Risk and the Capital of Insurance Companies

Richard W. Kopcke

Vice President and Economist, Federal Reserve Bank of Boston. *Kathryn Cosgrove provided valuable research assistance. A version of this article was presented as a paper at a conference sponsored by the Competitive Enterprise Institute, "Rethinking Insurance Regulation," January 12, 1996, Washington, D.C.*

Insurance companies, like other financial institutions, have been evolving from specialized businesses to enterprises offering a variety of financial services. Rising interest rates impelled this evolution during much of the past three decades as most insurers tried to remain competitive. As insurers' profit margins subsided and they attracted new business, their assets generally grew more rapidly than their capital. This erosion of capital per dollar of assets for insurance companies concerned their regulators, especially as more insurers increased their investments in assets commonly regarded as risky.

To maintain the safety and soundness of insurance companies, regulators increasingly are adopting risk-based capital requirements instead of rules that limit insurers' investments and contracts. The prompt enforcement of capital requirements linked to the risks assumed by each company may reassure policyholders of the integrity of their investments in their companies without imposing excessive costs on insurers, which could diminish their capacity to serve as efficient financial intermediaries. The consequences of such policies, however, depend greatly on the design and enforcement of these requirements. These policies work best when capital requirements properly reflect the risks assumed by each insurer, when the assets and liabilities of insurance companies are priced fairly in financial markets, and when insurers may sell their risky assets, if necessary, without incurring a significant penalty. Otherwise, these policies can weaken the insurance industry by pricing inaccurately the risks assumed by insurance companies.

Existing risk-based capital regulations are not so much a new way of measuring and controlling insurers' risks as they are a new way of managing those controls. The current regulations essentially define an insurer's risk by the properties of its assets and obligations considered in isolation, not by the blend of its assets and liabilities. Accordingly, these regulations give too little credit to those companies that mitigate their risks by diversifying their investments or matching the terms of their

assets closely to the terms of their liabilities. Furthermore, prevailing measures of insurers' capital mark some assets according to their market values while marking other assets and most liabilities according to their book values. Consequently, these measures of capital can substantially misrepresent a company's capacity for bearing risk.

These apparent deficiencies in existing regulations may reflect more than problems with technical details. If markets for financial instruments are not perfect, as assumed in the reasoning supporting risk-based capital requirements, then coherent measures of risk and capital may be elusive. If the assets and liabilities of insurers are not always priced efficiently

To maintain the safety and soundness of insurance companies, regulators increasingly are adopting risk-based capital requirements instead of rules that limit insurers' investments and contracts.

in liquid markets, the strategy of promptly enforcing any capital requirement at times may undermine, rather than foster, safe and sound financial institutions. In these circumstances, promising measures of risk and insurers' capacities for bearing risk rest on judgments about the odds of future economic conditions and about the implied correlations among returns on investments; yet, the prevailing regulations, striving for a degree of simplicity and objectivity, grant these judgments little force.

I. The Promise of Risk-Based Capital Requirements

The assets of insurance companies are investments made on behalf of their owners and policyholders.[1] Policyholders' claims against these assets are defined by their contracts, which typically obligate insurance companies to make specific payments on behalf of their policyholders in the event of retirement, death, illness, accident, or natural disaster. Accordingly, insurers collect premiums from their policyholders in order to accumulate assets, designated as reserves, that are sufficient to meet these claims. While basic hazard, term life, or health insurance policies may not require substantial reserves for each dollar of coverage, other policies such as popular permanent life insurance policies, annuities, and investment contracts accumulate considerable reserves.

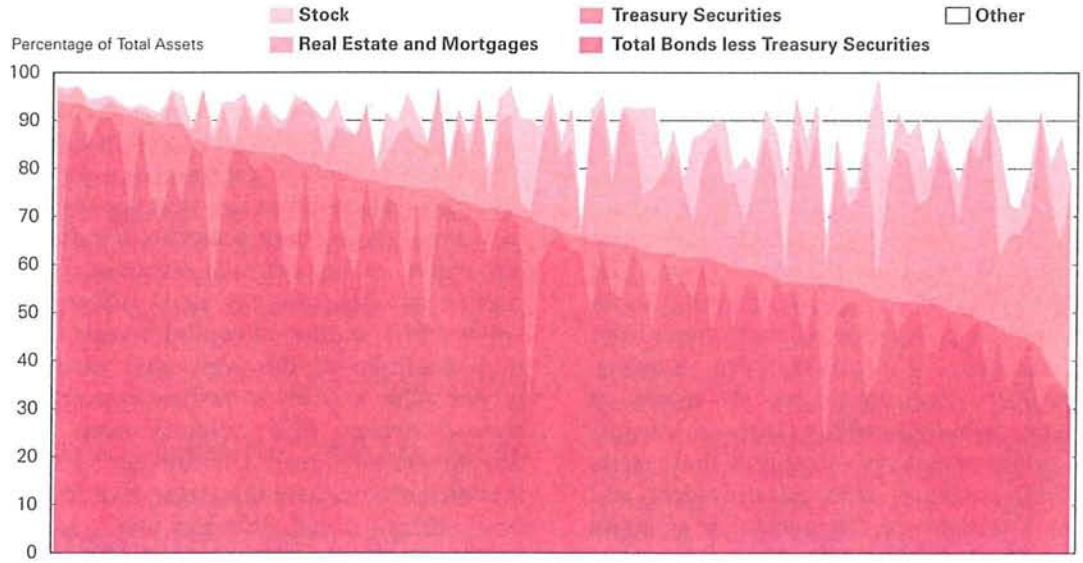
Because insurance companies continually are writing new contracts and collecting new premiums even as they are making payments as warranted by older contracts, their reserves tend to represent fairly stable portfolios of funds that they principally invest in longer-term assets such as bonds, mortgages, and equity (Figure 1). Although all invest a substantial proportion of their general accounts in bonds, the allocation of these investments among different types of bonds vary greatly. The darkest segment in each graph shows the proportion of each company's assets invested in bonds other than U. S. Treasury securities. For life insurers these bonds are most often corporate securities; property-casualty companies are more inclined to hold municipal bonds. In any case, as the graph suggests, no simple correlation exists between an insurer's commitment to bonds and the allocation of this investment among safer and riskier bonds. The graphs also show that companies that invest a smaller share of their assets in bonds tend to invest a greater share of their assets in mortgages, real estate, and equities. Accordingly, regulations that would treat the companies constituting the life or property-casualty industries equitably must weigh the consequences of their different investment strategies as well as the often considerable differences among their contracts with their policyholders.

Although not all insurance contracts are regarded as investments by policyholders, the premiums for all contracts depend on the returns companies expect to earn on their reserves. A company that earns competitive returns can afford to credit its shareholders with a competitive yield while charging a competitive premium for its contracts. When a company's return on assets is greater than expected, it can credit its shareholders with greater earnings, or charge its policyholders lower net premiums, or both. When a company's rate of return falls short of its expectation, it must reduce the yields it effectively pays to its shareholders or policyholders. If this deficiency is sufficiently great, the company also risks not being

[1] The distinction between owners and policyholders is not always sharp, especially for mutual insurance companies or for participating, experience-rated, and variable insurance policies.

