The ART of Risk management

Alternative Risk Transfer, Capital Structure, and the Convergence of Insurance and Capital Markets

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preface
a comprehensive approach to corporation finance

Capital and insurance markets are converging in both product offerings and institutional participation. Consider some examples. At the product level, asset assurance can be obtained through either (re-)insurance guarantees or credit derivatives, and foreign exchange or commodity price hedging now can be done with futures, forwards, options, and swaps or with a multiline insurance contract. At the institutional level, investment banks like Goldman Sachs and Lehman Brothers now have licensed reinsurance subsidiaries, and reinsurers like Swiss Re now directly place the functional equivalent of new debt and equity with their corporate customers.

The recent trend toward convergence in insurance and capital markets is much more fundamental than just increasing product or institutional similarities. The real convergence is between corporation finance and risk management. No longer is it possible to consider seriously how a firm will manage its risk without simultaneously considering how that firm raises capital. And conversely.

At the center of this convergence maelstrom is alternative risk transfer (ART), or contracts, structures, and solutions provided by insurance and/or reinsurance companies that enable firms either to finance or to transfer some of the risks to which they are exposed in a nontraditional way, thereby functioning as synthetic debt or equity (or a hybrid) in a firm's capital structure. In short, ART forms represent the foray of the (re-)insurance industry into the corporation financing and capital formation processes.

Today providers of risk control products like derivatives also are integrally involved in the capital formation process, although many participants in this area may not realize this. To discuss risk management in a corporate finance context is still considered odd by some. And yet, increasingly, to discuss one without considering the other is quite likely to lead to serious inefficiencies in either how a firm manages risk or how it raises funds—if not both.

A comprehensive approach to corporate finance must take into account both risk finance and risk transfer alternatives, both capital and insurance market solutions, and both risk management and classical treasury decision-making processes. Companies like Michelin, United Grain Growers, and

British Aerospace that have adopted this comprehensive approach to corporate finance have met with tremendous success and provide us with very useful examples of the kinds of efficiencies that can all too easily be left on the table when a more compartmentalized approach is adopted.

The objective of this book is to explore the theoretical foundations underlying a comprehensive approach to corporation finance and the practical solutions and structures available to corporate treasurers for turning this theory into practice.

TWO FACES OF RISK MANAGEMENT

Risk management remains a divided world. In one camp are the classical insurance types who speak using terms like "retrocessionaires" and "funded retentions" and "attachment points." In another camp are the financial risk managers who focus on concepts like value at risk, credit limits, and hedge ratios. Despite the fundamental similarities between what members of the two camps are trying to do for their companies, often it is impossible to hold a conversation with both groups at the same time without a translator.

The difference is not simply one of vocabulary, although that is surely still a major source of disparity between the insurance and capital markets worlds. The disparate nature of the two worlds of risk management, however, is more fundamentally a difference in perspective. Derivatives and financial instruments are considered the domain of asset pricers and financial engineers. And insurance is widely regarded as the playground of actuaries and brokers bent on finding the right attachment points for the hundreds of perils and hazards they can identify. Not helping things, most college and graduate insurance texts today pay little more than cursory attention to financial products. And even worse are the best-selling financial instrument texts, in which insurance concepts are virtually never mentioned.

The rise of "enterprise-wide risk management" in the 1990s has helped heighten awareness to the basic similarities between the two risk management camps. As companies increasingly seek to identify, measure, monitor, and control their risks in a holistic, top-down, integrated, and comprehensive manner, the basic complementarities between the financial and insurance risk management worlds have become more obvious.

The common ground underlying a comprehensive and integrated risk management program is one of *capital structure optimization*—that is, how to maximize firm value by choosing the mixture of securities and risk management products and solutions that gives the company access to capital at the lowest possible weighted cost. The questions a corporate treasurer must ask today thus now go well beyond questions like "What should be our dividend policy?" and "Should we have a target leverage ratio?" The questions

today now include "How much excess capital should we hold for risk and signaling purposes?" and "What form should that capital take?"

We are taught, of course, that a firm's financing decisions do not affect its value under certain assumptions. And even when those assumptions are violated, there is no single empirically valid theory that delivers any clear notion of "optimal capital structure." Nevertheless, in some situations certain sources of capital simply make less sense for particular companies than others. And similarly, risk management products and solutions can impact the value of firms quite differently depending on the circumstances and business objectives surrounding those firms. The lack of any empirically supported theory of optimal capital structure thus does not appear to stop firms from searching for one, and in many cases value-enhancing decisions are the result. As such, there can be little doubt that the era of a comprehensive approach to corporation finance has arrived.

TARGET AUDIENCE AND OUTLINE OF THE BOOK

This book is aimed at participants in both the capital markets (derivatives and securities alike) and (re-)insurance industries as well as—if not more so—at corporate treasurers and financial officers responsible for deciding how their firms should finance themselves. Risk managers also should find the work relevant, as should university students seeking a graduate course on relations between risk management (both worlds) and corporate finance.

My 2001 book *The Risk Management Process: Business Strategy and Tactics* does have a few similarities to this book, but not many. That book was concerned principally with examining the organizational process of risk management, including risk identification, measurement, and control. This book, by contrast, focuses almost entirely on risk control, or the various products and solutions firms can use to maximize their value by closing gaps between actual risk exposures and the risk exposures security holders want their firms to have. With the exception of some overlap in Chapters 3, 9, and 10, the books are basically different.

Those familiar with my prior book will detect some similarities in the themes of Part I in each book, both of which seek to lay down a solid corporate finance foundation for what follows. Although similar in spirit, the actual groundwork laid is quite different. Part I of my 2001 book dealt mainly with how risk management can increase the value of the firm in a corporate finance framework. Part I here focuses much more on corporate finance itself and the process by which firms strive to find the holy grail of an optimal capital structure.

