolvency proceedings is less clear. For example, most of the world's OTC derivatives markets use the International Swaps and Derivatives Association's (ISDA) "Master Agreement" as "...a single contract used to

bring together separate swaps and derivatives transactions between two parties into a unified agreement [so that] ... payments under a swap to be made between two parties on a payment date will be netted" (Cunningham, 1996). This kind of netting is referred to as payment or settlement netting and can significantly reduce risk. More importantly, the ISDA Master Agreements provide for so-called termination or "close-out netting," pursuant to which, in the event of defaults, including insolvency, all transactions are terminated early if any is, and the settlement payment due to a party is calculated by reference to the net value of all transactions. This kind of bilateral netting could represent a significant reduction in counterparty risk in Latin America, but its enforceability, at least in the context of insolvency proceedings, is not yet clear and certainly not to the extent of legal clarity demanded by the Basle Committee to permit its use in regulatory capital calculations.

Indeed, in some jurisdictions in Latin America, netting after bankruptcy occurs is specifically barred. Radzimirski reports that with OTC swaps in Argentina "...the operation of netting requires that the obligations of both parties come due prior to the bankruptcy judgement otherwise, netting shall not be deemed to have taken place" (Radzimirski, 1996). Similarly in Mexico, he reports that no "set-offs" or closeout netting is permitted following bankruptcy, except in certain limited circumstances. By contrast, Radzimirski finds that under Brazilian law, agreements to provide for netting of outstanding obligations under insolvency are enforceable.

A separate but related concern is whether, once insolvency or similar proceedings have commenced, a receiver or similar official would be entitled to keep in place transactions that are favorable to the insolvent entity, requiring payments from the other party, while rejecting transactions that are unfavorable to the insolvent entity, leaving the other party with a claim that is unlikely to be recovered. Until the law was changed in 1989 and 1990, this sort of “cherry picking” was a risk in dealings with U.S. banks and corporate counterparties. If OTC derivatives markets are to grow and prosper in the region concerns over the risk in Latin America will have to be eliminated for regulatory recognition of the benefits of close out netting for capital adequacy purposes,

In many jurisdictions “contracts for differences” or “aleatory contracts” whose outcome depends upon an uncertain event are akin to gaming and unenforceable under law. “A former rule of Argentine law provided that speculations known as ‘differences’ (*juegos de bolsa*) and consisting of sales or purchases which do not oblige either party to effect delivery and are settled only by the payment of the differences in price between the day of purchase and that of delivery, are illegal and void of legal effect” (Radzyski, 1996). Swap contracts are an exchange of cash flows (or exchange of differences) and depend on an uncertain event and could be mistaken for gaming contracts. There is a fundamental difference, however, gaming *creates* risk where there was none before, while hedging with derivatives *transfers existing* risk from one party to another. Only in the special case of speculators on each side of a derivatives contract is risk created and these types of trades are tightly controlled (by exchanges and risk management committees of banks) because they are deemed necessary to provide

liquidity to hedgers. Notwithstanding this, Radzyski reports that derivatives contracts in Argentina, Brazil and Mexico *likely* would not fall under gaming provisions, but the issue is important and sufficiently unclear that it should be investigated in each country in the region.

The issue of the legal power of counterparties to lawfully enter into a derivatives contract arose in 1991 in the celebrated United Kingdom case of Hammersmith and Fulham. The House of Lords ruled that Hammersmith and Fulham, a local unit of government, had no express or implied authority in its charter to enter into a derivatives contracts. This ruling chilled derivatives activity in the United Kingdom and its aftereffects continue today so that derivatives dealers worldwide must assess the legal capacity of the counterparty to enter into these contracts. Little work has been done on the legal power of end-users in Latin American with respect to their growing derivatives markets.

### **Operational Risk**

The highly publicized derivatives losses of the last few years can, in almost every instance, be traced to a breakdown in management oversight and control. In operating companies, management control over the trading function was weak or nonexistent, permitting speculation to be mischaracterized as hedging. In banks, a level of speculation was permitted that was out of proportion to the bank’s profit and risk objectives or the size of the bank’s capital. In the aftermath of these losses, a number of public and private bodies studied the lessons to be learned from these experiences and published reports of their findings.

## **BOARDS OF DIRECTORS AND SENIOR MANAGEMENT OVERSIGHT**

Failure by top management to understand the uses of derivatives or to seek competent outside counsel has resulted in the treasury function becoming a profit center and taking on speculative financial positions unrelated to the firm's core business. This is a sharp departure from the traditional role of the treasury function as a cost center whose purpose is to reduce nonbusiness related financial risk through hedging revenue and cost streams.

Firms and banks must identify and quantify the risk they face and develop a written policy detailing acceptable risks. For a nonfinancial operating company the risks willingly assumed do not normally include currency, interest rate or commodity price risks. These risks are not part of their core business. On the other hand, a financial institution may appropriately assume speculative financial risks if that is core to the institution's business. It is management's responsibility to be aware of the kinds of risks that a business is facing and determine which are appropriate for the business. This determination should be communicated in the following corporate actions:

- C A policy statement by the board of directors and, if necessary, amendment of the articles of incorporation or by-laws to reflect a derivatives policy. The policy may include a description of what risks (credit, market, operational and legal) the firm or bank will bear and what risks will be hedged and by how much.
- C The board should decide on a disclosure policy relating to the use of derivatives.

This policy should identify how derivatives activity will be discussed in annual reports and other public documents.