Figure 1a

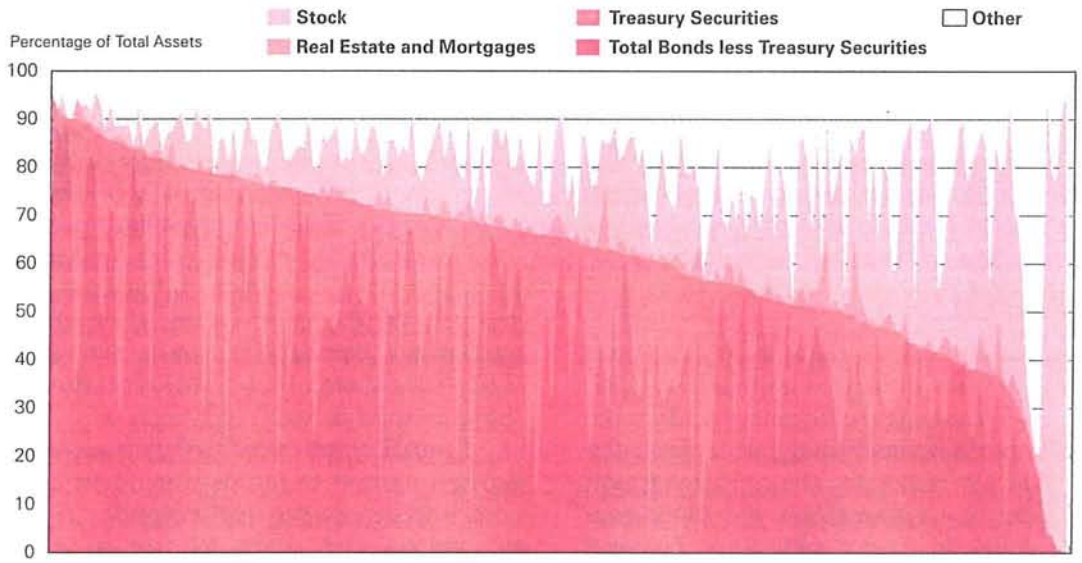
Assets of 100 Largest Life Insurance Companies
Ordered by Percentage of General Account Assets Held in Bonds, End of 1993



Note: These 100 companies hold 80 percent of the industry's general account assets.
Source: National Association of Insurance Commissioners

Figure 1b

Assets of 220 Largest Property and Casualty Insurance Companies
Ordered by Percentage of General Account Assets Held in Bonds, End of 1993



Note: These 220 companies hold 80 percent of the industry's general account assets.
Source: National Association of Insurance Commissioners

able to pay fully its policyholders' claims, especially if the company must liquidate assets at inopportune times when its disappointing returns induce its customers to shift their business out of the company.

The Role of Capital

Shareholders' earnings, which are the difference between insurers' returns from their assets and their net credits to policyholders, represent a financial shock absorber that protects policyholders' investment from the inevitable variations of insurers' return on assets. In perfect financial markets, the value of this margin of protection equals the market value of insurers' capital, the difference between the market value of their assets and that of their contracts with policyholders and other creditors. The more capital per dollar of assets and, consequently, per dollar of reserves, the more secure are policyholders' investments and claims, other things equal.

The increasing diversity of insurers' portfolios poses a challenge for regulators.

The regulation of insurance companies has been shifting away from attempting to control insurers' risks toward setting capital requirements commensurate with insurers' risks in order to protect policyholders' interests. As financial markets have evolved and as economic conditions have changed, fixed rules governing the investments of insurers and the designs of their contracts with policyholders have become dated. Ironically, rules that once made insurance companies safer and sounder now might compromise their security by limiting their ability to diversify adequately in accordance with changing market conditions. At the same time, rules that impeded financial innovations at insurance companies might undermine their role as financial intermediaries and increase the price of insurance. Consequently, the rules governing the activities of insurance companies, like those governing the activities of banks and other financial institutions, have been relaxed since 1950 as regulators increasingly audit risks rather than enforce regulations that delimit the activities of financial institutions. The increasing diversity of insurers' portfolios poses a challenge for regulators: Rules for measuring risk that do not comprehend fully the risks created by the various blends of assets and liabilities often unintentionally subsidize certain types of risk-taking while taxing certain financial strategies that diminish risk.

When insurance companies assume more risk, they must maintain more capital per dollar of assets in order to shelter their policyholders from bearing the consequences. For example, suppose an insurer with a current liability (reserves) of $1 billion to policyholders and $100 million of capital invests this $1.1 billion in a portfolio of relatively safe assets, a portfolio whose value is likely to neither appreciate nor depreciate 5 percent ($55 million) more than expected during the next year. This insurer's capital probably is sufficient to protect the interests of its policyholders, other things equal, through two years of adverse returns. If, on the other hand, the insurer invests in a portfolio of assets whose value is likely to appreciate or depreciate 10 percent ($110 million) more than expected, then its capital probably will not protect policyholders much beyond one year of adverse returns. In the first case, the longer interval of protection not only gives the insurer more time to take defensive actions, it also diminishes the odds of a "fatal draw" —a single year of very low returns occurs more frequently than several years of such returns one after another. The insurer in the second case must maintain at least twice as much capital in order to provide the same protection for policyholders as the insurer in the first case.

An insurance company's risks and, therefore, its need for capital depend on its blend of assets. The risk in a diversified portfolio of assets typically is less than the average risk for each of its assets (Sharpe and Alexander 1990; footnote 3, below). Accordingly, an insurer that purchases risky assets whose returns do not rise or fall rigidly in unison dilutes, to a degree, the risks inherent in each of these assets. When one investment falters, others falter less or may even prosper, thereby diversifying the insurer's risk. The greater the correlations among the returns on an insurance company's investments, other things equal, the greater is its need for capital.

Capital requirements, of course, should take into account more than the risks inherent in an insurance company's assets by considering the risks entailed by its policies and contracts. Just as assets may be blended to reduce risk, so the matching of assets with liabilities also may reduce risk. Insurers expose themselves to substantial risks by financing even safe assets with permanent life insurance or annuity contracts

that guarantee their policyholders a specific rate of return and contracts that allow policyholders to "withdraw" their cash values with little penalty.[2] If yields on alternative investments rise above those implicitly offered in insurers' outstanding contracts, then insurers who invested in long-term bonds run the risk of substantial losses whether they sell assets to meet their customers' withdrawals or they pay their customers a competitive rate of return in order to deter these withdrawals. On the other hand, if insurers invest in short-term securities, they run the risk of substantial losses if interest rates should fall below those either guaranteed in their contracts or offered by their competitors. Insurers assume much less risk either by issuing contracts that impose appropriate penalties on customers who withdraw funds prematurely or by financing shorter-term assets with contracts whose yields vary with market returns.

An insurer's need for capital does not depend simply on the risks inherent in its assets and obligations; it also depends on the frequency of its supervisors' audits, the liquidity of its risky assets, and the power of its supervisors to enforce minimum standards for capital.

Insurers also can manage their risk through financial contracts such as derivatives (financial reinsurance contracts), which do not necessarily appear on their balance sheets, in order to hedge the risks in their balance sheets. For example, insurers holding long-term bonds financed by permanent life or annuity contracts that grant policyholders valuable guarantees can diminish their potential losses by purchasing put options on bond contracts, thereby offsetting the put options they have sold to their policyholders.