Specifically, Part I of this book begins by discussing the nature of capital (Chapter 1) and how the investment banking process enables firms to raise capital by issuing traditional securities (Chapter 2). We develop in these two

chapters two fundamental concepts that will be used throughout the book. The first is a perspective on capital structure that allows us to view different sources of capital through a common lens—the lens of options theory, through which similarities between securities, derivatives, and ART forms will be very easy to see. The second concept is the notion of an economic balance sheet, or a way of viewing a firm's assets and liabilities from an economic perspective—without the constraining limitations of accounting rules.

Chapters 3 through 6 introduce the notion of optimal capital structure. We begin with a review of the assumptions under which a firm has no optimal capital structure—when its cost of capital and capital structure do not affect its investment decisions or value. In Chapters 4 and 5, we consider two competing theories of when and how a firm's capital structure does affect its value. Chapter 6 provides a summary of the empirical evidence for and against these theories. In Chapters 7 and 8, we consider a world where investment and financing decisions are not independent of one another and how that world can lead firms to want to hold capital for nontraditional reasons. Chapter 7 explores the role of risk capital and signaling capital, and Chapter 8 reviews various issues concerning regulatory capital.

Part II relates the corporate financing and capital structure issues explored in Part I to a firm's risk management decisions. The risks to which a firm may be subject through its primary business activities are reviewed in Chapter 9, and the process by which firms engage in the enterprise-wide management of those risks is summarized in Chapter 10. Chapter 11 explicitly explores the link between risk management and capital structure decisions.

In Part III, we review the traditional methods available to firms for controlling their risks and altering their effective economic balance sheet leverage in the process. Chapters 12 to 16 present an overview of the risk control and capital structure functions provided by banking products (Chapter 12), derivatives targeted at market and credit risk (Chapter 13), asset divestitures and securitizations (Chapter 14), insurance (Chapter 15), and reinsurance (Chapter 16).

Part IV examines the emerging market for ART forms based on their type and function. Chapter 17 introduces the ART world and distinguishes between two distinct parts of that world: risk finance and risk transfer. Chapters 18 and 19 review the major alternative risk financing structures, including funded self-insurance programs and captives (Chapter 18) and finite risk products (Chapter 19). Chapter 20 presents some recent developments in risk transfer products, including integrated risk management products that have emerged as a response to the heightened awareness of the benefits of enterprise-wide risk management. Multiline and multitrigger products are reviewed, especially in the context of some fairly prominent failures in the former category. Chapter 21 reviews contingent capital in the form of committed capital (i.e., synthetic debt) and guarantees (i.e., synthetic equity). Fi-

nally, Chapter 22 reviews some of the more important recent developments in alternative risk securitization and securitized products.

Part V presents some practical issues that potential users of ART products will want to take into consideration. To accomplish this, it made sense to seek out the advice of the experts themselves. Accordingly, the four chapters are written by guest contributors. In Chapter 23, Morton Lane presents a comparison of two catastrophic insurance structures to illustrate specifically some important distinctions between catastrophic insurance products and to show more generally the difference between catastrophic insurance derivatives and securitized products. In Chapter 24, J. B. Heaton provides some important background on the increasingly important role of patent law on financial innovations, relying on a number of specific ART examples to make his points. Chapter 25 by Andrea Kramer discusses the distinctions between derivatives and insurance in the area of weather risk management and presents some important issues for energy companies to take into account in choosing between these products. Part V concludes with an extensive review by Theodore Boundas and Teri Lee Ferro of the numerous ART forms available to facilitate corporate transactions such as mergers and acquisitions.

a guide for readers

Having summarized the outline of the book, a few comments are now in order on how to *read* the book. Importantly, the book is *written* in a way to develop the theory before getting into the products and applications. All case studies, for example, appear in Parts IV and V of the book so that readers might have an understanding of the theory behind these cases before getting embroiled in their details.

For academics and students seeking an understanding of both the theory and practice of ART in the context of modern corporate finance, it probably makes sense to read the book from start to finish. Similarly, practitioners directly involved in this market who already know how ART forms work may find a sequential reading of the book most beneficial.

For those readers, however, whose main interest is on understanding ART as a type of product—how ART forms work and how they have been used—skipping direclty to Parts IV and V (possibly with a review of existing risk management products in Part III) may make more sense than reading the book in order. Part I, in particular, admittedly requires a reasonable investment of time to get through, and it is *not* essential if your objective is just to get an overview of the market. If, having read about the mechanics of these products, readers want to learn about how ART fits into the theory and practice of corporate finance, returning to Parts I and II for a subsequent read is certainly still possible.

CHAPTER 16
Reinsurance

The insurance structures explored in Chapter 15 all were directed at single policyholders wishing to purchase insurance on a specific risk from a single insurance carrier. When the assumptions underlying the M&M propositions hold, these sorts of contracts make sense only when sold by insurance companies to risk-averse individuals, and there is no role for the purchase of insurance by corporations—including insurance companies.[1] But when the assumptions underlying M&M do not hold, insurance companies themselves often wish to buy insurance—called *reinsurance*—to help them manage their risks and capital structures.

In this chapter we explore the basic principles of reinsurance, seeking to answer the following questions:

- When one or more M&M assumptions are violated, how can insurance companies increase their value by acquiring insurance for their own insurance underwriting activities?
- What are the different forms of reinsurance contracts?
- How are different types of reinsurance "treaties" distinguished from one another?
- How can "excess of loss reinsurance treaties" be viewed from an options perspective?

FUNCTIONS OF REINSURANCE

An insurance company that buys insurance is called a *cedant*. The outward transfer of risk by the cedant to the reinsurance company is called a *cession*, and the taking up or inward transfer of risk by the reinsurance company is called an *assumption*. In return for taking up the risk originally borne by the cedant, the reinsurance company receives a premium from the cedant.

