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The Persistence of Inflation and the Cost of Disinflation

Jeffrey C. Fuhrer

How costly would it be in terms of lost output and jobs to lower the inflation rate to zero? One can answer this counterfactual question only in the context of a model that allows us to estimate the effects of pursuing counterfactual monetary policies. The answer to the question can vary widely depending upon the characteristics of the model used to address it.

This article argues that one cannot answer the above question accurately without using a model that properly captures an important feature of the real world: the persistence of inflation. This persistence and the cost of disinflating may arise for several reasons, including the inertia that wage and price contracts impart to the inflation rate, the inertia that slowly adjusting expectations may impart to inflation, or the inertia that imperfect credibility may impart to inflation. The author examines the question using the results of both stylized and fully articulated models. 3

Interest Rate Derivatives and Asset-Liability Management by Commercial Banks

Katerina Simons

Bank participation in derivative markets has risen sharply in recent years. The total amount of interest rate, currency, commodity, and equity contracts at U.S. commercial and savings banks soared from $6.8 trillion in 1990 to $11.9 trillion in 1993, an increase of 75 percent. A major concern facing policymakers and bank regulators today is the possibility that the rising use of derivatives has increased the riskiness of individual banks and of the banking system as a whole.

This study uses quarterly Call Report data to shed some light on the pattern of derivative use by U.S. commercial banks. It finds that among banks with assets of less than $5 billion, larger banks tend to use interest rate swaps more intensively, while no clear relationship was found between size of bank and other interest rate derivatives. In addition, the study found that for banks with more than $5 billion in assets, those with weaker asset quality tend to be more intensive users of derivatives than banks with better asset quality. However, the author points out that these results, while intriguing, do not give a clear indication of how derivatives are used to manage interest rate risk, or whether they are used to increase or reduce that risk. 17

Contents

Financial Innovation and Standards for the Capital of Insurance Companies

Richard W. Kopcke

Since their inception, insurance companies, banks, and other financial institutions have played prominent roles in our capital markets. These intermediaries have fostered saving and investment by issuing liabilities that appeal to savers in order to purchase the obligations of investors on attractive terms. Among financial intermediaries, life insurance companies traditionally have distinguished themselves by attracting long-term savings and by providing long-term financing for investment in real estate and durable equipment by businesses.

This article reviews the distinctive features of life insurance companies and how they have reshaped their liabilities and restructured their assets in order to cope with the consequences of rising interest rates and increasing competition for savings during the past three decades. The author analyzes the consequences of these financial innovations for the capital of the industry as well as the distribution of capital among life companies, and goes on to examine the issues relevant for measuring and controlling the capital of life companies. He concludes that prudent standards for capital should take into account an insurance company's entire balance sheet, not just its holdings of risky assets. Marking only risky assets according to their disposal values, while reporting other assets and liabilities according to other rules, can greatly misstate the financial condition of life insurance companies. And to the degree that financial intermediaries increasingly favor more familiar assets, the role of nonfinancial corporations as financial intermediaries will continue to expand.

The Persistence of Inflation and the Cost of Disinflation

Jeffrey C. Fuhrer

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Some economic questions can be considered only within the context of an economic model. For example, "How costly would it be (in terms of lost jobs and output) to lower the inflation rate to zero?" is a question that, because it is counterfactual, can only be answered by creating an economic model that allows us to estimate the effects of pursuing counterfactual economic policies. Models are not all created equal, however, so that the answer to this question can vary widely depending upon the characteristics of the model used to address the question.

This article will argue that one cannot answer the above question accurately without using a model that properly captures an important feature of the real world: the persistence of inflation. In essence, the more persistence inflation exhibits, the harder monetary policy has to push on it to bring it down. The harder monetary policy has to push, the more it will disrupt the real economy, and the greater will be the cost associated with disinflating.

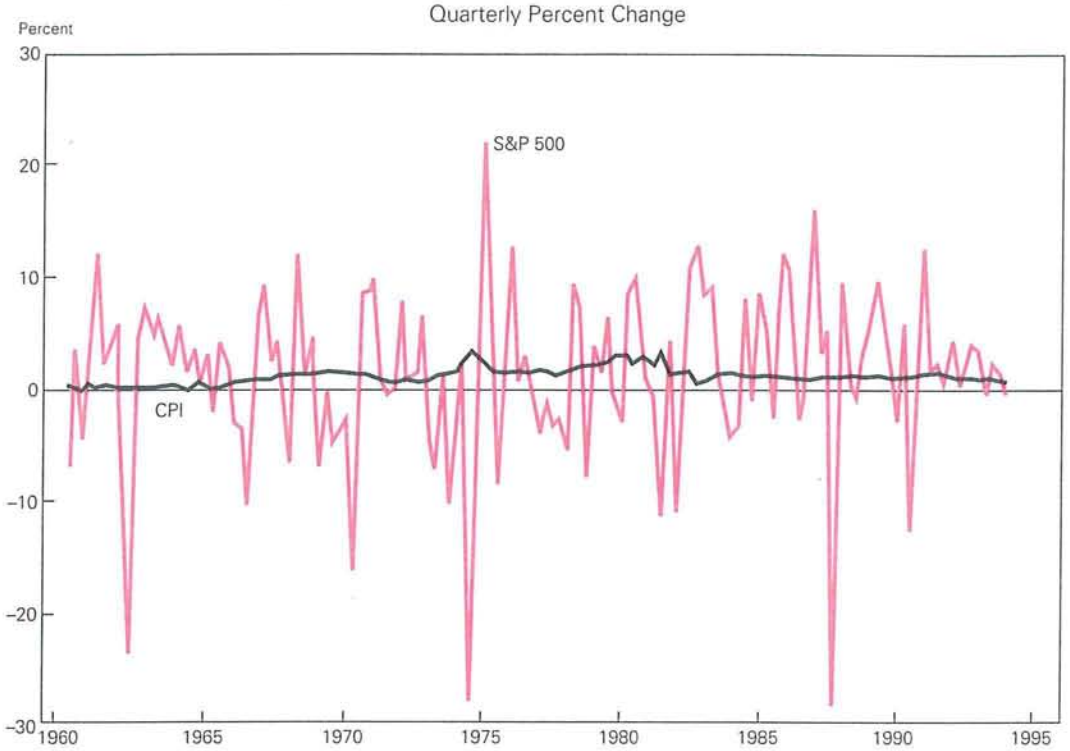
While there is wide agreement that inflation is persistent and that disinflations have been costly, the source of persistence and the reason for the cost are not widely agreed upon. As will be discussed below, persistence of inflation and the cost of disinflating may arise for several reasons, including the inertia that wage and price contracts impart to the inflation rate, the inertia that slowly adjusting expectations may impart to inflation, or the inertia that imperfect credibility may impart to inflation.[1] This study will demonstrate the importance of persistence in a model of inflation, and then consider each of the explanations given above.

Different sources of inflation persistence bear different implications for the conduct of monetary policy. If disinflations are costly because the Federal Reserve lacks credibility, then the Fed should determine whether and how it can improve its credibility. If persistence arises from other aspects of price-setting behavior, then monetary policy must accept the costs of disinflation unless these behaviors change.

Figure 1

Inflation Rates in Core CPI versus Stock Prices

Quarterly Percent Change



Source: U.S. Bureau of Labor Statistics, Consumer Price Index, all items less food and energy, seasonally adjusted. Standard & Poor's Index of Stock Prices, U.S. 500 Common Stocks.

I. Defining Persistence

What do economists mean when they talk about the "persistence" of an economic variable? Persistence refers to the tendency for a variable to stay away from its average level for an extended period when perturbed.[2] For example, when the unemployment rate deviates significantly from its "natural" rate, most economists would not expect it to return immediately. Similarly, this study will show that historically, when inflation has deviated from the rate that the monetary authority desires, its return to the desired rate takes quarters or years, not weeks or months. Failure of the model to incorporate this "inflation persistence" can produce misleading policy prescriptions.

The persistence of inflation in the prices of goods and services contrasts sharply with the lack of persistence in the inflation in prices of financial assets. A leading example is the price of stocks traded on the New York Stock Exchange. The rate of change in a basket of stock prices, which averages out idiosyncratic movements of individual stocks, shows little or no persistence. A graphical comparison of these two qualitatively different behaviors is displayed in Figure 1, which shows the monthly percentage changes in the consumer price index (CPI) and the Standard & Poor's composite stock index. The difference in the volatility

[1] Blinder (1991) and Carlton (1986) provide survey evidence of the prevalence of price and wage contracting arrangements.

[2] Thus, this definition assumes the existence of an average level. For many economic measures—the inflation rate, the unemployment rate, the savings rate—this assumption may be a reasonable approximation to reality. For others—the general price level, the level of GDP—it is clearly false. However, even for the latter measures, their *growth* rates may well tend to settle at an average level.

of the two series is obvious and striking. Stock prices are about as likely to rise as to fall markedly from month to month, regardless of which direction they were headed last month. The CPI changes only a bit from month to month, and the tendency for positive (negative) changes to be followed by positive (negative) changes is pronounced.

Common-sense economic reasons can be given for the difference in the behavior of these two types of prices. The prices of financial assets may be thought of as the valuation that the financial markets place on the expected stream of returns to holding the asset. For equities, the price will reflect the (discounted) expected earnings that a firm will accrue over its lifetime, or the dividends that the firm is expected to pay to shareholders over its lifetime. Thus, the price depends on the market's *expectations*, which are free to change from minute to minute.

In essence, the more persistence inflation exhibits, the harder monetary policy has to push on it to bring it down, and the more it will disrupt the real economy.

In contrast, the prices of goods and services—the prices of chicken and haircuts, for example—cannot move as freely as the prices of financial assets. While their prices may reflect in part the expectations of market participants, they also depend on the cost of inputs to production and the terms of contracts with suppliers and buyers. The largest of the input costs for most goods and services is the cost of labor, which varies slowly as salaries and benefits are adjusted, usually annually. Thus, it is unlikely that the average level of goods and services prices, as reflected in the CPI, for example, will exhibit the same flexibility as the average level of financial asset prices.

Measuring the Persistence of Inflation

One commonly used measure of the persistence in an economic measure is its *autocorrelation function*. The autocorrelation function, as its name suggests, describes the correlation of an economic time series with its own history. For example, a variable would be said to exhibit a positive autocorrelation if an above-average (below-average) reading for the variable over the past few time periods tended to be followed by an above-average (below-average) reading for the variable in the current period. A variable is said to exhibit negative autocorrelation when an above-average (below-average) reading over the last few quarters tends to be followed by a below-average (above-average) reading in the current quarter. The variable exhibits zero autocorrelation when positive readings in past quarters are not followed systematically by either positive or negative readings.