An insurer's need for capital does not depend simply on the risks inherent in its assets and obligations; it also depends on the frequency of its supervisors' audits, the liquidity of its risky assets, and the power of its supervisors to enforce minimum standards for capital. If regulators seldom audited insurance companies, then policyholders would require sizable capital-asset ratios to protect their interests. An extremely conservative policy might require that capital equal 100 percent of the value of risky assets. Whenever a company's investment in risky assets exceeds its capital, policyholders' investment potentially is at risk. Although a 100 percent capital requirement certainly would guarantee policyholders' claims, the need for such a severe standard could be relaxed with periodic monitoring and intervention. If, for example, regulators appraised the values of assets quarterly or annually, if insurers could sell their risky assets when necessary with little penalty, and if regulators could require insurers to sell their risky assets when their capital falls below specific bench marks, then this policy of enforcing prompt remedies would allow insurers to maintain much less capital per dollar of risky assets without compromising the interests of policyholders. The more frequent these appraisals by regulators and the more liquid the markets for risky assets, the lower prudent standards for capital may be set.

Balancing Capital Requirements against the Cost of Capital and Regulation

Capital requirements and the implicit, if not explicit, "assurance" resulting from regulators' "seal of approval" allow insurance companies to sell their contracts at more favorable and more stable terms. The challenge for regulators is to set capital requirements that are commensurate with companies' risks, so that the price of this assurance is neither too cheap nor too expensive.

Policyholders' need for the protection provided by capital depends on their ability to assess properly the degree of risk inherent in an insurance company's assets. If all customers understood the risks they were assuming by purchasing an insurer's contract, the need for capital would be moot; policyholders would require returns implicit in their contracts that would compensate them for the risks they bear. Policyholders would assess the appropriate "deposit insurance" premium themselves. Customers, however, rarely understand insurers' risks adequately, and expecting all to assess these risks for themselves would be inordi-

[2] Fixed contract loan rates and guarantees of cash values give policyholders valuable options. Likewise, policyholders also have the option not to renew short-term contracts with life and property and casualty insurers.

nately costly, even if it were feasible. Consequently, regulations have long imposed both minimum standards for the capital of insurers and rules that restrict the types of assets insurers might purchase, in order to protect the investment of policyholders.

To the degree these regulations reassured policyholders, they also benefited insurers by allowing them to sell insurance contracts at more favorable and more stable terms. If, for example, policyholders as relatively uninformed investors generally were too wary of the risks inherent in an insurer's portfolio, then they would require better terms of their insurance contracts, terms that would appear too expensive to insurers. These requirements would be no less volatile than customers' confidence in insurers' investments. Regulations that enforced adequate standards for capital and limited insurers' risks also comforted customers who purchased longer-term contracts: Insurance companies would not assume substantial risks sometime in the future, thereby diminishing the value of their contracts. Accordingly, longer-term contracts could be sold on better terms. Finally, regulations benefited most insurance companies by preventing those companies most inclined to take risks (perhaps to gain a competitive advantage) from undermining policyholders' confidence in the entire insurance industry should these substantial risks produce substantial losses. The success of this regulation, of course, rests on regulators' assessing each company's risks more accurately than the typical policyholder.

Because the managers of insurance companies typically possess better information than other investors about the risks inherent in their investments, the cost of funds for insurers typically rises with capital requirements. Savers not privy to information available to insurance companies generally are less certain than the companies' managers about the potential returns on insurers' assets. For this reason insurance companies, like other financial intermediaries, have profited by transforming the obligations of investors into financial instruments that appeal to savers: Policyholders generally value the guarantees and options embedded in insurers' contracts more than management believes they cost. This advantage, however, becomes a disadvantage when insurers must sell equity to "outsiders," who require a rate of return that "insiders" regard as excessive (Myers 1984; Myers and Majluf 1984).

If regulators assess the risks of insurance companies accurately, then the diligent enforcement of capital requirements that vary with the risks assumed by insurers may allow regulators to strike a good balance between promoting sound intermediaries and fostering efficient intermediation. Capital requirements that are not linked to each company's risks would impose excessive costs on most insurance companies if these requirements were set high enough to protect the interests of the policyholders of companies that assume above-average risks. By linking each company's requirement to its risks, insurers would avoid much of the expense of holding excessive capital, while policyholders and regulators would avoid much of the expense of bearing excessive risk.

Risk-Based Capital Requirements

The prompt enforcement of risk-based capital requirements is tantamount to portfolio insurance for policyholders (Fortune 1995). As the value of an insurer's assets falls relative to that of its liabilities, thereby reducing its capital, regulations compel the insurer either to raise new capital or to reduce its risks commensurately. Should an insurer's capital per dollar of assets fall below a minimum control level, its regulators may take control of the company. For this portfolio insurance to be effective, the risk-based capital requirements ought to take into account the likely costs of selling risky assets in weak markets, and the rules governing regulatory actions ought to allow intervention before a company's capital is likely to be exhausted. For this portfolio insurance to be efficient, both the assets and the contractual obligations of companies ought to be marked according to their "market values"; otherwise, regulators would overestimate the capital for companies whose obligations correspond poorly with their assets and underestimate the capital for companies whose obligations correspond well with their assets.

The prompt enforcement of risk-based capital requirements is tantamount to portfolio insurance for policyholders.

The risk-based capital requirements (RBCR) proposed by the National Association of Insurance Com-

missioners assess the risks inherent in the assets, liabilities, and lines of business of insurance companies (Webb and Lilly 1995; Barth 1995 and 1996; Cummins, Harrington, and Niehaus 1994; Cummins, Harrington, and Klein 1995). The NAIC's proposals also recommend intervention by regulators when insurers' capital does not exceed these requirements.

The RBCR for life insurance companies comprise four components (Table 1). The NAIC's RBCR implicitly assume that the elements of risk within any of these four components are perfectly, positively correlated.[3] The largest of the four components is the asset charge (C1), about two-thirds of risk-based capital (RBC), which comprises assessments for life companies' holdings of bonds, stocks, mortgages, and other investments. For example, assessments for bonds range from no assessment for U. S. Treasury debt to a 30 percent assessment for bonds near or in default; the assessment for the stock of businesses not engaged in insurance is 30 percent; and assessments for mortgages range from 0.1 percent for insured mortgages in good standing to 6 percent for farm and commercial mortgages at least 90 days past due to 20 percent for mortgages in foreclosure.[4] Almost one-fifth of the RBCR for life companies may be attributed to the risks of underwriting various lines of business (C2), risks that arise from inaccurately pricing or estimating morbidity and mortality. These assessments generally are specific proportions of the premiums or net reserves in each of a life company's lines of business. The third component of life insurers' RBCR levies additional assessments on their obligations, assessments that depend on the interest rate risk in their contracts (C3). For example, reserves backing "low risk" contracts (those with cash values that either policyholders cannot withdraw or are subject to market value adjustments) entail a 0.5 to 0.75 percent assessment; reserves against "high risk" contracts (those with guaranteed cash values that policyholders can withdraw without penalty) entail a 2 to 3 percent