When a reinsurance company buys insurance on a reinsured risk, the outward transfer of risk is called a *retrocession* and the reinsurance company buying the reinsurance protection called the *retrocedant*. The reinsurance

company that assumes the risk in a retrocession is called the *retrocessionaire*. The reinsurance and retrocession process is shown in Exhibit 16.1.

Insurance companies can engage in reinsurance and retrocession for a wide variety of reasons, some of which are discussed below. Note that these structures would not make sense in an M&M world. But when capital markets are imperfect and information asymmetric, all can make sense in at least some circumstances. And in that context, the benefits of reinsurance should look extremely familiar. (See Chapter 11.)

Capacity

Perhaps the most obvious potential benefit of reinsurance is the creation of additional capacity for the cedant or retrocedant. In other words, reinsurance is a classic form of synthetic equity for insurance companies.

Capacity can be inadequate for a primary carrier or reinsurer along two dimensions. *Large-line capacity* is an insurer's ability to absorb an extremely large (i.e., catastrophic) loss on a single policy. In many situations, a policy may be attractive for an insurer but only up to a certain amount of losses (or, as we shall see later, only between certain loss layers). In order to underwrite

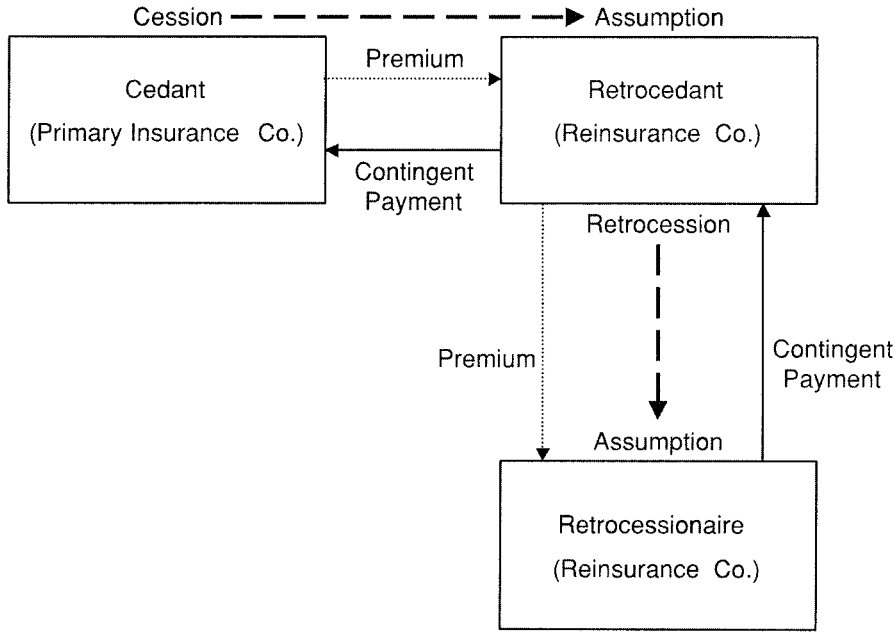

EXHIBIT 16.1 Reinsurance and Retrocession

the policy, the insurance company needs to know *ex ante* that it will not have to retain all of the underwriting risk. Reinsurance can provide insurers with precisely this assurance.[2]

Separately, some insurers lack *premium capacity*, or the ability to write a large volume of policies in the same business line. Of concern in this case is the insurer's ability to weather a large number of possibly small losses rather than a single massive claim. But the fundamental rationale for reinsurance is essentially the same as in the large-line capacity case—"renting the balance sheet" of another insurance company as synthetic equity so that the primary carrier or reinsurer can provide all the policies that it would like to write.

Reinsurance sought for capacity purposes can be viewed as a means of mitigating underinvestment and debt overhang problems in the sense of Myers (1977). If a single large policy or a business line of policies represents a positive NPV opportunity for the insurer but cannot be offered due to a lack of equity capital, reinsurance creates a synthetic equity infusion large enough to enable the firm to accept the positive NPV business opportunities.

Increased Surplus or Debt Capacity

As noted earlier, the total premiums written by a primary insurance carrier are constrained by the equity capital of the insurance company, sometimes called the firm's surplus. Reinsurance can provide synthetic equity capital to an insurance company if the firm might otherwise have to forgo positive NPV insurance lines because of capacity constraints. But reinsurance as synthetic equity also can be used to increase the firm's total debt capacity.

When premium is collected at the beginning of a policy term, the insurance company must establish an unearned premium reserve. Some types of reinsurance involve a cession of premium as well as loss exposure to the reinsurer. This in turn can reduce a firm's required unearned premium reserves, thereby increasing the firm's surplus and increasing its debt capacity.

Reduced Earnings and Cash Flow Volatility

When the diversification of risks in a policy line is too low, earnings and cash flows can be strongly influenced by underwriting losses. Like other firms, insurance companies may wish to reduce that volatility of earnings and/or cash flows to avoid underinvestment problems, to increase the signal-to-noise ratio in accounting signals, or just to facilitate their internal cash management operations and capital budgeting activities. Reinsurance thus can be used to effect "synthetic diversification" and reduce the vulnerability of earnings and cash flows to highly correlated adverse underwriting results.

Reduced Expected Financial Distress Costs

Volatility of earnings or cash flows in a particular policy line need not necessarily arise from a single massive claim on a single policy. Indeed, claims of a small to medium size whose arrival rates are highly correlated often can induce more volatility over time than just a single claim. The possibility of a single catastrophic loss thus tends to pose a different problem for insurers—the risk of incurring financial distress costs.

The need for some carriers to secure catastrophic protection usually arises from low-frequency, high-severity events such as natural disasters, major industrial accidents, multiple accidents arising from a single peril or hazard, and the like. As explained in Chapters 4 and 11, high-severity losses of this kind can cause the market value of a firm's assets to approach or perhaps fall below the face value of the firm's outstanding liabilities, both in a financial capital structure and technical loss reserves context.