- C The board should provide for written procedure manuals for management, trading, accounting and auditing staff to define duties, responsibilities and reporting channels relating to derivatives activities. Operational controls should be put into place to ensure adherence to policy.
- C The board should design an employee compensation system that bases incentives on risk-adjusted profit performance.
- C Depending upon its degree of derivatives activity, the firm or bank may require a formal organization for risk control that uses Value-at-Risk models and scenario analysis to measure credit and market risk. "Dealers and end-users must ensure that adequate systems for data capture, processing, settlement and management reporting are in place" (Group of Thirty, 1993).
- C Depending upon the extent of derivatives activity used in the firm or bank, derivatives training programs for boards of directors, senior management, traders, accounting and auditing staff may be appropriate. Management should designate an internal risk management unit, or at a minimum, seek competent and objective outside advice.

Many of the above principles were endorsed recently by the Basle Committee in its "Principles for Managing Bank Interest Rate

Risk,” (Basle, 1997). The Committee published 12 principles that can be grouped into five categories: the role of senior management, policies and procedures, measurement and monitoring systems, independent controls and the information provided to supervisory authorities.

The rash of “derivatives debacles” led to a series of lawsuits alleging abusive sales practices. As a result, the derivatives industry proposed a number of changes in industry practices to regain the confidence of the public and regulatory officials. At the suggestion of U.S. supervisors, six large securities houses formed the Derivatives Policy Group, and in March, 1995, issued a document entitled “Framework for Voluntary Oversight” (DPG, 1995). This document represents voluntary self-policing by the derivatives industry to conform to recommendations in four broad areas: (i) strengthening its internal management controls; (ii) providing more information to public regulators; (iii) evaluating capital adequacy standards with respect to credit and market risks; and (iv) publishing guidelines on how professional derivatives intermediaries should deal with nonprofessional derivatives counterparties or end-users. These voluntary guidelines would apply generally to broker/dealer affiliates of the firms involved in the DPG, to the extent the affiliates are not already subject to supervisory oversight by regulators.

For the DPG, issues dealing with strengthening of *management control* centers on the integrity of risk management systems and clarification of accountability. Should be addressed in boards of directors’ written guidelines that:

C [define] the scope of permitted OTC derivatives activity;

C [set limits] for acceptable levels of credit and market risks, and;

C [create] the structure and appropriate independence of the risk monitoring and risk management processes and related organization checks and balances (DPG, 1995).

With respect to *enhanced reporting*, the DPG seeks to demonstrate to U.S. regulatory authorities that internal risk management systems assure prudent management and oversight of risk exposure. The information voluntarily provided to the regulatory agencies would cover credit concentration and portfolio credit quality. The DPG recommends that derivatives dealers report credit concentration in the top 20 net exposures counterparty-by-counterparty. Portfolio credit quality would be reported “...by aggregating, by counterparty, gross and net replacement value and net exposure (after accounting for collateral and legally enforceable netting agreements), organized by credit rating category, by industry and by geographic location” (DPG, 1995).

The evaluation of *capital adequacy* with respect to credit and market risks are dealt with more extensively below, but the DPG arrived at the conclusion that the best risk measurement models are those currently in use by the major derivatives dealers. However, since these models are proprietary, they differ from firm to firm, and it was necessary for the DPG to specify minimum standards and model verification criteria. The DPG makes the important point that, whatever the degree of precision implied by quantitative models, there will always be an element of judgment concerning the adequacy of capital that management and supervisors must take into account.

*Counterparty relationships* have been a controversial area in the derivatives industry recently and one that has resulted in a number of lawsuits alleging abusive sales practices on the part of derivatives dealers. The DPG has published guidelines for professional intermediaries in dealing with nonprofessional counterparties (end-users). The DPG begins with the premise that a derivatives transaction is predominately an “arms-length business deal” in which each party to the contract has a responsibility to inform him/herself of the terms, conditions and risks involved or to obtain independent professional advice if necessary. In a recent ruling (*Procter & Gamble Co. v. Bankers Trust Co.*). A federal district court in Ohio seems to have accepted this principle. The court ruled that “...no fiduciary relationship exists ... [where] the two parties were acting and contracting at arm’s length...” and “...P&G and BT were in a

business relationship. They were counterparties.” (Gooch and Klein, 1996).

In the interest of promoting public confidence, the DPG encourages professional derivatives intermediaries, in dealing with nonprofessional counterparties to: (i) consider providing a generic risk disclosure statement; (ii) provide marketing materials that are good faith representations of the benefits and risks involved in derivatives transactions and not make misleading oral statements; (iii) provide nonprofessional counterparties with scenario analyses of particularly complex transactions that employ good faith assumptions in the calculations; (iv) use written agreements, trade confirmations or other written material that clarify the rights and obligations of the parties; and, (v) use good faith in providing evaluations or price quotes for transactions.

# THE MEASUREMENT AND CONTROL OF CREDIT AND MARKET RISKS

## Credit Risk

As previously noted, there is an extensive literature and growing practice in the measurement and control of credit and market risks. We begin with a brief overview of the evolution in thinking about these two kinds of risk.

“Credit risk is the exposure to a loss if a counterparty in a derivatives position defaults on their obligations in the contract or a loss of value stemming from a credit downgrade of a counterparty” (Gastineau, 1992). Credit risk is handled differently in the exchange-traded and OTC derivatives markets. Exchange-traded futures and options markets create clearinghouses that stand between the buyer and seller and become the counterparty to each. Because clearinghouses are typically well-capitalized and have collateral and guarantees to rely upon, credit risk is virtually eliminated in exchange-traded derivatives markets. The Basle Committee recognized the safety of exchange margins and multilateral netting in its 1988 Capital Accord by not requiring any regulatory capital beyond margin already posted to cover credit risk for transactions done on organized futures exchanges using daily margining.