Table 1
Capital of Life Insurance Companies

Composition of Risk-Based Capital (RBC)	1994 RBC for 1,540 Life Companies (Millions of Dollars)	Percent of Total 1994 RBC
Total Asset Risk (C1)	55,671	65.9
Bonds After Size Factor	10,342	12.2
Mortgages	6,977	8.3
Preferred/Common Stock	25,205	29.9
Separate Accounts with Guarantees	432	.5
Real Estate	4,966	5.9
Schedule BA Assets	4,855	5.7
Asset Concentration Factor	1,885	2.2
Total Underwriting Risk (C2)	15,788	18.7
Individual & Industrial Life Insurance	4,715	5.6
Group & Credit Life Insurance	2,931	3.5
Individual Health Insurance	3,672	4.3
Group & Credit Health Insurance	7,494	8.9
Premium Stabilization Credit	−3,024	−3.6
Total Liability Risk (C3)	9,970	11.8
Interest Rate Risk-Low	3,643	4.3
Interest Rate Risk-Medium	2,171	2.6
Interest Rate Risk-High	4,157	4.9
Total Business Risk (C4)	3,002	3.6
Total Risk-Based Capital Assessments	84,431	100.0
Risk-Based Capital After Covariance	74,577	88.3

Total Adjusted Capital (TAC)	1994 TAC for 1,540 Life Companies (Millions of Dollars)	Percent of Total 1994 TAC
Capital and Surplus	142,109	79.5
Asset Valuation Reserve	25,200	14.1
Voluntary Investment Reserves	1,329	.7
Dividend Liability	6,518	3.6
Life Subsidiaries' Asset Valuation Reserve	3,444	1.9
Total Adjusted Capital	178,855	100.0

Source: Barth (1995).

[3] The assessment for each asset held by insurers, for example, reflects the volatility (standard deviation, σ_i) of its returns multiplied by the proportion of the portfolio invested in the asset (s_i). The volatility of the return on a portfolio comprising two risky assets is

$$\sqrt{(\sigma_1 s_1)^2 + (\sigma_2 s_2)^2 + 2\rho\sigma_1 s_1 \sigma_2 s_2}.$$

This expression equals the weighted sum of the volatilities of the two assets ($\sigma_1 s_1 + \sigma_2 s_2$) only when the correlation coefficient (ρ) between the assets' risks equals its maximal value, one. For all other values of ρ, the risk of the portfolio is less than the simple sum of the assets' risks.

[4] Some of these assessments can be more or less, depending on the concentration of investments, the number of an insurer's investments (bonds), or an insurer's previous losses (mortgages). The assessment for investments in bonds, for example, depends on the number of different bonds held by an insurer. The assessment for companies holding only 50 bonds is about 2.5 times that for companies holding 1,300 bonds. Yet, this size factor recognizes neither the diversification of credit risks over industries or types of issuer nor the diversification of market risk resulting from the conversion, put, or call options and other features of the bonds.

assessment. The last component of RBCR represents other business risks (C4).

The four components of life insurers' RBCR are combined to obtain the authorized control level risk-based capital (ACRBC). A simple sum would treat these four different types of risk as though they were perfectly, positively correlated. Instead, the formula assumes that the asset and interest rate components are so correlated, while the underwriting component is not correlated with either the asset or the interest rate components of RBC:[5]

$$ACRBC = .5 \times (\sqrt{(C1 + C3)^2 + C2^2} + C4).$$

According to the NAIC's model, when the total adjusted capital (TAC) of a life company (Table 1) is more than 2.5 times its ACRBC, the company is not threatened with regulatory action. When TAC is between 1.5 and 2 times ACRBC, the company must present a plan to increase this ratio, to be approved and monitored by its insurance commissioner. When TAC is between 1.5 and 1 times ACRBC, the commissioner also may issue corrective orders to the company. When TAC is less than ACRBC, the commissioner may take the necessary actions to rehabilitate the company, including seizure or liquidation.

Because the underwriting risks of property and casualty companies are commensurately greater than those of life companies, the assessments for these risks represent almost two-thirds of the RBCR for property and casualty companies (Table 2). These underwriting charges for each company—which comprise assessments for net premiums received by line of business, for reserves against future claims, and for loss adjustments—depend on the industry's previous experience in pricing its claims and the company's previous experience relative to that of the industry. Charges for property and casualty insurers' investments in bonds and equity, which are similar to those for life insurers, represent only about one-seventh of the RBCR for property and casualty insurers. The remaining components of RBCR for property and casualty insurers include charges for reinsurance and other receivables as well as for guarantees and other liabilities that do not appear on their balance sheets.

According to the NAIC's formula, the ACRBC for property and casualty companies assumes that the risks for investments in equity and fixed-income securities, credit risks, and underwriting risks are not correlated, while the sum of these risks is perfectly, positively correlated with the asset risk for affiliates:

$$ACRBC = .5 \times (R0 + \sqrt{R1^2 + R2^2 + R3^2 + R4^2 + R5^2}).$$

The NAIC's proposal requires the ratio of the total adjusted capital to ACRBC for property and casualty companies to pass the same tests that are applied to life insurers.

Table 2
Capital of Property and Casualty Insurance Companies

Composition of Risk-Based Capital (RBC)	1994 RBC for 2,244 P/C Companies (Millions of Dollars)	Percent of Total 1994 RBC
Asset Risk—Affiliates (R0)	24,038	18.1
Asset Risk—Fixed Income (R1)	2,633	2.0
Bonds of Affiliated Insurers	273	.2
Other Bonds	1,363	1.0
Bond Size Factor	560	.4
Asset Concentration Factor	210	.2
Asset Risk—Equity (R2)	16,944	12.8
Stock of Affiliates	2,327	1.8
Other Stock	8,852	6.7
Asset Concentration Factor	3,342	2.5
Asset Risk—Credit (R3)	5,632	4.2
Underwriting Risk—Reserves (R4)	52,955	39.8
Underwriting Risk—Written Premiums (R5)	30,693	23.1
Total Risk-Based Capital Assessments	132,894	100.0
Risk-Based Capital After Covariance	94,907	71.4

Total Adjusted Capital (TAC)	1994 TAC for 2,244 P/C Companies (Millions of Dollars)	Percent of Total 1994 TAC
Capital and Surplus	204,808	98.4
Life Subsidiaries' Asset Valuation Reserve	2,971	1.4
Life Subsidiaries' Voluntary Investment Reserves	859	.4
Life Subsidiaries' Dividend Liability	367	.2
Non-Tabular Discount	−864	(.4)
Total Adjusted Capital	208,133	100.0

Source: Barth (1996).

[5] Business risk, according to the formula, is perfectly, positively correlated with the sum of the first three components of risk.

II. Problems with Current Risk-Based Capital Requirements

Risk-based capital requirements for insurance companies, like those for banks and other intermediaries, are new and still experimental. As techniques for measuring risk and regulating intermediaries according to their risks continue to evolve, future capital requirements should satisfy several deficiencies apparent in current regulations. Some of these deficiencies may be remedied by improving the design of prevailing rules but, whatever the design, some may be intrinsic to the strategy itself (Merton 1995).

Risk-based capital requirements for insurance companies, like those for banks and other intermediaries, are new and still experimental.