Reinsurance can create an additional layer of synthetic equity capital that reduces the expected costs of financial distress by reducing the probability that the firm will encounter financial distress.

Information Acquisition

The reinsurance process is extremely information-intensive. Accordingly, the information acquired by a reinsurer during the underwriting process can be quite extensive—and valuable. Like banks doing credit checks on their customers, reinsurers engaging in due diligence of prospective cedants may acquire information that enables them to better serve their insurance company client again in the future. In addition, the reinsurer also may require valuable market intelligence, information about its competitors, pricing information, and the like.

Synthetic Liability Dispositions

Chapter 13 reviewed the various means by which derivatives and securitizations can be used to accomplish synthetic asset divestitures. In the same spirit, reinsurance can help primary carriers or reinsurers engage in synthetic *liability* divestitures.

Suppose, for example, that a primary carrier decides that the risks of providing marine coverage are too high and beyond its shareholders' risk tolerances. The firm really can only leave the business by terminating any new marine underwritings and then allowing its outstanding contracts to wind down. Or the carrier could purchase reinsurance, thereby synthetically eliminating the entire business line virtually overnight.

FORMS OF REINSURANCE

Reinsurance contracts can take one of two forms—*facultative* or *treaty*. A facultative reinsurance contract covers a single risk and insurance policy. In other words, the reinsurer and insurer negotiate separate facultative contracts for each policy the primary carrier wishes to reinsure. Consequently, facultative reinsurance is extremely flexible and can have terms fully customized by the two parties to the contract. Facultative reinsurance is commonly used for the reinsurance of extremely large or catastrophic risks, very unusual or exotic risks, or specific risks that are not core business line risks for the ceding insurance company.

Treaty reinsurance, by contrast, involves the reinsurance of a group of policies that fall within general guidelines defined by the cedant and reinsurer (or retrocedant and retrocessionaire). In treaty reinsurance, the reinsurer cannot refuse any specific risk or policy in the business line or policy group as long as that policy falls within the predefined parameters of the treaty itself. Because treaties have broad terms negotiated in advance, this type of reinsurance is popular for insurance carriers wishing to reinsure a large number of similar policies, a whole business line, or a fairly traditional set of risks.

Facultative reinsurance is generally subject to larger potential moral hazard and adverse selection problems than treaty reinsurance because the risk, hazard, or peril underlying a facultative reinsurance is defined very specifically. Accordingly, facultative reinsurance generally involves a more in-depth due diligence exercise on the part of the reinsurer. Facultative reinsurance is also more time-consuming to negotiate and more expensive than treaty reinsurance.

TYPES OF REINSURANCE TREATIES

Risk-sharing arrangements between the insurance provider and purchaser in classical insurance programs are defined on a policy-by-policy basis. Because reinsurance treaties involve the inclusion of more than one policy, however, the sharing of risk can be accomplished in a number of different ways. All risk-sharing arrangements in treaty reinsurance either fall under the proportional or excess of loss designation. Specific types of proportional and excess of loss (XOL) treaties are discussed in the sections below.

Proportional Reinsurance Treaties

Proportional reinsurance involves the sharing of risks between the cedant and reinsurer (or retrocedant and retrocessionaire) on a proportional basis. The proportionality may be defined in fixed or variable terms. The proportion of

risk shared usually also acts as the proportion of premium collected that is divided between the two firms as well as the proportion of any loss adjustment expense (LAE) that must be allocated in the reinsurance program.

Quota Share Treaties

Reinsurance treaties that allocate risk, losses, premium, and loss adjustment expenses on a fixed-percentage basis are called *quota share reinsurance treaties*. A quota share treaty defines a common ratio when the original treaty is bound. This percentage is used immediately to cede a fixed proportion of premium collected from the cedant to the reinsurer, in return for which the reinsurer will bear the same proportion of subsequent claims and LAEs.[3] To compensate the cedant for the expenses incurred in originating the primary policies, the reinsurer also pays a ceding commission to the cedant.

Exhibit 16.2 shows a policy distribution diagram, which is common to the analysis of insurance and reinsurance structures. The x-axis represents the number of policies written by an insurance carrier in a single business line, and the y-axis represents the policy limit corresponding to each policy. Each point on the curve is a single policy. The symmetric nature of the diagram is indicative of a reasonably mature insurance portfolio that has a fairly large number of large-limit policies as well as a decent share of smaller ones.

From the exhibit, it can be seen that the quota share treaty simply in-

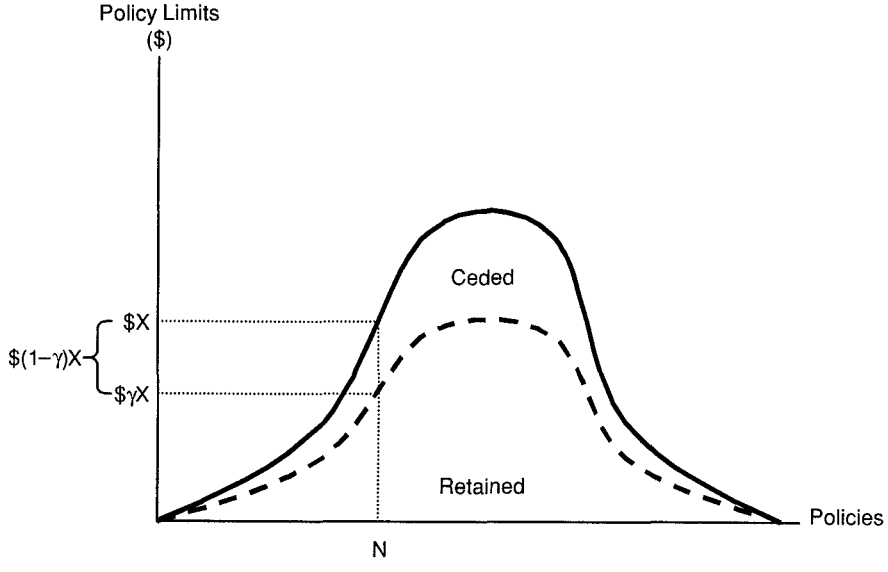

EXHIBIT 16.2 Quota Share Treaty Policy Distribution

volves the cession of a fixed percentage of each policy and premium to the reinsurer based on the policy limit. In other words, the reinsurance cession is based on the terms of the policy itself and not on the actual claims made.