Thus, the autocorrelation function provides a measure of the persistence in an economic time series. When economic conditions push inflation away from its average level, if it tends to stay away, then we will see positive autocorrelation in the rate of inflation. If instead, when economic conditions push inflation away from its norm, it reverts immediately to its norm, we will see no autocorrelation in the rate of inflation.

Figure 2 displays the autocorrelation functions for several measures of inflation over the past 25 years. As the panels in the figure show, all of the measures of inflation exhibit a good deal of persistence: Higher-than-average levels of inflation over the past 1 to 12 quarters tend to be followed by higher-than-average levels of inflation today. This appears to be a strong qualitative feature of the inflation data, not dependent upon the precise definition of inflation nor on the sample period over which the autocorrelation function is computed. In contrast, the autocorrelation function for the stock price index in the bottom panel shows little or no significant autocorrelation; it is not very persistent at all.

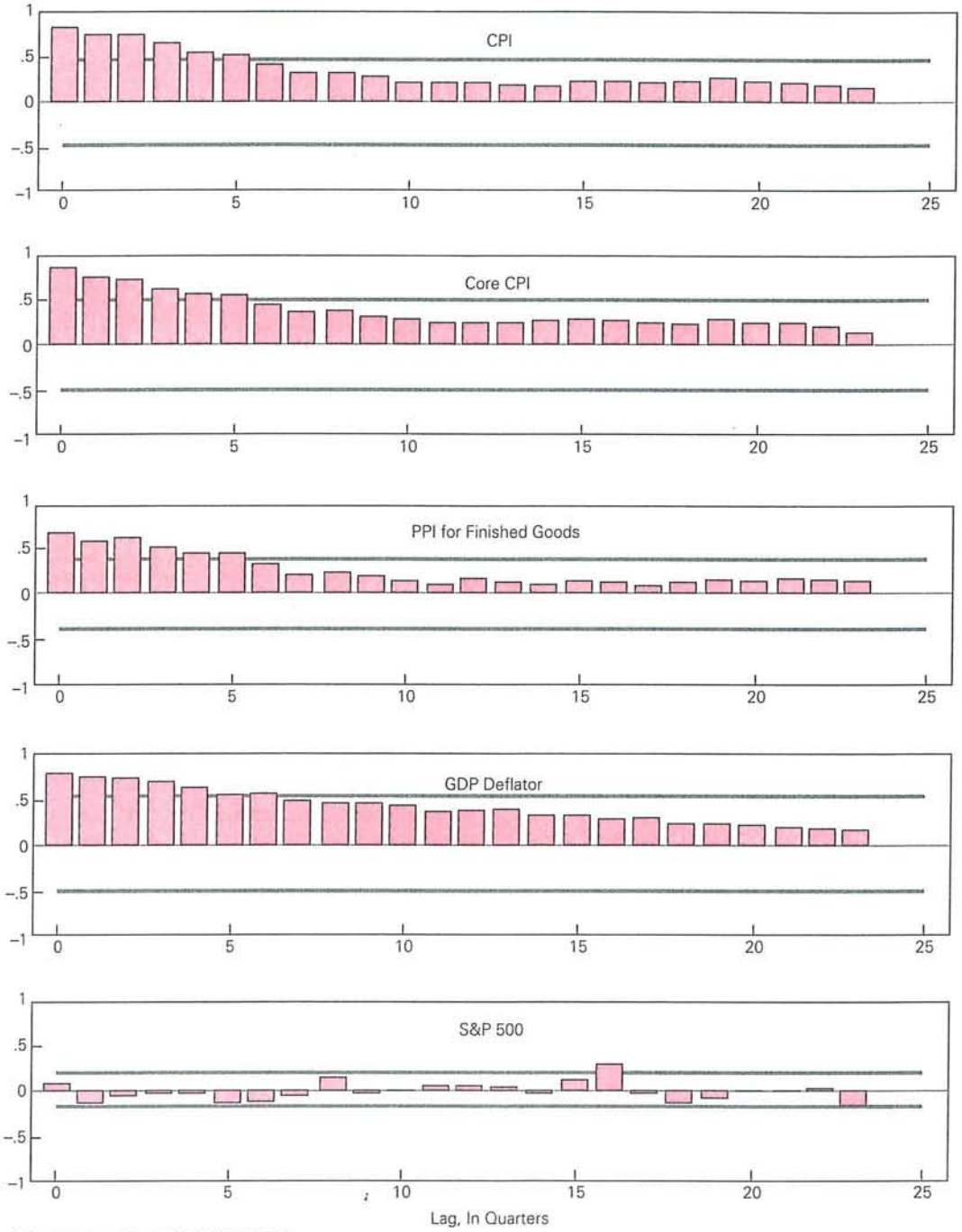
Figure 3 displays the response over time of inflation to a perturbation of inflation from its average level (for example, an oil price shock).[3] As the figure illustrates, inflation historically has not returned quickly to its average level in response to shocks, but has instead remained away from its average level for several years, only gradually returning to its resting place.[4] The rate of change of stock prices, on the other hand, shows no such persistence.

[3] The responses are computed from regressions of measures of inflation on their own lags and a constant.

[4] This simple description of inflation does not distinguish among different types of shocks to inflation. For example, inflation might respond differently to a supply shock, such as a change in the relative price of oil, than it responds to a demand shock, such as unexpectedly accommodative monetary policy. Note that in Figure 2, the average level to which all the inflation rates return is set arbitrarily to zero.

Figure 2

Autocorrelation Functions for Various Inflation Rates

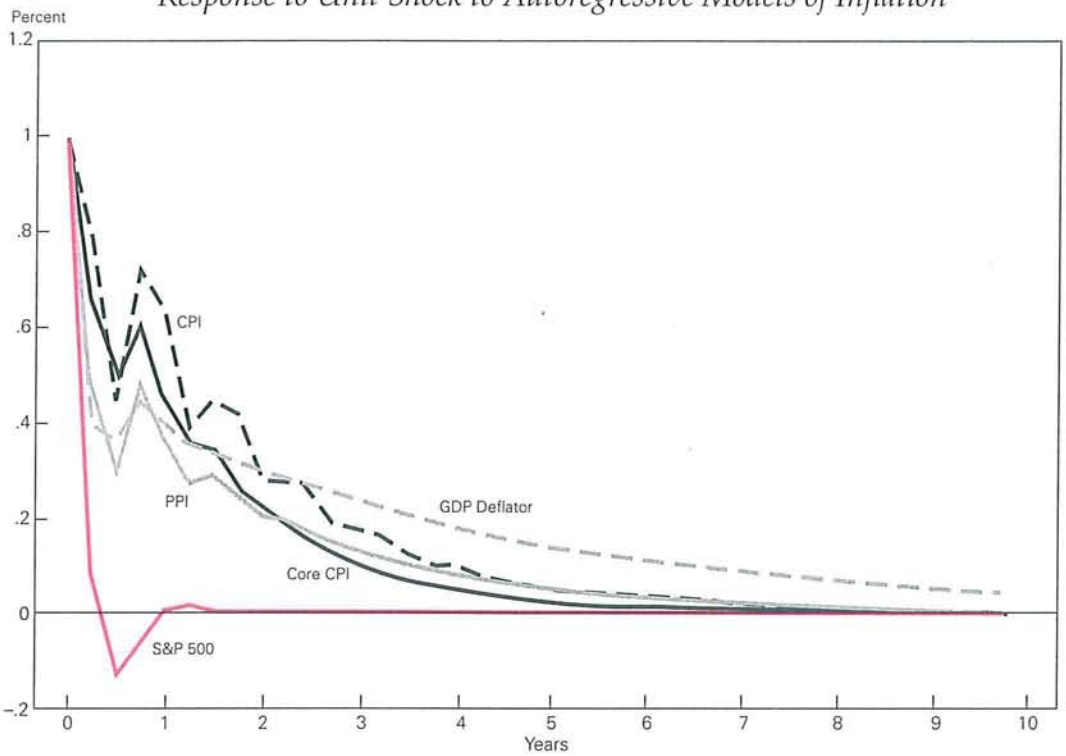


Note: Lines denote two standard error bands.

Source: U.S. Bureau of Labor Statistics, Consumer Price Index, all items, seasonally adjusted; Consumer Price Index, all items less food and energy, seasonally adjusted; Producer Price Index, finished goods, seasonally adjusted; U.S. Bureau of Economic Analysis, Gross Domestic Product Implicit Deflator. Standard & Poor's Index of Stock Prices, U.S. 500 Common Stocks.

Figure 3

Response to Unit Shock to Autoregressive Models of Inflation



Source: See Figure 2.