OTC derivatives contracts, on the other hand, are negotiated between two parties that look to each other for fulfilment of contract conditions. This poses serious credit counterparty risks in multi-year swaps, in which cash flows between the parties must be exchanged for years into the future. Efforts have been made recently to reduce

counterparty risks through the use of netting agreements, the requirement of collateral and the use of statistical and portfolio techniques to model credit defaults. The problem of credit risk is even more acute in Latin America and the Caribbean where there are few investment grade companies, limiting the possibilities for undertaking multi-year swaps.

A very recent development that may have wider application to Latin America and the Caribbean has been the creation of clearinghouses or depositories that offer margin and collateral administration services. The *Bolsa de Valores de Sao Paulo*, the Chicago Board of Trade, the Chicago Mercantile Exchange and Spain's Fixed Income Market are offering these services to the OTC swaps markets in their countries. Presently, these facilities are limiting their services to their own countries with the exception of the CME, which will offer services initially to commercial and investment banks in the Group of Five countries. These depositories may, in time, offer this type of service to banks and end-users in emerging markets throughout the world. The CME's depository, which is the most advanced, will provide global, multi-currency services for collateral administration, matching trade details, revaluation of transactions, collection and payment of net cash flows and reporting for regulatory capital purposes. These are valuable models for OTC swaps markets in emerging markets and deserve serious consideration as a mechanism to reduce the credit risk of these markets.

The least sophisticated way of measuring credit risk was, in the past, to assume that the notional amount (outstanding nominal value) of the credit exposure was the risk facing the dealer. Since it is highly unlikely that all credits everywhere will fail, even in a systemic event, this approach gave way to a static analysis in which the total credit exposure was multiplied by an arbitrarily determined percent and that percent was treated as representing a probable credit default rate. This static analysis has been replaced by a dynamic measurement of credit risk through the marking-to-market of positions (where current price information is available) and the estimates of future exposure under different scenarios. Marking-to-market allows derivatives dealers to know the current market value or the replacement value of their portfolios. More recently, credit risk analysis has been borrowing some of the techniques used in market risk analysis to incorporate the “portfolio effects” of variance and correlations to estimate the risk of a portfolio of credit exposures.

The DPG *Framework*, discussed above, recommends that when measuring credit risks, its members seek to assess both current and future credit exposures with respect to concentrations by credit rating, industry and location. DPG members will periodically issue Credit-Concentration and Credit-Portfolio Reports to the U.S. Securities and Exchange Commission and the Commodity Futures Trading Commission. These reports will measure the net exposure, the aggregate net replacement value and the gross replacement value for exposures to each firm’s 20 largest counterparties and 10 largest geographic locations. They also will report net revenue data by product (interest rate, currency, equity and commodity derivatives) and by business unit. Finally, the DPG recommends that

“...Management should also consider the use of risk-reducing practices such as bilateral and multilateral netting arrangements, collateral agreements, third-party credit enhancements and offsetting exposures to the same counterparty” (DPG, 1995).

### **Market Risk**

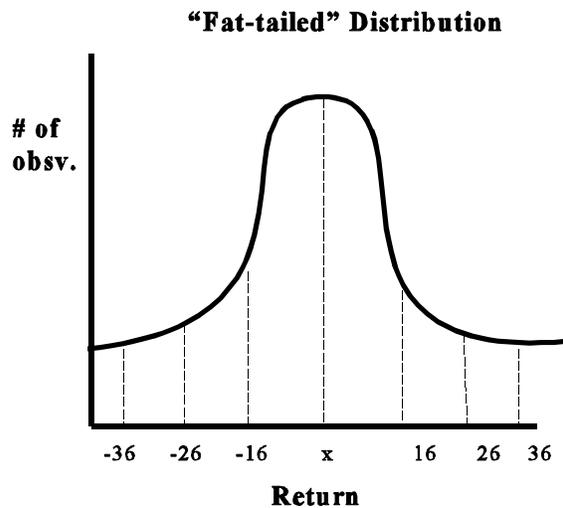
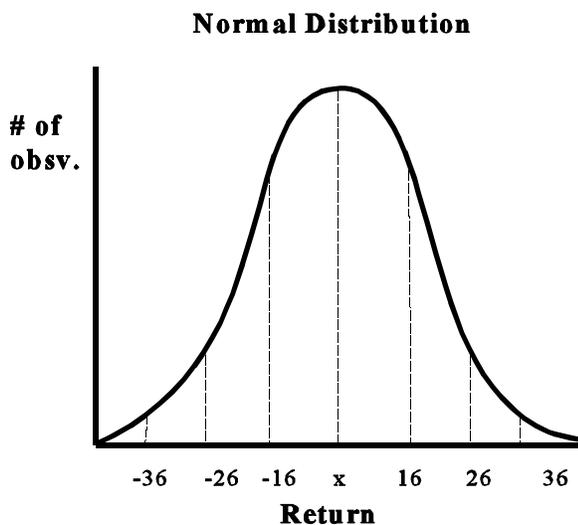
Before turning to the measurement of market risk, we note that there is a presumption that well-developed cash markets exist everywhere and that competitive and transparent prices are generated in these markets. However, this may not always be the case. A derivatives value, in large part, is “derived” from the underlying asset or liability which is traded in cash markets. For derivatives to function properly, the underlying cash markets must be deep and liquid with dealers making two-way markets of bids and offers. The ability to execute “short sales” should also exist. Information regarding trading prices and volumes should be readily available for the construction of indices, time series and descriptive statistics. The commodity derivatives markets, when they do not provide for cash settlement, must specify geographic points of delivery for physical delivery of the commodity for contracts not closed out prior to expiration. The warehouse system, upon which both exchanges and OTC markets depend, must have clear and unequivocal proprietary rights supporting the instruments they issue, including right and ease of foreclosure.