Suppose the quota share treaty calls for a cession of $(1 - \gamma)\%$ of each policy in the policy class to the reinsurer. For any given policy—say, policy N, as shown in Exhibit 16.2—the policy limit is \$X. Under the quota share treaty, the ceding insurance company retains $\$\gamma$ for every dollar in the policy and the reinsurer assumes $\$(1 - \gamma)$ for every dollar in policy N. This proportion applies to the losses covered as well as the premium collected. If the policyholder files the maximum of \$X in claims, the reinsurer pays $\$(1 - \gamma)X$ of these claims and the cedant retains a commitment to pay the remaining $\$\gamma X$.

Quota share treaties are used frequently by insurance companies seeking either increased debt capacity through unearned premium reserve reduction or additional diversification to reduce cash flow and earnings volatility. As concerns the latter, *reciprocity* is a practice in which two primary insurers essentially exchange portions of their insurance portfolios with one another to increase the diversification of both firms' underwriting businesses. A quota share treaty can be a useful mechanism to accomplish a reciprocity cession.

In this connection, a quota share treaty used to facilitate a reciprocity cession can be viewed as a type of asset swap as discussed in Chapter 13.

Surplus Share Treaties

A reinsurance treaty that allocates risk, losses, and premium on a variable-percentage basis is called *surplus share treaty*. Although a treaty rather than a facultative reinsurance structure, the net retention of the cedant in a surplus share treaty is explicitly stated as a separate monetary amount for each policy or group of like policies. Because the dollar amount of the retention is fixed per policy or group, the percentage of each policy retained by the cedant varies from policy to policy or group to group.

Exhibit 16.3 shows a surplus share treaty with a retention level of \$X across all policies.[4] Policy N, for example, would be 100 percent retained by the cedant under this surplus share treaty because its coverage limit is below \$X. Policy M, by contrast, would involve a retention of \$X by the primary carrier and a cession of $\$(Y - X)$ to the insurer.

Note that this is still a proportional reinsurance contract in which the cedant retains a proportion of all premium, losses, and adjustment expenses. The dollar value is chosen relative to a policy limit to define the proportion of risk to be ceded, but care should be taken not to assume that the reinsurer bears losses sequentially based on whether or not actual losses hit that fixed monetary amount. In other words, suppose a surplus share treaty defines a fixed cession based on \$X of losses on Policy M. If a loss of exactly \$X occurs on Policy M, the reinsurer does not have a zero liability. Instead, the reinsurer bears a proportion of those \$X in losses equal to $(Y - X)/Y$. More generally,

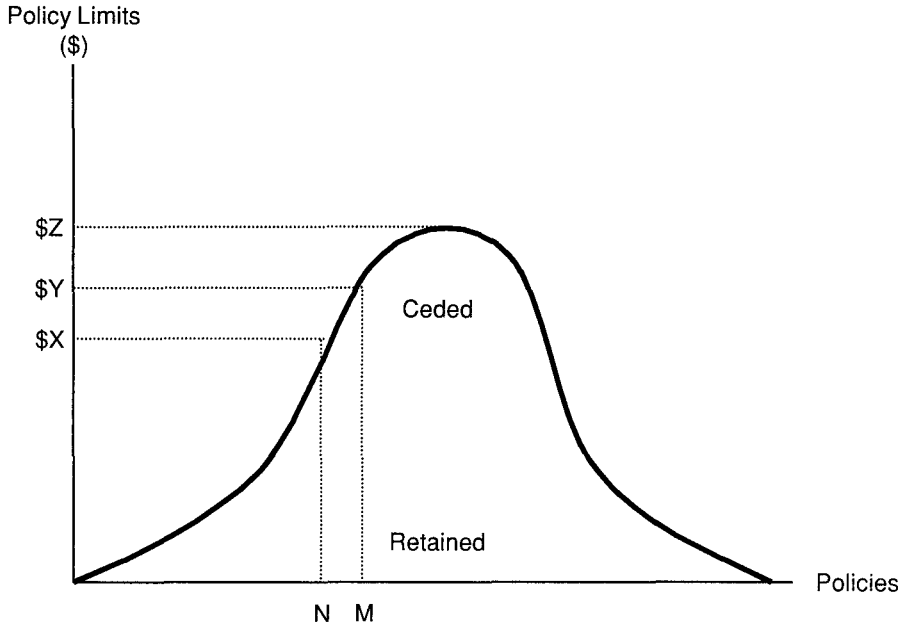

EXHIBIT 16.3 Surplus Share Treaty Policy Distribution

the reinsurer is ceded (Y – X)/X dollars of each dollar of premium and bears (Y – X)/X dollars of each dollar loss submitted in a claim. If X is $90,000 and Y is $100,000, the reinsurer thus receives 10 percent of the premium and bears 10 percent of any claims arising on the policy.

A surplus share treaty is effective in creating large-line capacity for the cedant, but it provides little unearned premium reserve relief because of the focus on large policy exposures. Note also that adverse selection problems can be significant with surplus treaties because the cedant can choose the retention on each policy. Accordingly, the cedant will tend to cede the bad business and retain the good business. Although the surplus share is a treaty, the moral hazard problems thus are more similar to a facultative reinsurance program than to a quota share treaty.