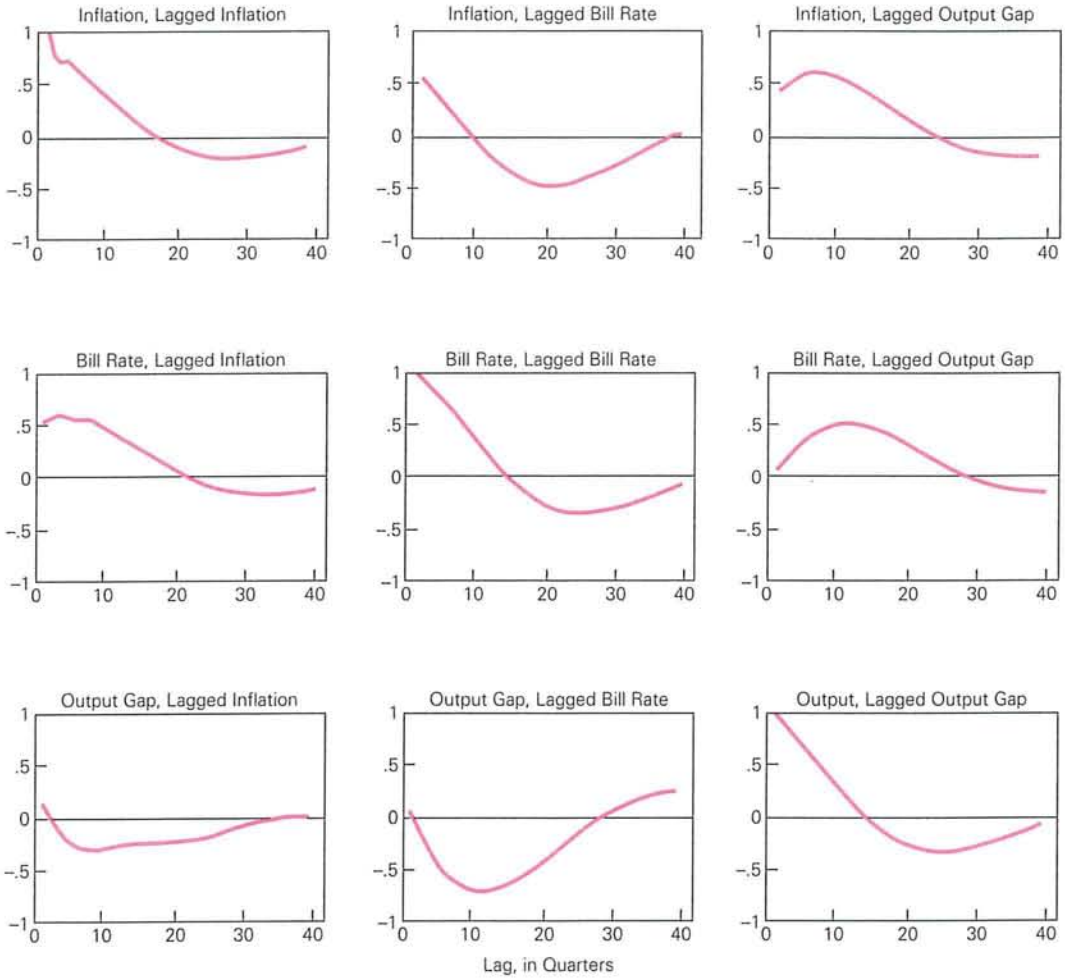
The persistence of interactions among economic variables may also be characterized by correlation functions. Thus, a change in output may affect inflation for several quarters after the change (a persistent effect) or it may affect inflation only concurrently. A series that displays persistence in its autocorrelation function can (although it need not) exhibit a persistent relationship with other series. Thus, an important corollary to inflation's own persistence is that its relationships with other economic variables can also exhibit persistence.

The correlations among economic series over time display graphically the degree of persistence in relationships among economic series. Figure 4 displays the cross-time cross-correlations among inflation, interest rates, and the output gap.[5] The panels on the diagonal in the figure are the *autocorrelation functions* described above. All of the series exhibit considerable persistence; their autocorrelations die out slowly. The series also exhibit persistent correlations with one another, as the off-diagonal panels in the figure show. For example, the top right panel of the figure shows that when the output gap was high 8 to 12 quarters ago, inflation tends to be high today. Although no unique interpretation exists for the correlations in the figure, this pattern is consistent with a standard description of the monetary policy transmission mechanism: The Fed wishes to lower (raise) inflation, so it raises (lowers) interest rates, and contracts (expands) real activity. Inflation responds gradually to the negative (positive) output gap, falling (rising) over several years to its new, lower (higher) level.

[5] Inflation is defined as the four-quarter log change in the GDP deflator. The interest rate is the three-month Treasury bill rate. The output gap is the difference between real log per capita GDP and a linear trend. The autocorrelations are computed from the estimated coefficients and error covariance matrix of an unconstrained vector autoregression. They are smoothed versions of the cross-correlations computed directly from the data.

Figure 4

Vector Autocorrelation Function



Source: Author's calculations.
Inflation - Quarterly inflation rate of the GDP Deflator expressed at an annual rate.
Output Gap - Deviation of the log of per capita real GDP from a linear trend.
Bill Rate - Three-month Treasury bill.

A good model of inflation, interest rates, and output must capture (at least reasonably well) these persistent dynamic interactions. As we will show below, a model that misses the persistence in inflation bears dramatically different implications for the conduct of monetary policy.[6]

II. Models of Inflation

Two contrasting models highlight the importance of inflation inertia. The first builds no persistence into inflation, by making inflation depend only on the rational expectation of future inflation. The second builds persistence into the rate of inflation by making

[6] Note that the measures of persistence in Figures 1 and 2 assume an "average" level for each of the variables; that is, they assume *stationarity* in the mean of the variables. If the variables were not mean-stationary or nearly nonstationary (as suggested by a number of authors), the degree of persistence that models would have to produce would be even greater. Thus, a stationary representation of the behavior of inflation may understate the true persistence in inflation.

inflation depend on both expected and past inflation. The difference in the behavior of these two models in a disinflationary episode is striking.

A Model of Flexible Inflation

In the discussion above, freely moving asset prices such as stock prices were contrasted with sticky or inertial prices such as the price of an automobile. The first model of inflation considered here implies a very flexible rate of inflation, for essentially the same reasons that stock prices were argued to be flexible above. In this model, inflation depends on expected inflation over the next period, $E_t \pi_{t+1}$, and on the "output gap," y_t, the difference between actual and potential output:

$$\pi_t = E_t \pi_{t+1} + \gamma y_t. \qquad (1)$$

The flexibility of inflation in this model arises from its dependence on the completely flexible expectation of inflation. When the output gap changes, expectations can adjust immediately to the new gap, so inflation can adjust immediately. In the long run, if the output gap is zero, inflation equals expected inflation. In the short run, when the output gap is positive (negative), current inflation will exceed (fall short of) expected inflation. This model is equivalent to a two-period version of the influential overlapping wage contract model found in Taylor (1980).[7] See the box for the relationship between these simple inflation models and their more sophisticated counterparts.

This flexible inflation model implies rather peculiar behavior during a disinflation.[8] If the Federal Reserve engineers a disinflation, it does so by pursuing a contractionary monetary policy that lowers output below potential ($y_t < 0$). But the flexible inflation model of equation (1) says that when output falls short

The Relationship between Wage Contracting Models and the Flexible/Persistent Inflation Models[9]

The "flexible inflation" model can be derived from a two-period version of John Taylor's (1980) overlapping wage contracting model. In that model, wage bargainers are assumed to negotiate contracts for their nominal wage, x_t, that remain in effect for a fixed period. They set contracts for their nominal wage so as to keep it in line with other wage contracts currently in effect (negotiated last period) and expected to be in effect next period, adjusted for excess demand conditions, y_t, in the labor market. For wage contracts that last two periods, this can be written as

$$x_t = (1/2)(x_{t-1} + E_t x_{t+1}) + \gamma y_t. \qquad \text{(B1)}$$

Prices are determined by the average level of wage contracts in effect. For wage contracts that last two periods, prices will be the average of last period's and this period's wage contracts:

$$p_t = (1/2)(x_t + x_{t-1}). \qquad \text{(B2)}$$

But equations (B1) and (B2) together imply that the equation for inflation is equation (1).[10]

Equation (4), below, may be shown to be equivalent to a similar two-period wage contracting model as well. In this model, the level of prices is determined by equation (B2); the difference is that wage contracts are set so that the real value of each wage contract, $x_t - p_t$, is in line with the real value of last period's and next period's wage contract, adjusted for excess demand conditions in the labor market:

$$x_t = (1/2)[(x_{t-1} - p_{t-1}) + E_t(x_{t+1} - p_{t+1})] + \gamma y_t. \qquad \text{(B3)}$$

Combining equations (B2) and (B3) yields equation (4), below.

None of the qualitative results presented here depend on these simplifications. Multi-period wage contracting models exhibit the same properties as the simple models of equations (1) and (4).

[7] Taylor's model made a vital contribution to the literature on wage and price behavior. It allowed wage-setters to have rational expectations, but it imparted significant persistence to the level of prices. Previous models with rational expectations implied a perfectly flexible price level, which seemed clearly at odds with data on prices.

[8] In fact, its peculiar behavior arises when one assumes that inflation expectations are formed *rationally*, as the developers of the model do. If expectations are sufficiently persistent, then this model can also build in the persistence exhibited by the inflation data. This possibility will be explored below.

[9] An extended discussion of the points raised here appears in Fuhrer and Moore (1995a), especially sections I and II.D.

[10] To see this, substitute the definition of x_t from the equation (B1) ($x_t = 2p_t - x_{t-1}$) into equation (B2), and simplify, using $\pi_t = p_t - p_{t-1}$, and $\gamma y_{t-1} = x_{t-1} - (1/2)(x_{t-2} + E_{t-1}x_t)$. This yields $\pi_t = E_t\pi_{t+1} + \gamma(y_t + y_{t-1})$. Equation (1) simplifies the y term to γy_t. Note that this model imparts tremendous persistence to the *level of prices*. In fact, this was the original motivation behind the model: to build a rational expectations model that did not imply perfectly flexible prices. This goal is clearly achieved by the model, but it brings with it the unintended implication of flexible inflation.

of potential, expected inflation in the next period must *exceed* current inflation. This does not sound like a disinflation. The only way for this to happen is for inflation to jump down immediately when output falls below potential, and then rise to its new, lower, inflation target from below! The extreme flexibility exhibited by inflation during the disinflationary episode illustrates its complete lack of persistence.

To display the behavior of the flexible inflation model graphically requires a description of the behavior of the output gap, which in turn depends on the behavior of interest rates, which in turn depends on the behavior of the Fed. A very simple characterization of these sectors includes a monetary policy *reaction function*. The Fed increases the federal funds rate when inflation, π_t, exceeds its target, π^*, or when the output gap is positive (output exceeds potential):

$$f_t - f_{t-1} = \alpha_\pi(\pi_t - \pi^*) + \alpha_y y_t. \qquad (2)$$

The coefficients α_π and α_y determine the vigor with which policy responds to inflation and output gap movements, respectively. Note that this description of monetary policy puts a degree of persistence into the federal funds rate. That is, the Fed is assumed to move the funds rate only by changing it incrementally relative to its level last period. While this behavior appears to be consistent with the behavior of the funds rate over the past 30 years, a policy of less gradual changes in the funds rate bears somewhat different implications for a disinflation, as will be shown below.