“Knight (1921) defined *risk* as a situation in which the randomness facing an economic agent can be expressed in terms of specific, numerical probabilities... *uncertainty* exists when an economic agent faces some randomness that cannot be expressed in terms of the probabilities of alternative outcomes”

(Culp, 1995). Modern portfolio theory has used Knight's insight into risk as a probabilistic phenomenon to define the relationship between "expected risk" and "expected returns." Investors, depending upon their risk preferences, will select a portfolio of securities from a continuum of assets ranging from the risk-free interest rate to portfolios comprised of ever increasing risky assets. As they move along the continuum of riskier portfolios, they will demand higher returns for bearing higher risks. Modern portfolio theory also recognizes that securities are correlated and that by selecting securities less positively related with each other, it is possible to increase returns with the same risk or maintain a rate of return with lower risk. Because a portion of the total portfolio risks can be diversified away (nonsystemic risks), investors will only be

rewarded for bearing the nondiversifiable (or residual) risks that remain in portfolios.

"Expected returns" are defined as the mean of past returns and "expected risk" as the standard deviation of the mean return. Securities are thus described by their mean return and the volatility or standard deviation of that return. Portfolio theory assumes that the standard deviations around the mean return are symmetrical or "normally distributed." The model defines risk as the "two-sided probability" that the security's average rate of return will not be achieved or will be exceeded. Since investors are not fearful of returns that exceed their expectations, we usually focus on the "one-sided" probability that the expected rate of return (whether we own the security or have sold it short) will not be met.



Risk management makes use of the technique described above to measure the risk of each security (the standard deviation of the security price) and, using a portfolio approach, to aggregate the risk of the entire portfolio, taking into account the correlations that exist between securities in a portfolio. A calculation is then made for the amount of risk capital required to hold this particular portfolio. For example, assume that a bank invests \$100 million equally in two assets, i.e. \$100 million in one-year U.S. Treasury Bills and 10,000 shares of XYZ stock at \$100 per share. Although the investments are equal in size, the capital charge against each asset will be quite different. Assume also that the U.S. Treasury Bills had a standard deviation of 6% over the past year (T-Bill prices can be expected to vary between \$94, and \$106, in one year) and the equity shares had a standard deviation of 40% (XYZ's stock prices may vary between \$60 and \$140 in the course of one year). The risk manager would assess a \$6 million capital reserve against the T-Bill position and a \$40 million reserve against the equity position to protect against a decline in the prices of these assets.

This also allows us to compute a *risk-adjusted return*. If the bank's fixed-income manager earned \$4 million per year from the T-Bill position and the equity manager earned \$20 million from the XYZ stock investment, the fixed-income manager's risk-adjusted return is approximately 67% (\$4 million earnings/\$6 million capital reserve), while the equity manager earned 50% (\$20 million earnings/\$40 million capital reserve). On a risk-adjusted basis, the fixed income manager required less of the bank's capital than the equity manager to earn his return.

Suppose a firm decides to go "short" (borrow and sell securities with the promise to replace

them at a later date) \$100 million of T-Bills and retain its "long" \$100 million position in XYZ stock. Also assume that the correlation of their prices is a positive 0.6. If T-Bill prices are rising (falling short-term interest rates) from history we know that XYZ stock will also rise 60% of the time. Therefore, it is not reasonable to assume that T-Bill prices will rise against the short T-Bill position *and* XYZ stock will decline against the long position. The capital charges for the *portfolio* will fall because the standard deviation of the *portfolio* fell due to the positive correlation of the assets, which give us partially offsetting long and short positions. In this case the standard deviation of the *portfolio* is approximately 22 percent (and a portfolio capital charge of \$22 million), compared to individual standard deviations of 6% and 40% for T-Bills and XYZ stock, respectively, and a capital reserve of \$46 million if these positions did not partially hedge each other. (The formulas for the variance of a portfolio can be found in any standard finance text, see Livingston, 1993.)

Market risk is commonly defined as "the risk that a change in trading liquidity or in the level of one or more market prices, rates, indices, volatilities, correlations or other market factors will result in losses for a specified position or portfolios." More specifically, the DPG agreed that "...the definition of capital at risk is the maximum loss expected to be exceeded with a probability of one percent over a two-week period" (DPG, 1995). The evolution in the measurement of market risk of a derivatives portfolio has followed a path similar to that of credit risk measurement. The first technique was to count the notional amount of the derivatives portfolio as risk. This crude technique quickly evolved into the second stage of scenario analysis and "what if" events to anticipate future risk. The measurement of market risk next used Value-

at-Risk models to first measure the market risk ensuing from individual derivative positions and later from a portfolio of derivatives.

The Basle Committee and IOSCO (Basle, 1995) recommend that supervisors evaluate VaR methodologies in terms of the key parameters of the models including: volatility (either implied or historical) and correlation assumptions; the holding period over which the change in portfolio value is measured (ten trading days is recommended); the confidence interval used to estimate exposure (99% or three standard deviations is recommended); and, the historical sample period from which the data are drawn (one or two years of historical data is recommended).