The current regulations take a narrow view of an insurance company's risks and capital. Risk, according to these regulations, essentially is defined by the properties of each class of asset and each class of obligation. Because the regulations admit only the correlation coefficients of zero or one among these risks, RBCR essentially make little allowance for the diversification of investments or for matched books. Moreover, measures of capital, the gauge of insurers' capacity for bearing risk, are defined by combinations of market and book values, not by a consistent accounting framework.

These apparent deficiencies in existing regulations may reflect more than problems with technical details. If markets for financial instruments are not perfect, as assumed in the financial theory behind RBCR, then coherent measures of risk and capital may be elusive. Therefore, if the assets and liabilities of insurers are not always priced efficiently in liquid markets, the strategy of promptly enforcing any capital requirement at times may undermine, rather than foster, safe and sound financial institutions.

The Concept of Risk in RBC

Prevailing RBC assessments for the risk in assets (C1) depend little on the diversification of an insurance company's portfolio of assets. The risk of financial instruments is defined by the share of the volatility of their returns that cannot be offset or fully diluted when they are combined with other investments. Accordingly, the risk inherent in any stock, bond, or loan depends on the division of an investor's assets among other investments. Yet, the RBC assessment for an investment in IBM shares, for example, is much the same whether an insurer's equity portfolio comprises the S&P 500 or only technology stocks, whether an insurer "overweights" or "underweights" equity among its assets.[6] Furthermore, by adding the assessments for investments in stocks, bonds, mortgages, and other assets, the RBC rules that define asset charges essentially assume that the returns on all assets are perfectly, positively correlated. The rules give insurers comparatively little credit for hedging their investments by holding assets whose returns either may tend to move in opposite directions or, at least, may not tend to rise and fall together very strongly.

The RBC assessments also do not change as the risks inherent in and among the assets change. The variances and covariances of returns in the past have varied with the phases of the business cycle, the rate of inflation, changes in relative prices (oil shocks, changing exchange rates, monetary policy), or the magnitude and composition of technological innovations in the economy. The variances and covariances among returns also depend on the length of time that insurers hold their assets and obligations.

As a consequence of this inflexible pricing of risk, prevailing RBC regulations are not so much a new way of measuring and controlling insurers' risks as they are an adjustment of the prices embedded in those controls. Regulations formerly proscribed certain investments by imposing prohibitive costs on insurers who might have considered buying these "risky" assets. RBC regulations reduce, but do not eliminate, these costs. For example, RBC rules assess an insurer purchasing IBM shares a 30 percent asset charge, regardless of the insurer's efforts to hedge its investment in IBM or diversify its portfolio; consequently, this charge encourages the insurer to shun

[6] Because RBCR include an asset concentration factor, the assessments are lower for portfolios that spread their investments in equity more evenly among more stocks or for portfolios that hold more assets other than stocks. But, neither this concentration factor nor the size factor (see footnote 4) takes into account the correlations among the returns on these assets in order to measure properly the degree to which a portfolio has reduced its risk by diversifying its investments.

equity in favor of other investments that entail smaller costs.

Contrary to the strategy incorporated in RBC regulations, the risks inherent in liabilities cannot be measured and controlled apart from asset risk. Interest rate assessments do not depend on the composition of an insurer's assets or the nature of its other obligations. The assessment for a company that issues many short-term policies or contracts is less than the assessment for a company that issues many long-term contracts that make specific guarantees to policyholders. If, however, the first company invested the proceeds of its contracts entirely in long-term bonds (a strategy of leverage similar to that of Orange County recently or much of the savings and loan industry before the mid-1980s), its risk could be many times that of the second company. The second company's contracts, on the other hand, might bear little risk if it had purchased suitable structured notes, swaps, or interest rate options. Ironically, this financial reinsurance entails additional RBC assessments even if companies use these instruments to reduce their risk. Despite the differences in their liabilities, both companies essentially could eliminate their interest rate risk by matching closely the terms and features of their assets to the terms and features of their liabilities. Such matched books also would reduce substantially their asset risk.

The Measurement of Capital

When financial markets are perfect, an insurance company's capital, the difference between the market values of its assets and its liabilities, measures its capacity for protecting the investments of its policyholders and other creditors. Yet, prevailing accounting standards value some assets of insurers according to their market values, other assets according to their book values (reflecting their face values or acquisition costs plus any necessary adjustments), and most liabilities according to their guaranteed face values. This mixture of accounting techniques can produce biases in the measurement of an insurer's capital, biases that would undermine the value of RBC standards even if these standards properly reflected the company's risks (Carey 1995). Companies that actually lack sufficient capital, for example, might meet their standards if book values overstated the values of certain risky investments; conversely, other companies possessing sufficient capital might fail to meet their standards if book values overstated the values of their liabilities.

Although RBC standards, at least in principle, recognize that the values of the assets and liabilities of insurance companies can vary with economic conditions, the measure of the capital that is to be compared to these standards may not reflect the changing values of these financial instruments. For example, current regulations do not recognize the "capital" that insurers carry by matching their assets with their obligations. Should interest rates rise abruptly, the prices of equities and bonds would fall, thereby depressing the value of assets and the capital of insurers. Yet, for the same reason the prices of these assets fall, the "prices" of longer-term, market-priced insurance or annuity contracts fall as well. Insurers that have issued these contracts are credited with lower RBC requirements, but this may be little solace if, for want of market value accounting for their liabilities, they are given no credit for preserving their capital as the value of their contracts falls in concert with that of their assets. Just as the capital of these companies would be understated when interest rates are rising, their capital would be overstated when rates are falling. Similarly, the reporting of mortgages and other investments at book values also distorts the measurement of capital.

Market-value accounting for all assets and liabilities is not a panacea, because it too may misrepresent the capital of insurance companies.

Market-value accounting for all assets and liabilities is not a panacea, however, because it too may misrepresent the capital of insurance companies. To the degree insurers hold assets that do not trade in perfect markets, they also may hold "capital" in the form of excess returns on these proprietary assets. Insurers, like other financial intermediaries, profit by investing in assets that are not very familiar within public financial markets and, therefore, are not priced efficiently by those markets. For providing this service and bearing the attendant risks, insurers may earn, on average, an extra margin in their returns over time, a margin that outside investors may not recognize consistently. If outside investors too often are wary of the value of these proprietary assets and the markets for these assets too often are shallow or illiquid, market

prices in these circumstances can be biased estimates of their values.[7] As the optimism of outsiders rises, prices of these assets may nearly meet or exceed proprietary valuations for a time, only to fall below proprietary valuations when this optimism subsequently ebbs. This potential volatility of prices for these assets induces a commensurate volatility of insurers' capital with market accounting. Insurance companies in the United States and Japan as well as banks in Texas, New England, Scandinavia, and Japan, for example, possessed more than adequate protection when the value of the enterprises and real estate backing their assets was very great, but their capital eroded quickly when the prices of these assets collapsed.

The Prompt Enforcement of RBCR Is Not the Same as Portfolio Insurance

Policies for enforcing capital requirements that promote sound insurance companies in some circumstances might fail to do so in other circumstances. For example, the prompt enforcement of RBCR is a conservative policy when the markets for financial instruments are liquid. Yet, this policy tends to weaken insurers when outsiders are most skeptical of the returns on their risky assets and the prices of these assets understate their value significantly.