Excess-of-Loss Reinsurance

Proportional reinsurance like quota and surplus share treaties always involve some cession of premium and some allocation of losses to the reinsurer. In an *excess-of-loss treaty*, by contrast, the order in which the losses occur and the total amount of those losses affect the reinsurer's contingent liability. The

reinsurer's obligations are based not on fixed or variable percentages of policy limits but rather on actual claims received. Small losses thus are retained by the cedant, and only losses over a certain amount are paid by the reinsurer.

A typical XOL structure involves the definition by the insurer and reinsurer of attachment points, or loss levels where the reinsurance treaty comes into effect and then subsequently terminates. Reinsurers usually abbreviate excess of loss as XS, X, or XOL. An excess-of-loss treaty that specifies $100,000 XS $50,000 would mean, for example, that the reinsurer is underwriting any losses above $50,000 and up to $150,000, or $100,000 in losses in excess of $50,000 in losses. The lower attachment point of such a treaty is thus $50,000. The number of zeros, moreover, usually is taken to be understood by the involved parties, so we would actually write the forgoing policy as $100 XS $50.

Different types of XOL treaties are available that are distinguished mainly in their triggers or in how losses are calculated, especially across multiple occurrences or risks. The most prevalent types of XOL reinsurance structures are summarized below.

Per Occurrence and Per Risk XOL Treaties

A *per occurrence* XOL treaty is a reinsurance structure in which losses are paid on each event causing damage to the insured party above the attachment point. Consider a casualty policy for workplace safety that specifies $50 XS $50 per occurrence. If a worker slips and falls and sustains $100,000 in total monetary damages, the cedant pays the first $50,000 of the claim, and the reinsurer pays the remaining $50,000. If the same worker—or, for that matter, a different one under the same policy—slips and falls again during the policy period and incurs $75,000 in medical expenses, the cedant again pays the first $50,000 and the reinsurer pays the remaining $25,000. As long as the occurrence is different, the reinsurer is liable for each excess of losses above the attachment point on all separate events.

Property claims often are defined *per risk* rather than per occurrence, where each separate piece of property is a single risk. Consider a blanket property damage reinsurance policy that covers $100 XS $500 per risk for a group of three buildings in a production facility, each of which is defined as a separate risk. If the policy period lasts a year and three buildings each sustain $550,000 in damage—from either the same or different events—the cedant will have a total liability of $1.5 million and the reinsurer a total payment obligation of $150,000, or $50,000 per building.

Now suppose the same building has two fires in the same policy year, one of which causes $400,000 in damage and the second of which causes $300,000 in damage. The reinsurer is liable only for the cumulative $100,000 loss, equal to its policy limit. Specifically, the reinsurer would owe nothing on the first loss because $400,000 is below the XOL reinsurance attachment

point of $500,000. On the second loss, the reinsurer pays its full reinsurance policy limit of $100 XS $500.

Excess-of-loss policies commonly are structured to involve more than one insurer or reinsurance treaty. In the last example, the cedant retains the first $500,000 in losses per building plus any losses above $600,000 per building. If the cedant wants coverage for losses above $600,000, the insurer will need an additional XOL reinsurance treaty, this time with a new attachment point of $600,000.

Excess-of-loss reinsurance often is depicted using layer-cake diagrams, such as the one shown in Exhibit 16.4. Each "layer" represents the total losses insured per risk between attachment points, and the "cake"—the width of a given layer—represents the cession versus retention within each layer. This particular structure is a per risk excess-of-loss insurance pro-

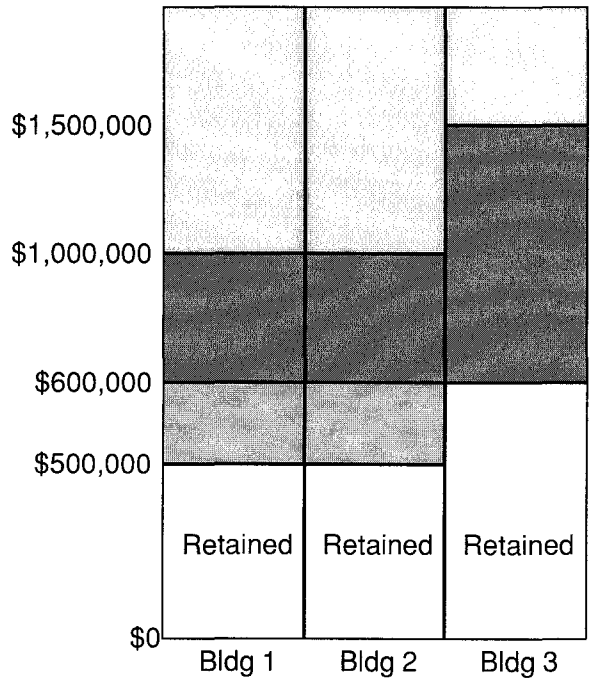

EXHIBIT 16.4 Per Risk Excess of Loss Treaties

gram with, say, a one-year duration and covering three risks or buildings. Each column of the diagram represents the loss exposure for a different building or risk. The different colors of the layers are chosen to indicate that different reinsurers have been engaged to reinsure different layers of losses on those buildings.

For Buildings 1 and 2, the cedant retains the first $500,000 in losses, whereas the first $600,000 are retained on Building 3. Both Buildings 1 and 2 then have three separate reinsurance treaties with attachment points of $500,000, $600,000, and $1 million. Building 3 then has its losses apportioned into three layers with attachment points of $600,000 and $1.5 million. The attachment points chosen by a cedant will depend both on the risk involved and the pricing quoted at different attachment points for the reinsurance.