Owing to the large number of proprietary systems in use for measuring VaR, the DPG felt compelled to issue minimum standards and verification techniques so that the models used are rigorous and produce roughly comparable results. The DPG urges that industry models should capture all material sources of market risk and the "...core risk factors which include (i) parallel yield curve shifts; (ii) changes in the steepness of yield curves; (iii) parallel yield curve shifts combined with changes in the steepness of yield curves; (iv) changes in yield volatilities; (v) changes in the value of equity indices; (vi) changes in equity index volatilities; (vii) changes in the value of key currencies (relative to the U.S. dollar); (viii) changes in foreign exchange rate volatilities; and, (ix) changes in swap spreads in at least the G-7 countries plus Switzerland" (DPG, 1995).

Finally, the DPG recognizes in its *Framework* that the predictive value of quantitative VaR models may be an imperfect guide to the amount of capital required by a derivatives dealer. For example, a number of assumptions

about the past, as incorporated in historic volatilities and correlations, may not be the best guide to future events. Even if high loss events carry a low probability of occurrence, from a public policy perspective, one would always want to carry enough capital to ward off even these rare events. And even if VaR models are predicting perfectly, a 99% probability level (3 standard deviations from the mean) of loss in a two-week period can be expected to deplete a firm's capital reserve for its derivatives portfolio at least once every one hundred biweekly intervals. For these reasons, VaR should be used as an indicator of risk, but prudence dictates allocations of capital in excess of the narrow result of a quantitative model. To see this, VaR models should be put through stress testing and scenario analysis allowing foreign exchange or equity market correlations to break down or yield curves to shift *and* twist. We turn to these topics below.

### **Value-at-Risk, Stress-Testing and Scenario Analysis**

In times of severe market stress (the market break of 1987, for example) trading liquidity dries up and the prices of securities can change dramatically, ending the smooth continuous movements seen just minutes before. In events like this, the returns on financial assets do not follow their historic volatilities (standard deviations), and correlations between securities break down. The ever present possibility for a "market event" immensely complicates the job of the risk manager. The useful properties of "normal distributions" that allowed the risk manager to specify confidence intervals within one, two or three standard deviations from the mean return no longer hold as the distribution of returns becomes "fat tailed" and previously remotely

possible events (defined as beyond three standard deviations from the mean) become more probable.

Even outside of catastrophic financial events, there is a class of derivatives (options on futures and options on swaps) whose price movements do not uniformly track the price of the underlying security. A change in the price of the underlying security (whose prices are assumed to be normally distributed) can be accompanied by an accelerating or decelerating change in the price of the option in what is called nonlinearity in options prices. This nonlinearity must be captured by the use of nonsymmetric return distributions or Monte Carlo simulation methods. An entire science has grown around the problem of options pricing and controlling the associated risk.

A few years ago, the CEOs of the largest banks began asking for summary statements of the value of their bank's capital that was at risk on any given day. The major derivatives dealers began to develop Value-at-Risk systems to measure the market risk of the assets, liabilities and derivatives held in their investment and trading portfolios. This process consists of valuing the portfolio at today's market prices and continually altering the prices of the securities in the portfolio through changes in volatilities and correlations to generate new portfolio values. Repeated many times, this process will produce a distribution of portfolio values. Using these values CEOs or risk managers can set parameters beyond which a bank's capital may not be put at risk.

A bank is not in business just to survive ninety-nine out of one hundred adverse events. A bank's capital must be strong enough to survive major market breaks. Various industry groups like the Group of Thirty have

recommended that "worst case" scenarios should be used to "stress" the portfolio. Stress testing should give management an idea of how much capital is required to withstand the worst case scenario given the portfolio the bank now holds. If survival is in doubt, management must reorganize the portfolio and the bank's business lines.

## **IDB TECHNICAL COOPERATION IN RISK MANAGEMENT**

The IDB has a long and successful history of helping countries with the development of their financial markets. As is befitting a public development bank, the IDB undertakes projects that have a wider public purpose and are therefore unlikely to be undertaken by the private sector. This is especially true in establishing the legal and regulatory foundations and financial infrastructure under which financial markets develop. Derivatives markets in Latin America, with the exception of Brazil, are comparatively new and still in a state of underdevelopment. This is an excellent opportunity for the region to establish the essential underpinnings of these markets and avoid the mistakes already committed in the developed derivatives markets. The IDB can help member countries in the following areas:

C The statutes authorizing derivatives activities, conventions and institutions are unlikely to already exist or to have been modernized in the civil law or the common law countries of the region. Existing law should be examined with respect to removing “gaming provisions,” defining counterparty power to engage in derivatives and the treatment of collateral, guarantees and the disposition of derivatives contracts in bankruptcy. In addition, the legal framework for recognizing ownership of derivatives positions should be analyzed, to ensure that legal certainty in this area exists.

C The issue of counterparty risk (or credit risk) is particularly severe in emerging markets and special steps may be necessary to ameliorate the problem. Emerging

derivatives markets have an opportunity to establish “master agreements,” clearinghouses, depositories and trusts to deal with counterparty risk. In addition, the clearance and settlement risks (or operational risks) can be dealt with by providing a legal basis for “bilateral netting,” “multilateral netting,” “netting by novation” and “closeout netting.”