If risky assets were priced efficiently, tomorrow's news would be no more likely to increase the value of these assets more than expected than to decrease their value more than expected (Cootner 1964; Merton 1990). Consequently, should substantial losses reduce a company's capital per dollar of risky assets, the chance that surprisingly high returns on these assets subsequently would increase the capital-asset ratio is little greater than the chance that surprisingly low returns would reduce this ratio. As the value of a company's assets falls relative to its obligations, the odds of insolvency increase, and prudent supervisors would require that safe assets supplant risky assets, thereby reducing the company's risk to correspond to its diminished capital.

Nonetheless, the prompt enforcement of capital requirements is not necessarily a conservative policy when markets are not liquid. If proprietary assets are not priced efficiently, their values may not follow random walks. Instead, the prices of these assets may revert to trends: Once a price falls below its proprietary valuation, the odds of its returning increase with time, while the odds of its falling further diminish. The prompt enforcement of capital requirements may even magnify the degree to which the prices of these assets diverge from trends. If, for example, an insurer must sell risky assets in order to restore its ratio of capital to risky assets after the prices of these assets subside in the opinions of outsiders, then these prices will fall further in illiquid markets.[8] After the prices of risky assets fall substantially the chance of redeeming capital gains increases with time, while the chance of commensurate losses diminishes. Therefore, when the value of an insurer's assets approaches that of its obligations and its liabilities are of sufficiently long duration, its expected losses due to insolvency may be low compared to the expected gains from retaining these assets.

Suppose an insurer attempts to maintain a ratio of capital to assets of 10 percent, while investing 40 percent of its assets in proprietary investments, 60 percent in safe assets. Because policyholders believe the insurer is regulated adequately, the yield on these accounts equals the yield on safe assets. The prices of proprietary investments follow a smoothed random walk: A below-average return on these assets creates no expectation of compensating above-average returns subsequently. When favorable earnings increase its capital per dollar of assets, the insurer sells more contracts, investing the funds as required to maintain the 3:2 ratio between its safe and risky assets. When poor earnings reduce its capital per dollar of assets, the insurer sells no new contracts and acquires no new risky debt. The capital of this insurer approaches zero, on average, nearly twice every one hundred years (Figure 2a). When the insurer practices portfolio insurance, selling risky assets as required in order to prevent the ratio of risky assets to capital from exceeding 4, then its capital approaches zero less than once every century (Figure 2b).

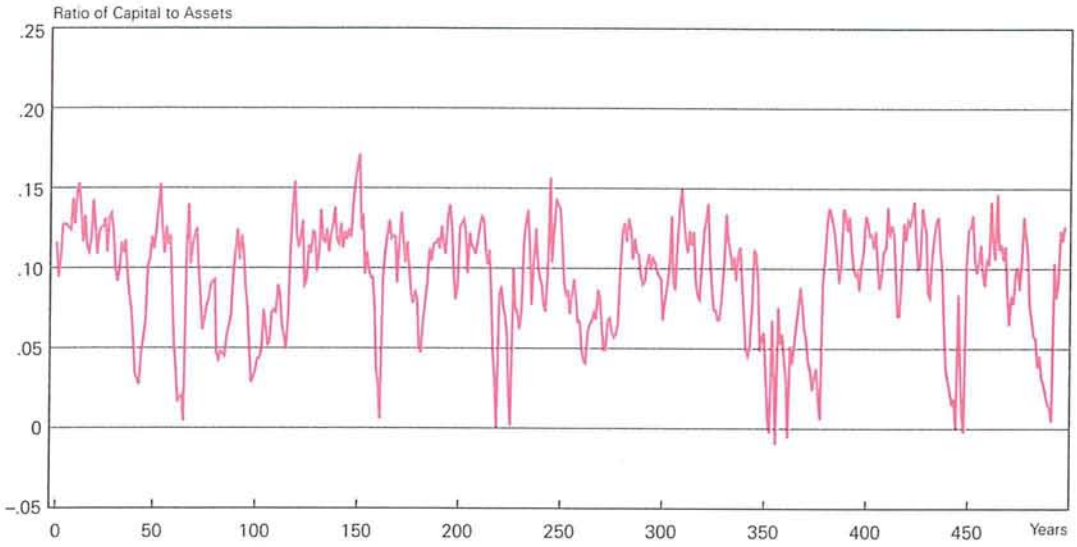
If the values of proprietary assets tend to return to trend—a run of below-average returns increases the odds of earning above-average returns—the capital-to-asset ratio almost never approaches zero with the

[7] When no true prices are quoted in markets for assets, supervisors often resort to prices of comparable assets, prices derived from models, or book values of assets net of estimates of losses (due to default or workouts).

[8] Disposing of risky assets is frequently more economical than selling new equity. When an insurer has reported losses great enough to impair its capital, wary outsiders are not likely to value its equity very greatly. If the insurer sold those assets that are most familiar to outside investors, it would only increase the proportion of its liabilities backed by questionable risky assets. If, however, outsiders discounted the value of risky assets too greatly, so that selling these assets entailed substantial losses and the insurer's capital were sufficiently near insolvency, management would need to issue new equity.

Figure 2a

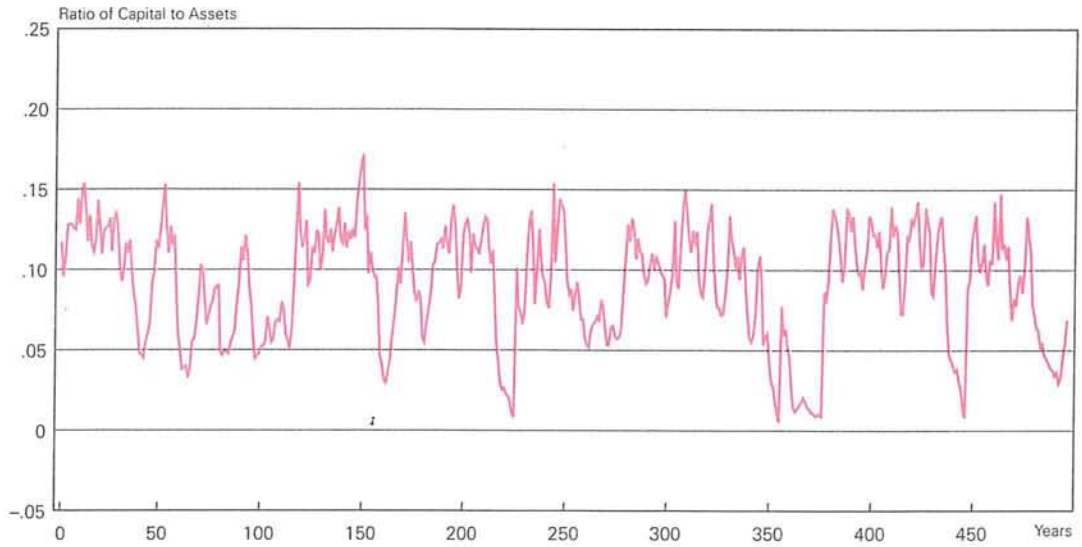
Capital Ratios When Prices of Assets Follow a Random Walk



See Appendix.