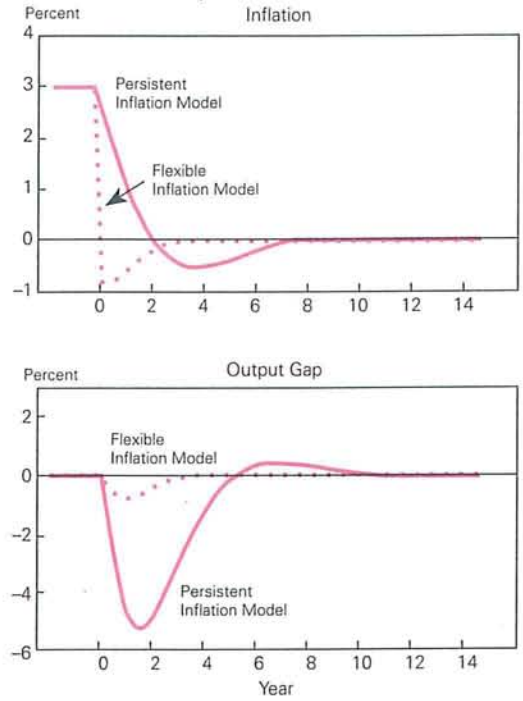
The Fed can raise (lower) short-term real rates, which will raise (lower) long-term real rates, ρ_t, which in turn will lower (raise) output gradually below (above) potential.[11] Equation (3) depicts the final link in this monetary transmission chain.

$$y_t = \lambda y_{t-1} + \beta\rho_{t-1}. \qquad (3)$$

The dashed line in the top panel of Figure 5 displays the path of inflation during a disinflation as implied by the flexible inflation model. In this and all of the following simulations, inflation and expected inflation begin at their initial target rates of 3 percent; the output gap begins at zero (output equals potential output). At the beginning of the year labelled "0" on the figure, the Fed lowers its target rate of inflation from 3 percent to 0 percent. The inflation rate jumps down immediately below 0 percent and rises to it from below. The increase in real rates, which arises not because the funds rate rises but because the inflation rate drops precipitously, depresses output slightly. The "recession" associated with this disinflation is depicted in the dashed line in the bottom panel of Figure 5. Output falls slightly below potential, returning to potential after about 15 quarters.

Figure 5

Disinflation Simulation



Source: Author's calculations.

One standard measure of the cost of a disinflation is the "sacrifice ratio"—the percentage shortfall of output below potential per percentage point decrease in the inflation rate. For the disinflation simulation in Figure 5, the flexible inflation model predicts a sacrifice ratio of 0.7, about one-sixth the size of the standard estimates presented in Gordon (1985), for example. By increasing the emphasis on the output gap, monetary policy can lower the sacrifice ratio to 0, making disinflation costless.

A Model of Persistent Inflation

A different characterization of the inflation process implies considerably more persistence in the rate of inflation, and consequently implies considerably higher costs to disinflating. The model assumes that

[11] This description of monetary policy and its transmission to real output follows the discussion in Fuhrer and Moore (1995b).

inflation depends on expected future inflation and on *lagged* inflation and on the output gap.[12]

$$\pi_t = (1/2)[\pi_{t-1} + E_t\pi_{t+1}] + \gamma y_t. \qquad (4)$$

As shown in the box, this model is equivalent to a two-period wage contracting model that is a variant of the Taylor (1980) model. Although both models are based on wage contracts, they bear very different implications for the persistence of inflation and for the costs of disinflation. When the output gap changes in the persistent inflation model, the rate of inflation cannot move as freely as in the flexible inflation model, because inflation depends both on what it was last period, which is fixed, and on expected inflation, which is flexible.

The difference between this specification and the flexible inflation specification can be seen in the solid lines in Figure 5, in which the same disinflation exercise is simulated for the persistent inflation model using the same description of monetary policy and the transmission mechanism. The simulation paths for the persistent inflation model are depicted by the solid lines in the figure. The inflation rate falls gradually to its new, lower target, as shown in the top panel. The output loss associated with the disinflation is shown in the bottom panel, and implies a sacrifice ratio of 4.1, about six times larger than that of the flexible inflation model and about in line with conventional estimates. Raising the emphasis on the output gap can lower the sacrifice ratio (as with the flexible inflation model), but it is difficult to lower the sacrifice ratio much below 2.0, even for a very vigorous output gap response. The difference in inflation behavior is striking, and the increase in implied costs is substantial.

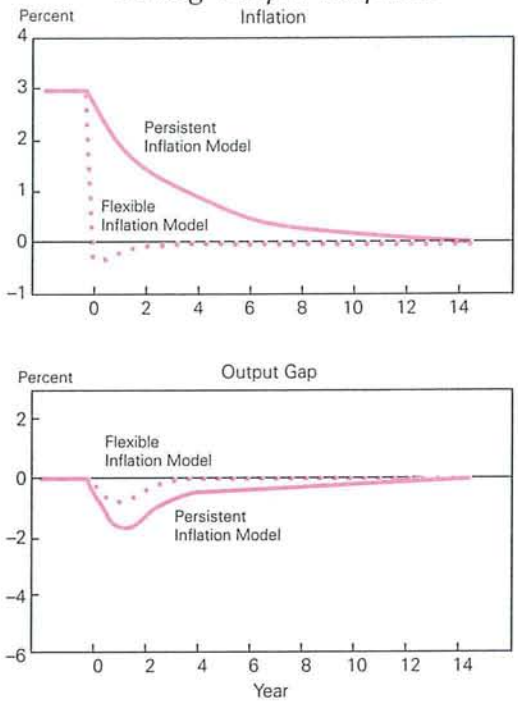
Note that the implication of the persistent inflation model for the flexibility of inflation does not depend on the exact specification of monetary policy and its transmission mechanism. We can rewrite equation (4) in terms of the change in inflation rates:

$$E_t\Delta\pi_{t+1} - \Delta\pi_t = \gamma y_t.$$

To see the implication using only the inflation equation, consider a disinflationary episode: Monetary policy tightens, lowering output below potential (making y_t negative). According to equation (4), the inflation rate will be falling, while the equation displayed above says that the expected *change* in the inflation rate will be negative upon commencement of a disinflation. Figure 5 corresponds exactly to this description.

Figure 6

Disinflation Simulation
Strong Output Response



Source: Author's calculations.

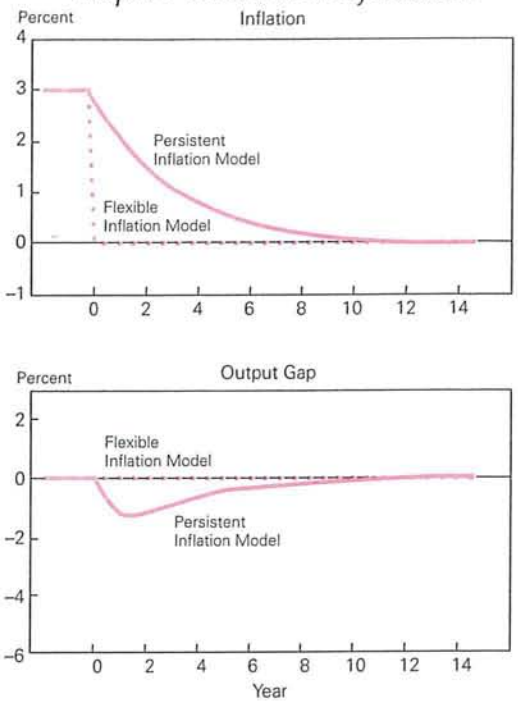
Figure 6 shows the extreme implications of the flexible inflation model under a disinflation in which the Fed places much more weight on stabilizing the output gap. Inflation jumps immediately to its new target, causing almost negligible disruption to output (the sacrifice ratio is 0.18 for this disinflation). In marked contrast, the inflation rate falls very gradually for the persistent inflation model, and output remains below potential for the duration of the simulation. The sacrifice ratio for the persistent inflation model is 1.8, ten times the size of the sacrifice ratio predicted by the flexible inflation model.

Finally, consider the effect on the estimated sacrifice ratio of removing the assumption that the Fed moves the funds rate incrementally. Suppose that the Fed were to move the federal funds rate more abruptly in response to deviations of its ultimate goals from their target values. Thus, it would alter the level

[12] This model is a simplified version of the model used in Fuhrer and Moore (1995a).

Figure 7

Disinflation Simulation
Rapid Funds Rate Adjustment



Source: Author's calculations.

of the funds rate without regard for its level in the previous period. A simple representation of this behavior is

$$f_t = f^* + \alpha_\pi(\pi_t - \pi^*) + \alpha_y y_t. \qquad (5)$$

When inflation reaches its target and output equals potential, the funds rate settles to its "equilibrium" or natural resting place, f^*.[13]

Figure 7 depicts the disinflation simulations for modest policy responses using equation (5) to describe monetary policy. As the figure shows, the disinflation still incurs significant costs according to the persistent inflation model; the sacrifice ratio for this disinflation is about 2. For the flexible inflation model, however, the costs of disinflation completely disappear. The sacrifice ratio is exactly zero. Thus, the only reason for a nonzero sacrifice ratio in the flexible inflation model simulations above is that policy chooses to move the funds rate gradually. Removing this constraint makes inflation literally costless.

Figures 5 to 7 also show what the two models predict about the correlations between the inflation rate and other variables in the system. The correlations observed in the data are displayed in Figure 4. The dashed lines in Figures 5 to 7 suggest virtually no persistence in the correlations between inflation and the output gap, whereas the data show a long-lived positive correlation. Figure 7 in particular shows that inflation and the output gap move instantaneously from one resting point to another, with no transition time. This clearly stands at odds with the data on inflation and output.

Thus, the different characterizations of the behavior of inflation can have dramatic implications for the persistence of inflation and for the costs of disinflating. The notion that disinflation could be achieved with no disruption to the real economy stands in stark contrast to the experience of all economies around the world (see Ball 1994). One explanation for the high cost of disinflation is that the rate of inflation is persistent, and its persistence arises because of the way in which laborers and firms engage in multi-period wage and price contracts.

III. Other Explanations for Costly Disinflation

Other explanations have been offered for the apparent costliness of disinflating. Two leading theories are as follows: (1) The flexible inflation model of equation (1) is correct, but price-setters' *expectations* exhibit more persistence than that model would imply; and (2) The flexible inflation model is correct, but the disinflations that have been conducted historically have not been *credible*, so that price setters did not

[13] In most descriptions of the economy, f^* would equal the equilibrium real interest rate plus the inflation target, π^*. Thus implementing this policy would, in principle, require knowledge of the equilibrium real interest rate for the economy. The lack of such knowledge is probably one reason that observed Federal Reserve behavior more closely resembles the smooth adjustments of equation (2), which require no such knowledge.