C The value of a derivative instrument is “derived” from the underlying cash market price or index. If cash markets are not deep and liquid, price formation in cash markets is unlikely to be transparent or competitive, and derivatives prices will be similarly distorted. The Bank can assist government agencies and private groups to develop and strengthen their cash markets and encourage the creation of derivative instruments based on liquid cash markets only. The Bank can also help countries to systemically collect times-series data from cash markets to provide the volatility and correlation estimates necessary for Value-at-Risk models.

C The Bank should assist banking and securities market regulators to meet the revised standards to the 1988 Basle Capital Accord for credit and market risk. This may include help in the development of a comprehensive risk management program which would require developed cash markets that provide adequate price and quantity information. The program would also identify and quantify the various types of market risks facing businesses and financial institutions. Finally, it would design a management-driven derivatives

control system with (i) policy statements by boards of directors and senior management; (ii) sample procedures manuals for management, trading, accounting and auditing staff, and automated procedures and documentation systems; (iii) value-at-risk and scenario analysis models and, (iv) examples of training programs for boards of directors, senior management, traders, accounting and auditing staff.

C Some governments, are attempting to open their agricultural sectors to market forces. In moving toward this goal, they necessarily expose farm groups (sometimes the most

impoverished group in the country), to market forces after having removed the safety net of subsidies that previously existed. Some governments have experimented with agricultural risk management programs to use private markets to shield food producers and consumers from commodity price swings. The Bank should identify the challenges and opportunities in using private derivatives markets to provide risk management services to agriculture.

## GLOSSARY

*Bilateral Netting* - A contractual agreement to reduce many payment and receipt flows between two parties, to a single payment. This reduces credit risk to the net amount of the obligation.

*Closeout Netting* - A specialized form of netting used when multiple transactions are terminated or liquidated early in connection with default; only the net value of the terminated positions is payable.

*Credit Risk* - The potential loss due to a change in credit rating or default by a counterparty.

*Derivative* - A financial instrument whose value depends, wholly or in part, on the value of an underlying asset, liability or index. Derivatives fall in the general categories of futures, forwards, swaps and options. The basic derivative instruments can be combined to produce an almost infinite variety of hedges or exposures.

*Hedge* - A position assumed to offset, reduce or remove a risk. For example, a farmer who owns (is “long”) corn, will sell (go “short”) corn forward in the futures market so that price changes for cash corn will be approximately offset by the opposite position in the futures market. Price risk is thus reduced to “basis risk” (that is, how close the futures price tracks the cash price). This technique reduces risk through fixing the future price of the commodity or security, but also removes the opportunity for future profit.

*Legal Risk* - The risk that a derivatives transaction will not be upheld in the courts because the transaction is contrary to law, the counterparty does not have power or capacity to enter into the transaction or a party’s rights under the transaction will not be enforceable in the event of bankruptcy.

*Liquidity Risk* - Liquidity risk can be categorized as funding risk and trading risk. The risk that a solvent institution will be unable to make payments due to a maturity mismatch between its assets and liabilities is funding illiquidity. Liquidity trading risk in securities markets is associated with a withdrawal of bids and offers, causing jumps or gaps in prices or an inability to buy or sell without substantially moving prices.

*Market Risk* - The potential for loss due to an adverse change in prices, yields, indices and, in the case of option prices, a change in volatility.

*Multilateral Netting* - The process of reducing to a single payment obligation payment and receipt flows between more than two parties. This is usually done within an exchange clearinghouse arrangement.

*Natural Hedge* - Rather than use derivatives, a bank or firm will arrange to reduce or eliminate its price risk through arranging for offsetting flows in its income statement or create offsetting assets or liabilities in its balance sheet. There is usually a residual amount of exposure that cannot be offset in the income statement or balance sheet that is hedged through the use of derivatives.

*Nonlinear Returns* - A linear relationship exist between two variables when the direction and rate of change in one variable is constant with respect to changes in the other variable. Swaps and options exhibit nonlinear returns. The price of the swap or option can change in a different direction and at a nonconstant rate of change relative to the price of the underlying asset. Nonlinear returns can lead to jumps, gaps and large discontinuous changes in swap or options prices that are non-normally distributed even though the return of the underlying is normally distributed.

*Normal Distribution* - “A purely theoretical continuous probability distribution in which the horizontal axis represents all possible values of a variable and the vertical axis represents the probability of these value’s occurring. The scores on the variable are clustered about the mean in a symmetrical, unimodal pattern known as the bell shaped curve or normal curve” (Vogt, 1993). If an asset’s returns are normally distributed, we can say that two-thirds of price observations will fall within one standard deviation of the mean; ninety-five percent of the price observations are within two standard deviations; and, ninety-nine percent within three standard deviations.

*Operational Risk* - The risk of loss from human error, malfeasance or a breakdown in mechanical or electronic operating systems. Operational risk also refers to a breakdown in the payments system resulting in a failure to clear and settle trades.

*Option* - The right, but not the obligation, to buy (call option) or sell (put option) a commodity or security at a specified price and within a certain time period. The buyer of an option pays a premium to the seller of the option. The buyer’s losses are limited to the premium paid whereas the seller of an option has exposure to unlimited losses. Options provide hedgers with downside risk protection, but also with the opportunity to participate in upside gains if the option expires worthless.

*Risk Management* - Risk management is the multidisciplinary effort to ensure that all of the risks that could affect the financial results of an institution or its ongoing ability to conduct business and serve clients have been identified, measured and controlled. A successful risk management process includes: i) senior management oversight and control; ii) identification and measurement of risk; iii) procedures and documentation; and, iv) risk disclosure guidelines.