Figure 2b

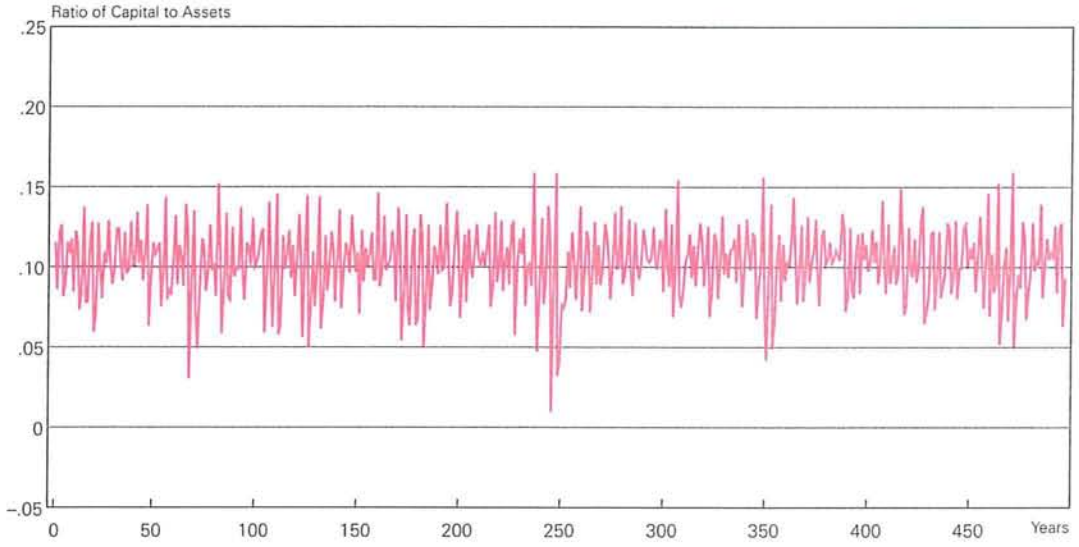
Capital Ratios When Prices of Assets Follow a Random Walk and Capital Requirements Are Promptly Enforced



See Appendix.

Figure 2c

Capital Ratios When Prices of Assets Revert to Trend



See Appendix.

Figure 2d

Capital Ratios When Prices of Assets Revert to Trend and Capital Requirements Are Promptly Enforced

See Appendix.

investment strategy described in the first simulation (compare Figure 2c to 2a), even though the annual volatility of the rate of return on proprietary assets is greater than in the first case. If, in this last instance, the insurer practices portfolio insurance by selling some of its risky assets after their values decline and if the disposal of these assets temporarily reduces their prices by an additional 10 percent, then the insurer's average capital-asset ratio (Figure 2d) falls and becomes more volatile. Consequently, the insurer's capital approaches zero more frequently, about once every century, when it sells its risky assets at distressed prices in order to meet its capital requirements. Furthermore, this policy of promptly enforcing capital requirements induces a clear credit cycle: The lending capacity of the insurer, as reflected in its capital per dollar of assets, falls further and remains depressed longer in this last case than it did in the former.

This example does not imply that financial institutions that hold illiquid assets always ought to enjoy the protection of forbearance. To be sure, the falling prices of mortgages and real estate during the commercial real estate slump of the 1990s greatly diminished the capital of many banks, a loss that often was exaggerated by their need to sell these investments. Insurance companies, on the other hand, generally survived the experience with less duress by not marking these assets according to market prices and for not having to sell them at bargain prices. Whereas patience was appropriate for insurers that financed their investments in real estate with longer-term policies that included an adequate pricing of policyholders' put options, this patience was less suitable for insurers that, like banks, had assumed more risk by financing these investments with short-term contracts or contracts that gave policyholders generous guarantees.

III. Beyond Current Risk-Based Capital Requirements

According to the current design of risk-based capital requirements, insurance companies should hold capital in proportion to their investment in assets that are designated risky, but these standards measure neither the protection for policyholders embedded in insurers' portfolios nor the rate at which this protection might change with economic conditions (Grenadier and Hall 1995). Furthermore, to the degree insurance companies hold assets that are not priced efficiently in public markets, the prompt enforcement of these capital standards might undermine, rather than foster, the safety and soundness of insurance companies. In any case, the difference between the values of an insurance company's assets and liabilities, whether these values are market or book, does not measure properly its "capital"—the protection inherent in its stream of net income—when its assets and obligations are not priced efficiently in liquid markets.

By pricing risk inaccurately, existing risk-based capital requirements may diminish the efficiency of financial markets by discouraging insurance companies from holding those assets that are not very familiar in public markets and those longer-term assets that are designated as most risky. The need to justify the valuation of assets and the potential need to sell risky assets in times of duress encourage an insurer to shun investments whose value to the company depends too greatly on the company's proprietary information. Insurers, therefore, withdraw to a degree from their role as financial intermediaries as they increasingly favor liquid, familiar assets. Insurers also cede financial intermediation to others as they alleviate their capital requirements by promoting business linked to separate accounts or mutual funds wherein policyholders bear more of the risks of the investments backing their contracts. This "mutual fund" strategy currently appeals to many customers who, as a result of the comparatively great yields generated by stocks and bonds since 1980, often expect to earn generous returns while bearing commensurately little risk.

Risk managers and regulators might use the models behind value-at-risk calculations to isolate those economic conditions that threaten the solvency of insurance companies.

Alternative standards for the capital of insurance companies ultimately might diminish such disintermediation by assessing the influence of economic conditions on insurers' earnings and cash flows, instead of "taxing" various assets and liabilities. The New York State Insurance Department, for example, requires a cash flow test for certain life insurance and

annuity contracts in order to assess the risks in these contracts. If a company's losses would threaten its solvency should interest rates rise 300 basis points or more, the company's directors and regulators might encourage the company to issue more equity or to alter the composition of its assets and liabilities in order to mitigate this threat. Such tests implicitly weigh the consequences of different portfolio strategies, including those related to: (1) the options assumed by insurers, including those embedded in their assets and liabilities; (2) the mismatches between long and short commitments at various maturities; (3) the correlation of returns among assets and liabilities; and (4) the possibility that the prices of some assets collapse and their maturities increase for want of dependable markets. These tests should be dynamic, incorporating managements' responses to changing conditions and covering intervals of time sufficiently long to encompass the full consequences of these changing conditions.

Some financial institutions currently are using models of "value-at-risk" in order to assess the adequacy of their capital. These strategies, using management's assessment of the likelihood of potential economic conditions, calculate the odds of an institution losing its capital. In principle, an insurer could avoid financial strategies for which the probability of its insolvency exceeded its tolerance. Nevertheless, the insurers still must contend with the risk that changing economic conditions entail surprisingly sharp changes in the prices of assets as well as in the customary covariances among the returns on these assets.