[14] Recall that the incremental policy rule of equation (2) suggests that the funds rate tends to move only gradually from its previous level. Because the inflation rate drops immediately to (or below) its new target in the flexible inflation model, this implies an immediate increase in the short-term real rate at the beginning of the disinflation. The increase in real rates depresses real activity, yielding a small, but positive sacrifice ratio. Contrast this with the persistent inflation model, in which inflation falls gradually, but only because the Fed raises the funds rate so as to increase real rates and depress real activity. This difference in the evolution of a disinflation in the two models does not depend on any particulars of the specifications.

believe that the Fed would go through with the measures necessary to lower the inflation rate. These two hypotheses are addressed in turn below.

Adaptive Expectations

Laurence Ball (1991) has suggested that adaptive expectations may explain the absence of costless disinflations. The essence of the idea is that, if price-setters adjust their expectations slowly to changes in Federal Reserve policy, then their expectations will impart persistence to the inflation process, even if the other mechanisms of wage- and price-setting do not.

A common rendering of adaptive expectations makes the expectation of inflation next period a geometrically declining weighted average of current and previous inflation rates.[15]

$$\pi_t^e = (1 - \delta) \sum_{i=0}^{\infty} \delta^i \pi_{t-i}. \qquad (6)$$

Imbedding this description of expectations into the flexible inflation model can, indeed, change the contours of the disinflation simulation. If equation (6) is substituted into equation (1), the result closely resembles a standard "Phillips curve": Inflation depends on lags of inflation and on the output gap.[16]

$$\pi_t = \sum_{i=1}^{k} a_i \pi_{t-i} + \gamma y_t.$$

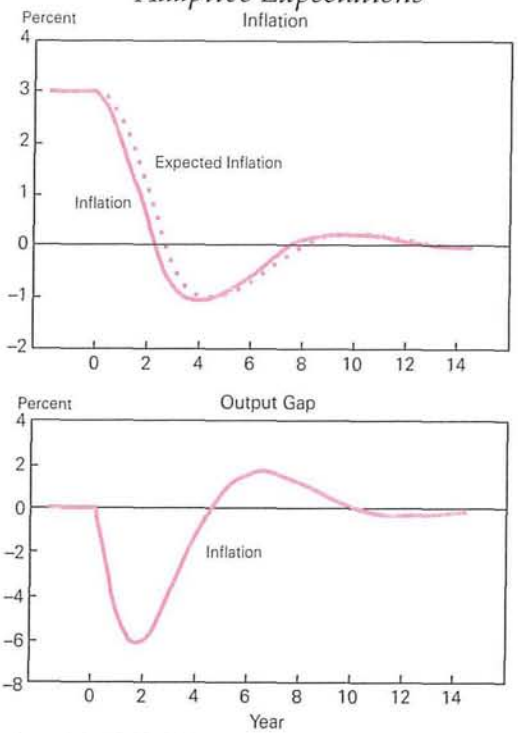
Because this model also makes inflation depend on lags of inflation, it imparts considerable inertia to the inflation rate. Thus we expect the contours of a disinflation to be similar for the flexible inflation/adaptive expectations model and the persistent inflation models.

Figure 8 displays the disinflation with adaptive expectations. Inflation now recedes gradually towards its new, lower target level, and output falls well below potential for an extended period. The sacrifice ratio associated with this disinflation is 4.1.[17] In fact, the difference between Figures 8 and 5 is quite small, suggesting that the persistent inflation model with rational expectations and the flexible inflation model with adaptive expectations may be equivalent for all practical purposes.

Figure 8 also displays the persistence of *expected* inflation during the simulation. As the figure shows, expected inflation declines somewhat more gradually than actual inflation, as price-setters place significant weight on past inflation observations in forming their expectations of subsequent inflation movements.

Figure 8

Disinflation Simulation Flexible Inflation Model With Adaptive Expectations



Source: Author's calculations.

[15] The classic definition of adaptive expectations makes the revision in expectations in the current period a function of the expectation error last period: $\pi^e_{t+1|t} - \pi^e_{t|t-1} = \lambda(\pi_t - \pi^e_{t|t-1})$. It can be shown that this is equivalent to forming expectations as a geometrically declining weighted average of current and past inflation.

[16] The coefficients on lagged inflation would follow the geometric pattern of equation (6). It is more common to use the unemployment rate, rather than the output gap, to drive movements in inflation. In the models discussed here, however, the output gap and the unemployment rate move one-for-one, so that the distinction is not important. See Tootell (1994) for descriptions of standard implementations of the Phillips curve.

[17] The value of δ in this simulation is 0.5. Note that, for the Phillips model, the total amount of output lost in a disinflation per point of inflation reduction does not depend on how the disinflation is conducted, quickly or slowly (it always equals $1/\gamma$). The *timing* of output losses can vary, however, and thus the discounted sum of output losses will vary across faster or slower disinflations.

While it is the expectations-formation process that lends persistence to inflation in this model, if one were to look at the inflation process that comes from the model, one would be hard pressed to distinguish between expectations persistence and contract-derived persistence.

Imperfect Credibility

An implicit assumption in the disinflation simulations conducted above is that price-setters knew that the Fed was contracting aggregate demand so as to lower the inflation rate and knew that it would continue to do so. Thus, price-setters saw the disinflation as perfectly credible: Policymakers were willing to inflict the costs of disinflation on the economy in order to lower the inflation rate. Expecting the real funds rate to remain high for an extended period, they bid up the real rates on long-term bonds, which lowered output below potential and decreased inflation.

The path that inflation and the output gap follow during a disinflation would likely depend upon the ways the Fed's and the public's views of the economy differed.

The scenario could look quite different if price-setters did not believe that the Fed would stick to its disinflationary policy. Three types of imperfect credibility, and their implications for disinflation, are discussed below. In each case, while the Fed may announce or begin a disinflationary program, the public (or some segment thereof) does not believe that the Fed will carry through with it.

The possibility of regime shifts. In this type of imperfect credibility, the Fed begins a disinflation intending to carry it through to completion. However, the public believes that there is a significant probability that the composition of the Federal Open Market Committee will change before the disinflation is completed. For example, FOMC members' terms may be expiring over the next several years, and the new appointees to the Committee could be less committed to the disinflation program.

In the simple framework described above, this type of imperfect credibility would manifest itself by an expected path for the federal funds rate that differs from the expectations implied by the policy rule (2) or (5). For example, the public might expect that with probability p, a new regime would dominate the FOMC at some time t in the future, with a much smaller emphasis on lowering inflation (much smaller α_π) or with a higher inflation target. If so, then long-term rates would not rise as much as in the perfect credibility case, because market participants would not be certain that short-term rates would remain elevated for the duration of the announced disinflation.

What effect would this type of imperfect credibility have on the path of inflation and output in a disinflation? If the fear is that the emphasis on inflation will be less than announced, this will not change the "overshooting" path that inflation follows in the perfect credibility simulations above. Inflation retained its perfect flexibility regardless of the policy rule followed in the disinflation simulations, so if the public believes that, on average, some mix of strong and weak inflation-fighting policies might obtain, this will not affect the behavior of inflation or the cost of disinflating.

If, however, the public expects that at some time in the future the Fed might raise its inflation target, this might give rise to quite different inflation behavior. The behavior of the economy could be quite complex to analyze in this case, as it would depend on how the public reconciled its observations of movements in the funds rate with its expectations based on an unchanged target, and how the public's expectations feed back into the determination of prices.

Different views of the world. Monetary policymakers who wish to disinflate will tighten monetary policy, contract aggregate demand, and lower inflation. How much they need to tighten and how long it will take for their actions to affect inflation are not unambiguous. The public may have a different assessment of the expected effect of a tightening on aggregate demand and inflation. Observing the Fed's actions, they may decide that, given their own assessment of the workings of the economy, the Fed's actions are not consistent with a falling inflation rate. If so, then they will find the Fed's attempts to disinflate not credible.

The implications of differences in economic frameworks for the outcome of an attempted disinflation are hard to know a priori. The path that inflation and the output gap follow during a disinflation would likely depend upon the ways the Fed's and the pub-

lic's views of the economy differed. As discussed in the regime shift case above, the dependence of the public's actions on its assessment of the impact of the Fed's actions, and vice versa, makes it particularly difficult to sort out the implications of this type of imperfect credibility. Whether either of these types of imperfect credibility can be modeled straightforwardly, and whether they might help the (otherwise) flexible inflation model match the basic properties of the data, is an interesting topic for further research.

Cheating. A third type of imperfect credibility is motivated by the work of Barro and Gordon (1983). Their work suggests that central banks that are not precommitted to stabilizing prices will always have the incentive to "cheat." This "time inconsistency" argument asserts that central banks under pressure from the electorate will consistently accept unexpected output gains at the cost of increased inflation, thus building in an inflationary bias. Central banks that have demonstrated this tendency in the past will find it difficult to persuade the public that they now intend to pursue a disinflation. They will have lost credibility and will have to convince the public by implementing consistent, pre-announced policy.

This argument seems particularly difficult to accept given the experience around the world during the past 15 years. Those who presided over the central banks of the United States, the United Kingdom, Germany, and Canada were widely viewed as extremely credible. Yet all of these countries paid a significant price for disinflation in lost output, as documented in Ball (1994). In addition, a recent comparison by Debelle and Fischer (1994) shows that the extremely "hawkish" and credible Bundesbank actually paid a *higher* price in lost output in its recent disinflations than many other central banks. It would seem that this motivation for credibility has been put to the test and found lacking.

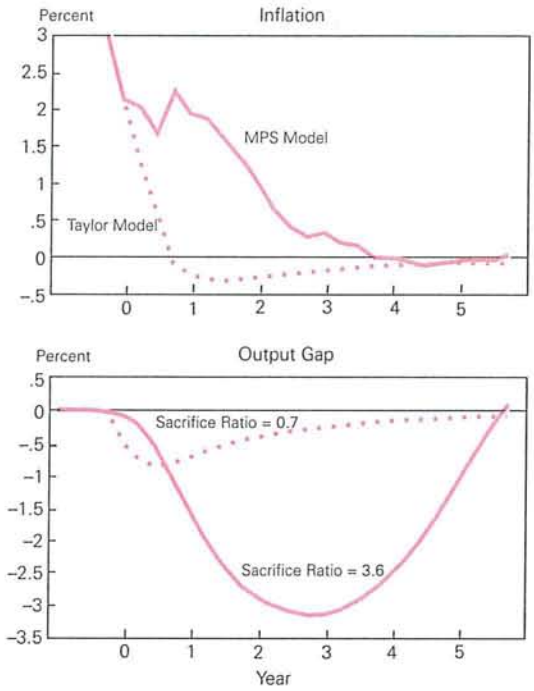
IV. Conclusions

How close a resemblance do the simple models of Section II bear to the models used by forecasters and policymakers for decision-making? For the broad patterns of inflation and the costs of disinflation, the simple models mirror the larger models closely.