*Scenario Analysis and StressTesting* - The application of “what if” and “worst case” scenarios to a VaR estimate. Since VaR gives a short-term probability of loss, managers wish to know the expected value of the portfolio if prices and/or volatilities change dramatically or liquidity dries up.

*Setoff* - The reduction of an obligation of A to B under a contractual agreement by an amount owed by B to A under another contract (when both A and B are acting in the same capacity in both contracts).

*Short Sale* - The borrowing and simultaneous sale of an asset with the intent of purchasing and returning the asset at a lower price. In derivatives markets, a short sale is merely the opposite of a long position where the intent is to benefit from a price decline.

*Systemic Risk* - The risk that the failure of a bank or security house can endanger other banks and investment houses and bring down a domestic or the international system of payments. The sources of systemic risk are credit, market and operational failures.

*Value-at-Risk* - An estimate of the potential loss to a single position or a portfolio of positions due to a change in prices, yields, indices or their volatilities over a given period within a confidence level. For example, there is a 1% probability that the portfolio will change by some unit of value in the next 10 days.

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## Annex

### Pricing a Swap Using a Biannual Compounding Approach

The problem illustrated in the main body of the text involves balancing the principal plus interest earnings of the fixed and floating rate arrangements by equalizing their present values. To illustrate the common sense of the solution, we demonstrate the biannual compounding approach conventionally used by market analysts to price the swap at origination and show the effect of a change in the interest rate yield curve on the value of the swap after origination.<sup>4</sup>

The feature of biannual compounding (called the "bond method") is that the biannual rate must be calculated as the quotient of a nominal annual rate quoted in the market and the number of periods (2 in this case). For maturities less than one year, prevailing market practice is to quote interest rates in nominal terms; therefore, they can be used directly in the bond method.<sup>5</sup>

Given the above relationships, the interest rates for the example discussed in the main text are:

**Table A-1. Interest Rates**

	Status	Nominal Annual	Nominal SemiAnnual
Periods in Yr.	Given		2
Fixed 1 Year Coupon Rate	Given	6.2500%	3.0776%
Current 6 month LIBOR Rate	Given	5.7500%	2.8750%
LIBOR Rate (in 6 months)	Unknown	6.5614%	3.2807%

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<sup>4</sup> This example mirrors the setup in Smithson, Clifford and Smith (1995), pp. 261-266.

<sup>5</sup> The rate quoted is called the nominal rate; represent it by  $j$ . The rate actually earned is the effective rate; represent it by  $i$ . The relationship between the nominal and effective annual rates of interest paid  $m$  times per year is:

$$(1) 1 + i = (1 + j/m)^m$$

or:

$$(2) i = (1 + j/m)^m - 1$$

and:

$$(3) j = m ((1 + i)^{1/m} - 1)$$

Since there is no reinvestment of coupon earnings in our example, the distinction between the bond method and the more familiar discrete compounding approach is no cause for concern. The same results can, of course, be obtained using effective rates and discrete monthly compounding.

The sections that follow show how to recursively solve for the LIBOR rate in six months that will satisfy the market arbitrage condition and, in a second step, find the annual fixed rate that will equate the present values of both sides of the swap.

### Biannual Compounding: Pricing a Swap at Origination

Pricing the swap proceeds sequentially. First, the value of the spot rate applying in the second half of the year is found from the arbitrage condition specifying that the annual fixed rate must be equal to the compounded biannual rates. Then, an adjusted annual fixed rate for the swap is calculated that sets the present values of the mid-year and end-year coupon payments equal across the fixed and floating schemes, assuming all mid-year payments are discounted by the six-month rate in effect at origination, and settlement payments at year's end are discounted by the one-year fixed rate in effect at origination. The six-month forward rate calculated from the arbitrage condition in step one is not used as a discount factor.<sup>6</sup>

#### Step One

Given the known fixed annual interest rate, expressed on a nominal basis,  $i_{fix} = 6.25\%$ , and today's six month spot rate which applies to the first half of the year,  $i_{flo1} = 5.7500\%$ , the problem is to solve for the annual nominal equivalent of spot rate  $i_{flo2}$  applying in the second six month period from the compounding formula, using the fundamental relation  $[1 + i_{part\ of\ year}] = [1 + i_{annual}/(n/12)]$  where n is the number of months in the sub period (six in this case). Since the spot six month rates are effective (or zero coupon) rates, they are already in the right form. Thus, letting  $P_0$  represent initial principal, and  $P_t$  the terminal value after 1 year ( $t=1$ ), and compounding:

<u>Fixed Rate</u>	<u>Floating Rates, 2 Six-Month Periods</u>
(1) $P_{t=1} / P_0 * 1.0625$	$= P_0 * (1 + 1/2 * 0.0575) * (1 + 1/2 * i_{flo2})$

Cancelling  $P_0$  and solving:

(2) $i_{flo2} = ((1.0625/1.02875) - 1) * 2 = 6.5614\%$
--

---

<sup>6</sup> If the present value of each scheme (fixed, floating) were calculated using only the "own" rates pertaining to that scheme (i.e. the fixed rate when discounting the fixed rate payments; the original six-month floating rate and the six-month rate expected six months hence when discounting the floating rate payments), they would automatically be equalized using the rates specified in the first step, making the second unnecessary. However, the present values of the flows are instead calculated only on the basis of the rates known with certainty when the agreement is entered into--the six-month floating and one-year fixed spot rates.

The second floating rate, 6.5614%, is the entry in the shaded bottom row, third column of Table A-1 above.