The actual policy coverage could require that the cedant enter into up to eight different reinsurance treaties, perhaps with eight different reinsurers: $100 XS $500 on Building 1, $100 XS $500 on Building 2, $400 XS $600 on Building 1, $400 XS $600 on Building 2, $900 XS $500 on Building 3, $1,000 XS $1,000 on Building 1, $1,000 XS $1,000 on Building 2, and $500 XS $1,500 on Building 3. The cedant might identify many variations of this, though. For example, a single reinsurer could be engaged to reinsure both Buildings 1 and 2 between any two of the attachment points shown, which would be reasonably easy because the attachment points are identical on these two risks. Or perhaps a single reinsurer would be willing to take multiple layers per risk. For example, perhaps a single reinsurer is willing to reinsure $500 XS $500 on Building 1, thus underwriting the layers above both the $500,000 and $600,000 attachment points in a single treaty.

The top layer for each building is often called the *catastrophic layer* because it is the least likely to be reached and yet the most potentially costly (and likely to generate financial distress costs for the insurer). In the structure shown in Exhibit 16.4, the primary carrier may wish to retain the catastrophic layer, or the $1,000 XS $1,000 layers for Buildings 1 and 2 and the $500 XS $1,500 layer for Building 3.

Insurers (and reinsurers in retrocession) frequently use per risk and per occurrence XOL treaties for capacity enhancement as well as to stabilize earnings and cash flows and to increase debt capacity by reducing the unearned premium reserve. XOL treaty reinsurance thus is a classic form of contingent equity capital as discussed in Chapters 2 and 7. The pricing of such treaties is generally flat rate for the whole reinsurance treaty and usually involves some LAE sharing. Premium is allocated between the cedant and reinsurer both in terms of actual claims submitted and on a ratable basis over time.

Catastrophic Excess of Loss

Insurance losses arising from natural disasters such as windstorms, hail storms, earthquakes, tidal waves, tornados, and tropical cyclones are often extremely large. Accordingly, catastrophic excess-of-loss reinsurance treaties frequently are utilized by primary carriers to increase debt capacity, increase total underwriting capacity (i.e., reducing underinvestment by allowing the carrier to underwrite all positive NPV lines), and reduce expected financial distress costs.

Catastrophic XOL coverage functions in much the same manner as per risk or per occurrence XOL treaties, but with three differences.

1. The catastrophic coverage not only covers a catastrophic layer as in Exhibit 16.4, but the policy itself is almost always tied to a specific catastrophe as a triggering event. The excess-of-loss treaty shown in the exhibit was essentially a blanket property damage policy, whereas a true catastrophic XOL policy would pay claims only if the property damage was sustained as a direct result of some named catastrophic event like a tornado.
2. Catastrophic excess-of-loss reinsurance usually contains a coinsurance provision, rarely protecting more than 90 percent of the losses.
3. Catastrophic insurance of this sort also may involve a deductible.

Exhibit 16.5 shows a new layer-cake diagram for a revised coverage structure of the same three buildings as before. The coverage now includes a catastrophic excess-of-loss treaty overlaid on the per risk treaties acquired for lower-loss layers. The catastrophic XOL treaty has a 10 percent coinsurance provision in the $1,000 XS $1,000 layer and a $50,000 deductible. The fact that the "cake" portion of the catastrophic layer now cuts across all three buildings means that the policy is now a cover for the three buildings taken together. The deductible thus applies to catastrophic losses sustained on all three buildings *or* on any single building. Similarly, reinsured losses could come from any or all of the three risks.

Aggregate XOL or Stop-Loss Treaties

A third type of excess of loss treaty is an *aggregate excess-of-loss treaty* that applies to a predetermined aggregate loss arising from a policy portfolio. Aggregate excess-of-loss treaties are designed to cover a large number of small losses arising on multiple policies in the same policy year and thus are essentially the opposite of catastrophic XOL treaties.

Consider a primary carrier that writes homeowner's insurance and takes out per occurrence XOL reinsurance on its homeowner insurance portfolio for $1,000 XS $125. But suppose the policy year is characterized by a large number of $100,000 claims, all of which will fall below the

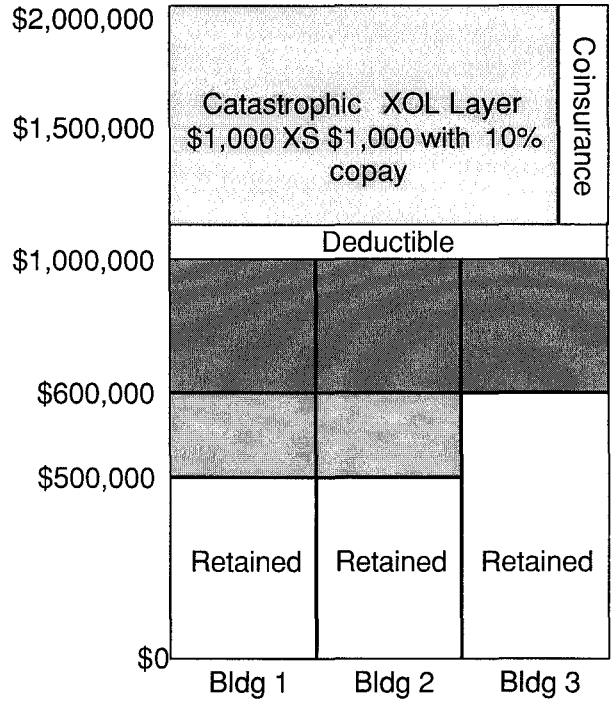

EXHIBIT 16.5 Per Risk XOL Treaties with Catastrophic XOL Overlay

$125,000 attachment point in the per occurrence reinsurance treaty. The carrier may wish to purchase aggregate excess-of-loss reinsurance for, say, $500 XS $500. Without the aggregate treaty, ten claims of $100,000 each would cost the carrier $1 million, because no single claim would be covered by the per occurrence treaty. But with the aggregate XOL reinsurance treaty in place, the cedant would be liable for only the first $500,000 in claims. The remaining five $100,000 claims would be covered by the aggregate treaty, even though no single claim is covered by any of the per occurrence treaties.