John B. Taylor maintains a large macroeconomic model in which price behavior is based on his models of overlapping wage contracts, which have been presented here in simplified form as equation (1).[18] Figure 9 (dashed lines) displays the paths of inflation and the output gap for Taylor's disinflation simulation, conducted as in the preceding examples. The path of inflation and the output gap during the disinflation are roughly in accord with the simulations from the small flexible inflation model. Inflation drops rapidly, falling below its new target level, and then rising to it from below. The output gap is quite small in comparison to the large gaps for the small persistent inflation model and for the large persistent inflation model described below.

Figure 9

Model Disinflation Simulation



Source: Solid Line – Author's calculations.
Dashed Line – Taylor (1993); simulation provided by John Williams, Board of Governors, Federal Reserve System.

The MIT-PENN-SSRC (Social Science Research Council) or MPS model of the U.S. economy is a large (about 130 behavioral equations) model designed to capture the persistence in prices and inflation. Its price sector is a wage-price Phillips curve in which wage inflation depends on expected price inflation and

[18] A full description of the model used to produce this simulation may be found in Taylor (1993). The author thanks John Williams for providing the simulation results displayed in the dashed lines in Figure 9.

unemployment. Expected price inflation is formed adaptively. Prices move with unit labor costs, the difference between wages and productivity. Figure 9 (solid lines) displays the path of inflation and the output gap implied by this model for a disinflation like those in the preceding figures. The model clearly shows the same degree of inflation persistence as is exhibited by the persistent inflation model of equation (4) or the simplified Phillips curve of equations (6) and (1). The output loss associated with the disinflation is considerable; the model implies a sacrifice ratio of 3.6, compared to about 4 for the other persistent inflation models. Thus, this carefully designed, highly articulated macro model delivers essentially the same predictions for a disinflation as the simple persistent inflation models of this paper. Inflation is persistent, and disinflation is costly.

There appears to be little doubt that disinflations have been costly. Broadly speaking, the cost of disinflation arises because inflation has been persistent. The question then turns to why inflation is persistent. This paper has examined several explanations of inflation's persistence, but much work remains in sorting out the explanation (or combination of explanations) that is most consistent with the data on prices and inflation.

Determining the source of inflation persistence is of much more than academic interest. If, for example, persistence arises through imperfect credibility of the Federal Reserve, then the Fed should be concerned about how to improve and maintain its credibility. On the other hand, if persistence arises because the public adjusts its expectations slowly to changes in the economic environment, or because inflation is inherently sticky because of the way in which wage and price contracts are negotiated, then monetary policy has to bear the costs of disinflation unless these behaviors change. Thus, the source of inflation persistence may be a reflection on the behavior of monetary policymakers, or it may be completely beyond their control.

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Interest Rate Derivatives and Asset-Liability Management by Commercial Banks

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Bank participation in derivative markets has risen sharply in recent years. The total amount of interest rate, currency, commodity, and equity contracts at U.S. commercial and savings banks soared from $6.8 trillion in 1990 to $11.9 trillion in 1993, an increase of 75 percent. A major concern facing policymakers and bank regulators today is the possibility that the rising use of derivatives has increased the riskiness of individual banks and of the banking system as a whole.

Banks have long used one type of derivative instrument, namely interest rate futures, to manage interest rate risk (Koppenhaver 1986; Booth, Smith, and Stoltz 1984; Parkinson and Spindt 1986; Franckle and Senchack 1982). However, the development of newer instruments, such as swaps, caps, collars, and floors (see the glossary in Box 1), has greatly expanded the menu of financial technologies available to banks for asset–liability management. In particular, interest rate swaps have become the preferred tool. According to a recent market survey of derivative users, 92 percent of responding financial institutions report using interest rate swaps to manage the interest rate risk of their lending portfolios (Group of Thirty 1993, pp. 40–41).

More recently, studies have focused on the determinants of the broader derivative activities of banks. Sinkey and Carter (1994) studied the determinants of bank use of derivatives between 1989 and 1991. They found that measures of maturity gap and liquidity are consistently significant across banks of different asset sizes. Brewer, Minton and Moser (1994) focused on the relationship between derivative use and bank lending, concluding that the growth of business lending is positively related to the presence of swaps on the bank's books, though the presence of futures had no significant effect on bank lending.

This article contributes to the growing literature on bank derivative use by analyzing the determinants of banks' use of interest rate derivatives between 1988 and 1993. It begins by explaining the use of gap models to measure interest rate risk and the way interest rate derivatives

Box 1: Glossary

Interest Rate Cap. An interest rate cap protects a floating-rate borrower against a rise in interest rates. At specified intervals over the life of the contract the seller pays the buyer the difference (if any) between a specified reference rate and the cap rate.

Interest Rate Floor. An interest rate floor protects a floating-rate investor against a decline in interest rates. At specified intervals over the life of the contract the seller pays the buyer the difference (if any) between a floor rate and a specified reference rate.

Interest Rate Collar. An interest rate collar is the purchase of an interest rate cap and the sale of an interest rate floor.

Swap. A swap is an agreement between two parties to exchange a series of cash flows for a period of time. The main categories of swap contracts are interest rate, currency, equity, and commodity swaps.

Plain-Vanilla Interest Rate Swap. The most common type of swap, it consists of an exchange between two parties of fixed-rate interest for floating-rate interest in the same currency.

Swaption. A swaption is a contract that gives the buyer the right, but not the obligation, to enter into a specified swap contract on a future date.

can be used to manage that risk. The article goes on to describe bank use of various interest rate derivatives in more detail and trace growth in recent years. Then it outlines the empirical specification of a model of derivative use and describes the data set used in the analysis. The subsequent section presents the estimation results and interprets parameter estimates. The article concludes by drawing policy implications from the analysis.

I. Interest Rate Risk and Gap Analysis

Banks use derivative products mainly to manage interest rate risk. The last 15 years have seen an increased volatility of interest rates compared to the earlier post-World War II era, making the need for accurate measurement and control of interest rate risk particularly acute. At the same time, financial innovations in the field of interest rate derivatives have given banks new and effective instruments for managing that risk.

Interest rate risk arises in bank operations because banks' assets and liabilities generally have their interest rates reset at different times. This leaves net interest income (interest earned on assets less interest paid on liabilities) vulnerable to changes in market interest rates. The magnitude of interest rate risk depends on the degree of mismatch between the times when asset and liability interest rates are reset.

One way to measure the direction and extent of the asset–liability mismatch is through gap analysis, which derives its name from the dollar gap that is the difference between the dollar amounts of rate-sensitive assets and rate-sensitive liabilities. A maturity gap is calculated for a given time period and includes all fixed-rate assets and liabilities that mature in that period and all floating-rate assets and liabilities that have interest rate reset dates in that period.

Banks use derivative products mainly to manage interest rate risk; the increased volatility of interest rates has made the need for accurate measurement and control of interest rate risk particularly acute.

A bank that has a positive gap will see its interest income rise if market interest rates rise, since more assets than liabilities will exhibit an increase in the interest rate. Similarly, a bank with a negative gap will be hurt by rising rates but will benefit from falling rates.

For example, a bank that issues a 3-month certificate of deposit, and uses the funds to buy a 2-year Treasury note, will see its net interest income eroded if interest rates rise after the first three months because it will have to roll over the CDs at a higher rate, while the rate on the Treasury note will remain the same. In general,

$$\Delta NII = (A - L) \times \Delta r, \qquad (1)$$

where *NII* is net interest income, *A* is rate-sensitive assets, *L* is rate-sensitive liabilities and *r* is the market interest rate. The problem with this simple gap measure is that unless the time interval chosen is very small, assets and liabilities will have their rates reset at different times within that interval. In an extreme case, if the chosen interval is three months, a bank that issues 3-month CDs and funds them by borrowing federal funds overnight will show a three-month gap of zero, even though that bank is exposed to a substantial interest rate risk.

One refinement of a simple maturity gap measure calculates a sequence of periodic maturity gaps, such as a series of three-month gaps for five years. This method has the advantage of more precision, although periodic gaps may be difficult to interpret, especially if they result in a long sequence of alternating negative and positive gaps. On the quarterly Call Reports, banks are required to report the book value of all interest-bearing assets and liabilities, classified according to whether they mature or have interest rate reset dates within the next three months, three months to one year, one to five years, or more than five years. Accordingly, one can calculate the book value of the corresponding periodic gaps for all reporting banks on a quarterly basis.

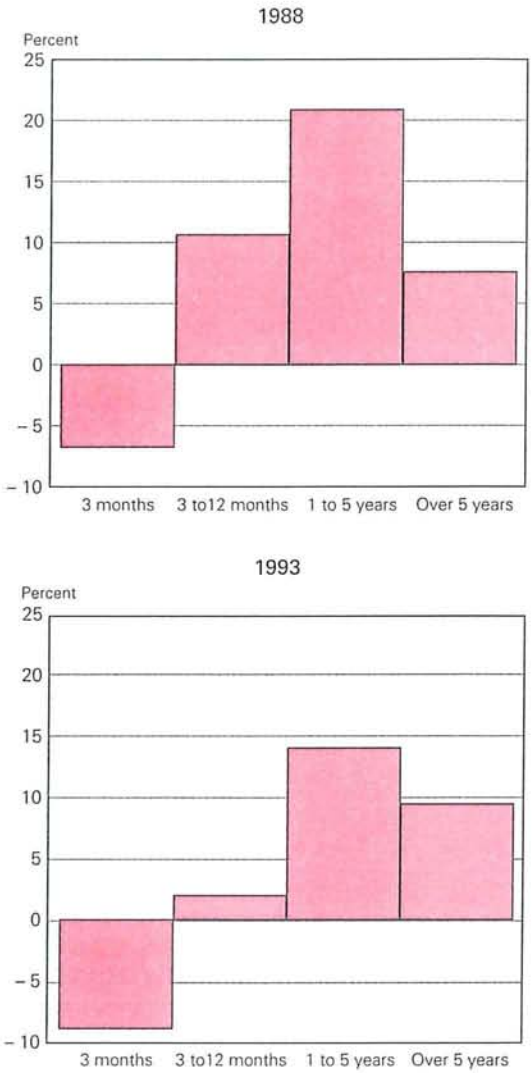
Figure 1shows two profiles of average periodic gaps (interest-earning assets less interest-bearing liabilities within the period, divided by total interest-earning assets) for all U.S. commercial banks with assets greater than $100 million. The first gap profile is for 1988 (the earliest year for which the classifications reported are consistent with the later periods) and the second is for 1993.