Risk managers and regulators might use the models behind value-at-risk calculations to isolate those economic conditions that threaten the solvency of insurance companies. A conservative policy might require that insurers adopt financial strategies that limit their maximum losses for all "feasible" conditions, a kind of minimax strategy. Each insurer's need for "capital" would vary according to the mix of its assets and liabilities. If, for example, a company is vulnerable to a specific shift of the yield curve, regulators might counsel it to alter its investments, to purchase hedges, or to sell more equity to insure that its earnings remained sufficiently great compared to its obligations should such a shift occur, even if this event were not regarded as a very likely threat.[9] This version of risk-based capital requirements might reveal best the risks that insurance companies were bearing and, when necessary, might tie their need for capital most directly to these risks, rather than to their commitments to individual assets and liabilities.

[9] Of course, the lower the odds of such an event, the more cheaply the company may purchase insurance for its potential loss. The most economical insurance may take the form of new investments or derivatives contracts designed to cover these specific risks rather than the umbrella insurance policy entailed by raising new capital.

Appendix

Figure 2

Panel a: An insurer holds risky and safe assets, financed by equity and "contracts." The expected return on risky assets, $E(r_t)$, is 10 percent annually; the standard deviation of this return, $\sigma(\varepsilon_t)$, is 6 percent annually; and the correlation coefficient between annual returns (a first-order Markov process) is 60 percent:

$$r_t = .10 + \varepsilon_t$$

$$\varepsilon_t = .6\varepsilon_{t-1} + \eta_t$$

$$\eta_t \sim N(0, .06^2(1 - .6^2)).$$

The return on the insurer's safe assets and the return that the insurer pays on its contracts is 7 percent. The values of risky and safe assets increase according to their returns and any new investments in these assets, Δ^r and Δ^s; likewise, the value of its contracts increases as a result of crediting interest and new inflows, Δ:

$$V_t^r = V_{t-1}^r(1 + r_t) + \Delta_t^r$$

$$V_t^s = V_{t-1}^s(1.07) + \Delta_t^s$$

$$L_t = L_{t-1}(1.07) + \Delta_t.$$

The capital of the insurer, C, is the difference between the value of its assets and the value of its contracts, L. When its capital per dollar of assets the previous year exceeds its target of 10 percent, the insurer issues new contracts; otherwise, Δ is zero. If the insurer's risky assets are less than 4 times its capital, the insurer purchases more risky assets in order to maintain the ratio of 2 dollars of risky assets for every 3 dollars of safe assets; otherwise, Δ^r is zero:

$$\Delta_t = \max([10C_{t-1} - (V_{t-1}^r + V_{t-1}^s)], 0)$$

$$\Delta_t^r = \max([4C_t - V_{t-1}^r(1 + r_t)], 0)$$

$$\Delta_t^s = \Delta_t - \Delta_t^r.$$

When the insurer's capital falls below 0.5 percent, it "fails," and its capital is restored to 10 percent. In the simulation

shown in the graph, the insurer fails 11 times, its mean capital-asset ratio is 9.5 percent, and the annual standard deviation of this ratio is 3.5 percent.

Panel b: The assumptions are the same as those for the previous panel, except that the insurer sells risky assets in order to maintain only 4 dollars of risky assets per dollar of capital when this ratio exceeds 4:

$$\Delta_t^r = 4C_t - V_{t-1}^r(1 + r_t).$$

In the simulation shown in the graph, the insurer fails 4 times, its mean capital-asset ratio is 9.1 percent, and the annual standard deviation of this ratio is 3.5 percent.

Panel c: The assumptions are the same as those for the first panel, except that the value of risky assets tends to revert to a trend:

$$trend_t = V_0^r(1.1)^t$$

$$r_t = .10 + \varepsilon_t$$

$$\varepsilon_t = .6\varepsilon_{t-1} - 2\log(V_{t-1}^r - trend_{t-1}) + \eta_t$$

$$\eta_t \sim N(0, 0.5^2(1 - .6^2))$$

$$V_t^r = V_{t-1}^r(1+\mathrm{r_t}).$$

The standard deviation of annual returns behind the simulation shown in the graph is 7.5 percent. Yet, because of the tendency of the value of risky assets to revert to trend, the insurer does not fail during this simulation, its mean capital-asset ratio is 10.3 percent, and the annual standard deviation of this ratio is 2.2 percent.

Panel d: The assumptions are the same as those for the previous panel, except that the insurer sells risky assets in order to maintain only 4 dollars of risky assets per dollar of capital when this ratio exceeds 4, and that this sale entails transactions costs equal to 10 percent of the value of the risky assets that are sold.

In this simulation, the insurer fails 5 times, its mean capital-asset ratio is 9.1 percent, and the annual standard deviation of this ratio is 3.6 percent.

References

Barth, Mike. 1995. "Trends in Life Risk-Based Capital Results." *National Association of Insurance Commissioners Research Quarterly*, vol. 1, no. 4, October, pp. 50–55.

———. 1996. "Risk-Based Capital Results for the Property-Casualty Industry." *National Association of Insurance Commissioners Research Quarterly*, vol. 2, no. 1 (January), pp. 17–31.

Carey, Mark. 1995. "Partial Market Value Accounting, Bank Capital Volatility, and Bank Risk." *Journal of Banking and Finance*, vol. 19, no. 3–4, June, pp. 607–22.

Cootner, Paul H., ed. 1964. *The Random Character of Stock Market Prices*. Cambridge, MA: MIT Press.

Cummins, J. David, Scott E. Harrington, and Robert Klein. 1995. "Insolvency Experience, Risk-Based Capital, and Prompt Corrective Action in Property-Liability Insurance." *Journal of Banking and Finance*, vol. 19, no. 3–4, June, pp. 511–27.

Cummins, J. David, Scott E. Harrington, and Greg Niehaus. 1994. "Risk-Based Capital Requirements for Property-Liability Insurers: A Financial Analysis." In E.I. Altman and I. T. Vanderhoof, eds., *The Financial Dynamics of the Insurance Industry*, pp. 111–51. Homewood IL: Irwin Professional Publishers.

Fortune, Peter. 1995. "Stocks, Bonds, Options, Futures, and Portfolio Insurance: A Rose by Any Other Name. . . ." *New England Economic Review*, July/August, pp. 25–46.

Grenadier, Steven R. and Brian J. Hall. 1995. "Risk-Based Capital Standards and the Riskiness of Bank Portfolios: Credit and Factor Risks." National Bureau of Economic Research Working Paper No. 5178, July.

Merton, Robert C. 1990. *Continuous Time Finance*. Cambridge, MA: Blackwell Publishers.

———. 1995. "Financial Innovation and the Management and Regulation of Financial Institutions." *Journal of Banking and Finance*, vol. 19, no. 3–4, June, pp. 461–82.

Myers, Stewart C. 1984. "The Capital Structure Puzzle." *Journal of Finance*, vol. 39, no. 3, pp. 575–92.

Myers, Stewart C. and N. S. Majluf. 1984. "Corporate Financing and Investment Decisions When Firms Have Information Investors Do Not Have." *Journal of Financial Economics*, vol. 13, no. 2, June, pp. 187–221.

Sharpe, William F. and Gordon J. Alexander. 1990. *Investments*. Englewood Cliffs, NJ: Prentice Hall.

Webb, Bernard L. and Claude C. Lilly III. 1995. *Raising the Safety Net: Risk-Based Capital for Life Insurance Companies*. Kansas City, MO: National Association of Insurance Commissioners.