Aggregate XOL treaties usually do not specify risks or perils as triggers and thus can include any claims arising on a book of underwriting business. As such, aggregate treaties are a highly effective means by which insurers can reduce their earnings and cash flow volatilities by locking in a maximum loss amount.

The versatility of these treaties also makes them quite expensive. In addition, to prevent the underwriter from being inattentive to the risk of its book, aggregate treaties usually include reasonably significant coinsurance provisions.

Sixth Loss Excess

Insurers and reinsurers historically consider the number of very large claims per policy period to be limited. In particular, the belief is that the sixth largest claim in a typical insurance pool will be about the same value each year, with only the top five losses representing extraordinarily large or catastrophic events and varying dramatically from year to year. Six claims thus should define a reasonable expectation of a "worst-case payout" during a policy year for an insurer.

A *sixth loss excess* reinsurance treaty is a reinsurance treaty that covers the top six losses during the policy period. It is essentially a pure bulk-capacity vehicle used by some primary carriers to increase the depth of their underwriting lines and raise the policy limits they can offer.

EXCESS OF LOSS TREATIES FROM AN OPTIONS PERSPECTIVE

All XOL treaties can be viewed from an options perspective as vertical spreads with the strike prices of the options corresponding to the upper and lower attachment points. In Chapter 15 when we were dealing with single insurance policies, we found it useful to treat insurance as a put on the value of the insured asset. Now that we are working with reinsurance treaties whose value is based on actual losses on an underlying insurance policy portfolio, it will prove easier to work with options whose underlyings are insurance losses rather than asset values. What was a short spread on asset values before thus will become a long spread on losses now.

Consider an aggregate XOL reinsurance treaty covering all the property damage policies underwritten by an insurance company in a single policy year. Suppose the aggregate XOL treaty has a lower attachment point of A and an upper attachment point of B—that is, a (B – A) XS A treaty—no deductible, and no coinsurance provision. Exhibit 16.6 illustrates the payoff value of this reinsurance treaty assuming the treaty pays off at the end of the policy year as a function of aggregate property damage claims received.

For any losses below the lower attachment point A, the reinsurance does not pay off. For losses above A and up to B, however, the reinsurance fully reimburses the primary carrier for any claims. And for losses above B, the carrier remains exposed. In the absence of further reinsurance, the primary carrier thus has a net retention of losses from 0 to A and above B.

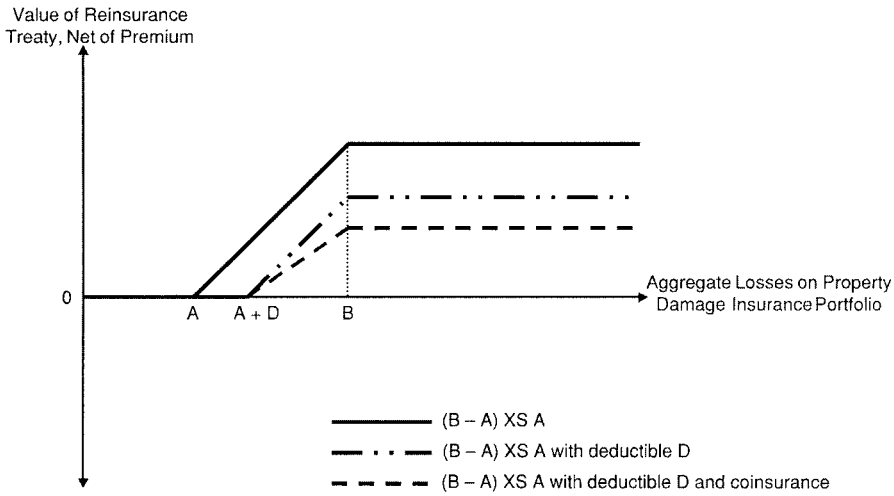

EXHIBIT 16.6 Aggregate Excess-of-Loss Treaty from an Options Perspective

The exhibit shows clearly that this treaty can be viewed as a long vertical spread consisting of a long call struck at A and a short call struck at B, both based on the underlying claims submitted on the property insurance portfolio.

Now suppose the aggregate XOL treaty involves a deductible of D. In this case, the reinsurance treaty has a payoff profile equivalent to a long vertical spread, but now with a lower strike price on the long call of A + D. The payoff on the reinsurance treaty is reduced by D at all insurance portfolio loss levels.

If we further add a coinsurance provision, the reinsurance does not pay off dollar for dollar for losses between A + D and B any longer. If the copayment percentage requires the cedant to pay γ dollars for every $(1 - \gamma)$ dollars paid by the reinsurer, the cedant gets only $1 - \gamma$ dollars for each dollar loss. The new position is now equivalent to $(1 - \gamma)$ long calls struck at A + D and $(1 - \gamma)$ short calls struck at B.

We could, of course, repeat this kind of analysis for all the types of XOL treaties examined in this chapter. The important point to recognize is that XOL treaty reinsurance is essentially similar to a portfolio of options whose values are based on reported insurance losses, again noting the important fact that this kind of risk transfer contract can be utilized only when an insurable interest exists. In addition, attention must be paid to any triggers contained in the XOL treaty. The aggregate XOL treaty shown in Exhibit 16.6 applies to any losses on the reference portfolio, but other types of XOL treaties may be conditional on a triggering event as well.

NOTES

1. See Culp (2001).
2. Indeed, reinsurance is sometimes called *reassurance*, and the purchaser of reinsurance called the re*assured*. See Kiln (1991).
3. The reinsurer in a quota share treaty usually also bears a fixed proportion of any loss adjustment expenses. See Kiln (1991) and Phifer (1996).
4. This is extremely unusual. One reason surplus treaties are used is to allow the retention to vary by policy.