The profiles for both years show a negative gap for very short maturities (under three months) and positive gaps thereafter. The gaps have a characteristic humpback shape, reflecting the biggest asset sensitivity in the one- to five-year period. The 1993 profile has a smaller "hump" in that period relative to the 1988 profile, but a larger positive gap for the longest maturities. Both gaps imply that the average bank in both years issued shorter-term liabilities to fund longer-term assets. Thus, in both years the average bank would suffer a loss in interest income when interest rates rose, because the bank would have to pay higher interest on the funds it borrowed, while the interest it received on assets would remain the same.

Ideally, one would want to reduce the measure of interest rate exposure to one number, showing how net interest income would react to a given change in the market interest rate. To provide such an estimate, the concept of "duration" was developed (Macaulay 1938). Duration represents an account's weighted average time to repricing, where the weights are discounted cash flows. The duration gap is the difference between the duration of assets, weighted by dollars of assets, and the duration of liabilities, weighted by dollars of liabilities. The larger the duration gap, the

Figure 1

Average Gap Profiles of Large Commercial Banks



Interest-earning assets less interest-earning liabilities, divided by total interest- earning assets, for all U.S. commercial banks with assets greater than $100 million.
Source: Call Report data.

Box 2: A Simple Example of Duration Gap

Suppose a bank has one asset, a $300 loan to be repaid in two equal annual installments, and two liabilities, a $200 1-year certificate of deposit and a $100 6-month certificate of deposit. For simplicity, suppose also that the interest rates on the loan and both CDs as well as the discount rate used to calculate the net present value are all equal to 5 percent. Since the CDs have one payment each coming at maturity, their durations are equal to their maturities, so that the liability duration weighted by the present value of liabilities is 1 year × ($200/$300) + 0.5 year × ($100/$300) = 0.83 year.

The duration of the loan is not equal to its maturity. To calculate the duration, note that at the interest rate of 5 percent per year, the loan will be repaid in equal installments of $161.34 each year. The present values of these cash flows discounted at 5 percent are $153.66 and $146.34. Thus, the duration of the loan is 1 year × ($153.66/$300) + 2 years × ($146.34/$300) = 1.49 years.

The duration gap of this balance sheet is the difference between the duration of assets (1.49 years) weighted by the present value of assets and the duration of liabilities weighted by the present value of liabilities. Thus, the duration gap is (1.49 years × $300) − (0.83 years × $300), or 196 dollar-years.

more sensitive the bank is to the changes in the market interest rate. Box 2 shows a simple example of calculating duration gap.

However, duration gap is an accurate measure of the interest risk only if the term structure of interest rates shifts in parallel, or if any departures from parallel shifts are known in advance. To the extent these conditions are violated, as they often are, interest rate risk cannot be summed up simply in one number.

II. Managing Interest Rate Risk with Derivative Contracts

Traditionally, banks controlled interest rate risk by adjusting the maturity or repricing schedules of their assets and liabilities. For example, a bank wishing to lengthen the duration of its assets can add long-term government bonds to its securities portfolio. More recently, however, many banks realized that they could accomplish the same goal more cheaply and efficiently by entering into plain-vanilla swaps, where they pay a floating rate, usually denominated in London Interbank Offer Rate (LIBOR), and receive a fixed rate, usually the Treasury rate of equivalent maturity plus a premium. A liability-sensitive bank, on the other hand, can enter into a swap where it pays a fixed rate and receives a floating rate. The bank can also use a "basis" swap, where both sides pay floating rates but the index rates are tied to the bank's cost of funds and lending rate. Specifically, the bank would pay the prime rate and receive LIBOR.

Alternatively, the liability-sensitive bank can buy a cap on LIBOR, so that if LIBOR rises above a certain predetermined level, the seller will pay the bank the difference between LIBOR and that level. A similar approach is a "costless" collar on LIBOR, where the bank buys a LIBOR cap from the dealer and at the same time sells a LIBOR floor to the dealer, with the premium on the bought cap exactly offsetting the premium on the sold floor. In this way, the bank reduces the cost of buying protection from a rise in LIBOR by giving up a potential benefit to its earnings from a fall in LIBOR.

Derivatives can also be used to create synthetic loan and deposit products. For example, a bank can transform a floating-rate loan into a fixed-rate loan by coupling new floating-rate financing with a plain-vanilla swap where the bank pays a floating rate in return for receiving a fixed rate.

The advantage of derivatives over more traditional methods of asset–liability management, such as adjusting one's securities portfolio, is that derivatives can transform the duration of the balance sheet while neither increasing it nor incurring significant additional capital requirement.[1]

As a result of these advantages, the use of interest rate derivatives by banks has exploded in recent years. Table 1 illustrates the growth of interest rate contracts at commercial banks with more than $100 million in assets. The table shows that futures and forwards

[1] While Treasury securities have zero risk weight in the risk-based capital requirements, their presence on the balance sheet still increases the required "leverage ratio" or the ratio of capital to total assets. In contrast, the capital requirement on off-balance-sheet items, such as swaps, is levied against current and potential replacement cost, which is only a small percentage of the notional principal of the swap. This is appropriate because the notional principal of the swap is not exchanged and is not at risk.

Table 1
Interest Rate Contracts at Large Commercial Banks[a]
Notional Values in Billions of Dollars

Interest Rate Contracts	1985	1990	1993	% Growth, 1985 to 1993
Swaps	186.04	1,714.97	2,938.18	1,479
Futures and Forwards	97.57	894.89	2,496.43	2,458
Written Options	n.a.	386.91	949.84	145
Purchased Options	n.a.	310.57	817.61	163
Total	283.61	3,307.34	7,202.06	2,439

n.a. = not available.
[a]U.S. commercial banks with more than $100 million in assets.
Source: Call Report data.

grew from $98 billion in 1985 to almost $2.5 trillion, a growth rate of nearly 2,500 percent. Interest rate swaps grew from $186 billion of notional principal in 1985 to almost $3 trillion in 1993, a growth rate of almost 1,500 percent. Options contracts (including caps, floors, and collars, described above), first reported on Call Reports in 1990, have since more than doubled in notional principal from $697 billion to $1.77 trillion in 1993.

Table 2 compares interest rate derivative use among banks in different size groups in 1985 and 1993. In both years, large banks used derivatives far more frequently than small ones. While fewer than 6 percent of banks with assets between $100 million and $300 million participated in interest rate derivative markets in 1993, 95 percent of banks with assets between $5 billion and $10 billion and 100 percent of the largest banks (those with assets over $10 billion) did so.

A distinguishing feature of banks' involvement in the derivatives arena is the heavy concentration of activity among a few major players, specifically the top seven banks for derivatives trading, which are among the most active intermediaries in the over-the-counter derivatives market. In 1993, the top seven banks accounted for 85 percent of the notional principal of interest rate contracts of all banks.

These seven banks are dealers as well as users of derivatives. They enter into transactions with custom-

Table 2
Interest Rate Contracts at U.S. Commercial Banks, by Size of Bank

1985				
Total Bank Assets ($ Millions)	Number of Banks without Derivatives	Number of Banks with Derivatives	Percent with Derivatives	Notional Amount of Derivatives ($ Billions)
100–300	1,713	66	3.71	.58
300–500	275	20	6.78	.17
500–1,000	178	29	14.01	1.63
1,000–5,000	142	97	40.59	13.20
5,000–10,000	3	44	93.62	20.87
Over 10,000	0	27	100.00	247.17
All Banks	2,311	283	10.91	283.62

1993				
Total Bank Assets ($ Millions)	Number of Banks without Derivatives	Number of Banks with Derivatives	Percent with Derivatives	Notional Amount of Derivatives ($ Billions)
100–300	2,001	125	5.88	4.51
300–500	314	75	19.28	8.48
500–1,000	168	75	30.86	8.91
1,000–5,000	105	146	58.17	98.17
5,000–10,000	3	64	95.52	196.61
Over 10,000	0	54	100.00	6,885.40
All Banks	2,591	539	17.22	7,202.08

Source: Call Report data.

Box 3: The Risk of Derivative Instruments

The risks associated with derivative activities can be divided into five types, namely market, liquidity, credit, operational, and legal risk. These risks are the same as those associated with more traditional financial instruments, such as stocks, bonds, mortgages, or bank deposits. However, because derivatives often combine these risks in new or unfamiliar ways, managing the risk of derivatives may present additional challenges.

Market Risk

In its most basic form, market risk refers to fluctuations in the price of a financial instrument. The assessment of market risk of derivatives depends on the valuation of underlying instruments. It is relatively straightforward for forward-based derivatives, as a change in the price or rate of the underlying asset generally results in a proportional change in the price of the forward-based derivative.

The assessment of market risk for options-based derivatives tends to be more complex, however. The value of most options is determined by five factors: (i) the price of the underlying asset; (ii) the exercise price of the option; (iii) the time to expiration of the option; (iv) the volatility of the price of the underlying asset; and (v) the discount rate over the life of the option.

Market risk of derivatives must be evaluated on a portfolio basis, in the same way as the market risk of any other financial instrument. An institution may hold a derivative contract to offset the market risk of a specific asset or liability or to reduce the overall market risk of its portfolio. Thus, the market risk of a derivative instrument to the institution is not measured by the price fluctuations of that individual contract. Rather, the relevant issue is whether or not the instrument reduces the overall market risk of the institution's portfolio.

Liquidity Risk

Liquidity risk refers to the risk of reductions in market liquidity. It arises when a large transaction in a particular instrument can have a noticeable impact on its market price. This makes risk management more difficult and expensive. A somewhat different type of liquidity risk is associated with sudden erosions of liquidity, sometimes associated with an extraordinary event or some other market disruption.

Credit Risk

Credit risk is the risk that a loss will occur when the counterparty defaults on a derivative contract. This risk fluctuates over time with the value of the contract and, therefore, must be evaluated for both "current" and "potential" exposure. Current exposure is the cost to replace the transaction if the counterparty defaults today. The replacement cost differs from (and is usually much smaller than) the notional principal of a contract, which is simply the hypothetical basis on which payments are calculated. The replacement cost could be positive or negative, depending on the changes in the market value of the contract since the original transaction occurred. When the market value is negative, the remaining party does not incur a loss when its counterparty defaults.