## Step Two

On a notional initial principal of \$1, the coupon payments at the middle and the end of the year are, symbolically:

<u>1st Half</u>	<u>2nd Half</u>
(3) Floating: $(0.5 * i_{flo1}) + (0.5 * i_{flo2})$	
Fixed : $(0.5 * i_{adjfix}) + (0.5 * i_{adjfix})$	

where  $i_{adjfix}$  is the adjusted fixed rate we can solve for that will equalize the present values of the coupon payments under the floating and fixed interest arrangements.

Setting the present values of the floating and fixed rate flows in (3) to be equal and discounting:

$(4) \text{ PV} = (0.5 * i_{flo1}) / (1 + 0.5 * i_{flo1}) + (0.5 * i_{flo2}) / (1 + 0.5 * i_{fix})$ $= (0.5 * i_{adjfix}) / (1 + 0.5 * i_{flo1}) + (0.5 * i_{adjfix}) / (1 + 0.5 * i_{fix})$
--

Simplifying (4) and solving for the adjusted fixed rate,  $i_{adjfix}$ :

$(5) i_{adjfix} = (2 * i_{fix} * i_{flo1} + i_{flo1} * (i_{flo2} + 2) + 2 * i_{flo2}) / (2 * i_{fix} + i_{flo1} + 4)$
---

Inserting the values in the example into (5) gives  $i_{adjfix} = 0.0615$ , or 6.15%:

$0.0615 = (2 * 0.0625 * 0.0575 + .0575 * (0.0656 + 2) + 2 * 0.0656) / (2 * 0.0625 + 0.0575 + 4)$
--

Table A-2 shows the actual and discounted coupon flows on a notional principal of \$10,000,000 using the rates calculated above. The present value of either arrangement is \$588,235.

**Table A-2. Payments**

SCHEME (Notional Principal= \$10,000,000)		PERIOD 1	PERIOD 2	YEAR TOTAL
FLOATING	Interest Rate (%)	$100 \cdot .5 \cdot (1.05750 - 1) = 2.875\%$	$100 \cdot .5 \cdot (1.065614 - 1) = 3.2807\%$	
	Coupon Payment (\$)	287,500	328,068	615,568
	Present Value of Coupon (\$)	279,465	308,770	588,235
FIXED	Interest Rate (%)	$100 \cdot .5 \cdot (1.0615 - 1) = 3.075\%$	$100 \cdot .5 \cdot (1.0615 - 1) = 3.075\%$	
	Coupon Payment (\$)	307,457	307,457	614,913
	Present Value of Coupon (\$)	298,864	289,371	588,235

***Bianual Compounding: Pricing a Swap after Origination***

After origination, if and when market conditions change, the present values of the swap will no longer be equal for both parties; rather, one will enjoy a gain and the other will suffer a loss. Suppose, for example, that the yield curve shifts upward 50 basis points (a basis point is 1/100th of a percent, so all rates go up 0.5 percentage points). Since the fixed rate and the first six month floating rate were contractually agreed upon at origination, it is the change in the expected floating rate interest payment in the second half that effects the value of the swap when it priced after origination, or "marked to market."

The calculations of the new expected LIBOR in the second half of the year proceed as before, yielding:

<p><u>Fixed Rate</u>    <u>Floating Rates, 2 Six-Month Periods</u></p> <p>(12) <math>P_{t=1} / P_0 \cdot 1.0675 = P_0 \cdot (1 + 1/2 \cdot 0.0625) \cdot (1 + 1/2 \cdot i_{flo2})</math></p>
--

so, cancelling  $P_0$  and solving:

$$(13) i_{\text{flo2}} = ((1.0675/1.03125) - 1) * 2$$

Or 7.0303%, the annual entry in the shaded bottom row, third column of Table A-3 below.

**Table A-3. Rates After a Shift of 0.05 Percentage Points in Yield Curve**

	Status	Nominal Annual	Nominal Semi-Annual
Periods in Year	Given		2
NEW Fixed Coupon	Given	6.7500%	3.3750%
NEW Current 6 month LIBOR	Given	6.2500%	3.1250%
NEW LIBOR (in 6 months)	Unknown	7.0303%	3.5152%

Now, to compute the gains and losses to the swap owing to the increase in rates. The only cash flow that changes is the floating rate interest payment in the second half of the year, since all other payments were contractually locked in at origination. Using the bond method, Table A-4 shows that the contracting party receiving the floating rate payments loses in the first half of the year, but this was more than offset in the second half from the increase in the LIBOR rate, so overall the value of the swap to the recipient of payments based on floating rates has gone from zero at origination to \$24,102. Discounting these expected net cash inflows by the current zero coupon rates (discount factors of  $1/(1+.5*0.06250)$  for the first half;  $1/1.0675$  for the second half), gives the present value of the swap (\$21,921) to the recipient of the floating rate payments.

**Table A-4. Marking to Market**

SCHEME	AMOUNT/RATE	FIRST HALF	SECOND HALF	YEAR
FLOATING	\$	\$287,500	\$351,515	\$639,015
	FLOATING RATE	5.75%	7.03%	
FIXED	\$	\$307,457	307,457	\$307,457
	FIXED RATE	6.15%	6.15%	
FLOATING-FIXED DIFFERENCE		(\$19,957)	\$44,058	\$24,102
DISCOUNT FACTOR		1/1.03125	1/1.06750	
PRESENT VALUE OF DIFFERENCE		(\$19,352)	\$41,273	\$21,921