Potential exposure is the potential replacement cost if the counterparty defaults in the future. It is more difficult to assess than current exposure, since it depends on the time path of the future market value of the contract, which cannot be known with certainty. Potential exposure can be understood as a probability that a contract will incur a certain level of credit exposure in the future, and it can be estimated on the basis of the volatility of the price, index, or rate of the instrument underlying the contract.

Credit risk is greater with over-the-counter derivative contracts than with exchange-traded ones. Exchanges significantly reduce credit risk because they require both buyers and sellers to post margin collateral. The contracts are marked to market and settled up on a daily basis. Moreover, the exchanges act as counterparties to all their transactions and all obligations are satisfied through clearing house offset, so that one can cancel an existing position by acquiring an equal but opposing position and be left with zero net exposure. In contrast, over-the-counter-traded derivatives are not settled for relatively long periods of time, usually are not collateralized, and are not subject to clearing house offset, which makes them less liquid and increases credit risk.

Operational Risk

Operational risk is the risk of losses occurring as a result of inadequate systems and internal controls, human error, or management failure. Although this risk exists with all securities, it is increased because of the complexity of many derivatives. The cost of mistakes also can also be higher than with traditional securities owing to greater volatility of some derivative positions.

Legal Risk

Legal risk is the risk of loss because a contract cannot be enforced. It arises because of uncertain legality or enforceability of contracts in bankruptcy, or because the counterparty lacks the authority to enter into the transaction.

Table 3
Interest Rate Contracts at the Top Seven U.S. Dealer-Banks, 1993

Bank	Notional Principal ($ Millions)	Replacement Cost ($ Millions)	Replacement Cost/Assets (Percent)	Replacement Cost/Equity (Percent)
Chemical Bank	1,049,995	12,390	11	156
Morgan Guaranty Trust	755,681	19,042	19	283
Citibank	564,461	8,155	5	74
Bankers Trust	534,118	10,597	16	270
Chase Manhattan Bank	368,616	6,541	8	102
Bank of America	286,348	7,088	5	61
First Chicago	166,525	3,222	9	120

Source: Call Report data.

ers and with other dealers. Dealers derive revenue from earning a bid–ask spread on a generally balanced portfolio of over-the-counter derivatives. Large dealers also trade for their own accounts, taking positions based on their forecasts of potential moves in interest rates, exchange rates, or commodity prices. They can take these positions by trading in the underlying instruments (such as bonds or currencies) or by using derivative contracts. Thus, proprietary trading may involve derivatives, but derivatives are not necessary for it.

While both market risk and credit risk are present in derivative trading (see Box 3 for a discussion of various types of risk), it is worth noting that it is credit risk, rather than market risk, that has been the cause of almost all bank failures.[2] Therefore, credit risk assumed by banks in their derivative activity is an important concern to bank regulators.

Table 3 lists the top seven dealer-banks in 1993 in terms of the notional principal and the current replacement cost of their interest rate contracts, as well as the ratios of replacement cost to the book value of assets and replacement cost to the book value of equity. The ratio of replacement cost to assets range from a low of 5 percent to a high of 19 percent, while the ratios of replacement cost to equity range from a low of 61 percent to a high of 283 percent. While these replacement costs appear large, they are comparable to credit exposures these banks face in more conven-

[2] One notable exception is the failure of First Pennsylvania in 1980.

Table 4
Commercial and Industrial and Commercial Real Estate Lending by the Top Seven U.S. Dealer-Banks, 1993

Bank	Commercial and Industrial Loans ($ Millions)	Commercial and Industrial Loans/Assets (Percent)	Commercial and Industrial Loans/Equity (Percent)	Commercial Real Estate Loans ($ Millions)	Commercial Real Estate Loans/ Assets (Percent)	Commercial Real Estate Loans/ Equity (Percent)
Chemical Bank	19,070	16.5	240.1	3,423	3.0	43.1
Morgan Guaranty Trust	8,730	8.6	129.8	59	.1	.9
Citibank	38,798	22.1	350.6	5,435	3.1	49.1
Bankers Trust	3,866	5.7	98.4	947	1.4	24.1
Chase Manhattan Bank	17,700	21.0	276.0	1,590	1.9	24.8
Bank of America	27,628	20.2	236.2	5,137	3.8	43.9
First Chicago	5,460	15.8	203.1	942	2.7	35.0

Source: Call Report data.

tional lending activities usually considered risky, such as business and commercial real estate loans. Table 4 shows commercial and industrial loans and commercial real estate loans at these seven banks, in dollar amounts and as loan-to-asset and loan-to-equity ratios. As a share of equity capital, the credit exposure on commercial and industrial loans is, in nearly all cases, higher than that of derivatives.

III. Empirical Specification

This section analyzes the determinants of derivative use among commercial banks with more than $100 million in assets. The classification of interest rate derivatives in the Call Reports is very broad and can include dissimilar instruments. For instance, interest rate swaps include plain-vanilla fixed/floating swaps, basis swaps, index-amortizing swaps, and other, more exotic types of swap contracts. The two categories for interest rate options—"purchased options" and "written options"—include standard put and call options on Treasury securities traded on the exchanges as well as customized over-the-counter instruments such as interest rate caps, collars, floors, or options on swaps. The "futures and forwards" category also includes exchange-traded futures and over-the-counter contracts such as forward rate agreements. Furthermore, long and short futures positions are aggregated (though they were reported separately until 1990).

Because of the very broad nature of the Call Report data, it is impossible to relate the derivative position of a bank to its interest rate risk profile with any degree of precision. Rather, the purpose of this paper is to determine which bank characteristics can explain whether or not a bank uses derivatives and the extent of that use.

The study estimates a fixed-effect model using pooled data from quarterly Call Reports for the period 1988:I through 1993:IV, resulting in a sample of 4,265 banks. Because derivative use is much more widespread among large banks, the primary sample is split into two subsamples: (1) "large" banks (banks with $5 billion or more in assets, excluding the seven dealer-banks mentioned above) and (2) "small" banks (banks with more than $100 million and less than $5 billion in assets).[3] It will be recalled from Table 2 that almost all banks with $5 billion or more in assets use derivatives, so that the problem of estimating a regression where many observations have the value of zero for the dependent variable is thus avoided for that group. A significant portion of the seven dealer-banks' derivative activities is likely to represent dealing and market-making rather than using derivatives for the institution's asset–liability management, and the determinants of the activities are likely to be different. Since it is not possible, using the Call Report data, to distinguish between the two types of the dealers' derivative activities, the seven dealer-banks were excluded, leaving 147 banks in the sample of large banks.

The base equation is as follows:

$$\frac{D_{jit}}{A_{it}} = b_t + bx_{it} + F_i + E_{it}. \qquad (2)$$

The dependent variable is the notional amount of the derivative category j of bank i in quarter t scaled by assets. There are four dependent variables: 1) futures and forwards, 2) interest rate swaps, 3) written and purchased options (available only since 1990:I), and 4) the sum of the notional amounts of the above three categories.

The time-specific intercept, b, accounts for time-varying characteristics that influence the use of derivatives and have changed in a uniform way for all banks (for example, new financial technologies, capital requirements, regulatory climate). In contrast, the bank-specific fixed effect, F, controls for factors that vary across banks but are not otherwise captured by the independent variables included in the model. These would include management preferences, degree of sophistication and risk aversion, and willingness to use financial innovation.

The vector of independent variables, X, consists of the following variables: the logarithm of assets, the ratio of equity to assets, the ratio of nonperforming assets to assets, the ratio of loan-loss reserves (LLR) to nonperforming loans,[4] the ratio of loan-loss reserves to loans and leases, and four "gap" variables measured as the difference between bank assets and liabilities maturing or repricing in a given time interval (0 to three months, three to 12 months, one to five years, and over five years). Following Kim and Koppenhaver (1993), the gap is expressed as the absolute value between assets and liabilities repricing within a given interval, divided by total assets.

[3] A few institutions were counted in both subsamples as their assets grew to exceed $5 billion during the sample period.

[4] Nonperforming loans are defined as loans and leases 90 or more days past due or in nonaccrual status. Nonperforming assets are defined as loans and leases 90 or more days past due or in nonaccrual status plus foreclosed property (other real estate owned, excluding direct and indirect investments in real estate ventures).

The presence of the equity-to-asset ratio and the standard measures of asset quality such as the ratios of nonperforming assets to assets, loan-loss reserves to nonperforming loans, and loan-loss reserves to total loans and leases, are meant to capture the regulatory environment. An important reason why managing interest rate risk through derivatives may be preferable to on-balance-sheet management is that off-balance-sheet contracts entail lower capital requirements. Thus, banks with lower capital ratios may be expected to be bigger users of derivatives, other things being equal. Similarly, banks with relatively poor asset quality (as measured by high levels of nonperforming assets relative to total assets or low levels of loan loss reserves relative to nonperforming loans) will need to conserve capital and might find derivatives to be a more desirable, capital-efficient way to manage the balance sheet. On the other hand, the use of derivatives may be perceived by regulators as risky, and poorly capitalized banks and banks with weak asset quality or low loan-loss reserves would be subject to more scrutiny or restrictions by regulators when they attempt to use derivatives, thus discouraging the use of derivatives by such banks.

The four "gap" measures are meant to represent a crude measure of the interest rate risk assumed by the bank before its derivative position is taken into account. Larger absolute values of the gap measures indicate a greater sensitivity to interest rate changes on the part of the bank. A bank can reduce its interest rate exposure by hedging with derivative positions.

IV. Results

Table 5 reports regression results for banks with assets below $5 billion, while Table 6 reports the results for the banks with assets of $5 billion or more. The gap measures show no consistent relationship to the use of derivatives. For instance, while a positive and significant relationship exists for large banks between the one- to five-year gap and the use of all derivatives, the relationship between these variables is negative and significant for the small bank subsample.

A somewhat unexpected result of the regressions is the negative relationship between the intensity of derivative use and bank size. Given that large banks use derivatives more frequently than small banks (Table 2), one might have expected the intensity of their use also to be higher.

It has sometimes been suggested that barriers to entry into derivative markets due to economies of scale prevent smaller institutions from participating. However, this argument has more validity for the over-the-counter instruments than for the exchange-traded ones. Over-the-counter derivatives are customized, must be purchased from a dealer, and may have large, indivisible contract denominations. The argument is less compelling for exchange-traded instruments, which are available even to retail investors.

The regression results in Tables 5 and 6 show a negative relationship between the use of derivatives and size for all derivative categories, for both large and small bank subsamples. The only exception is the regression for swaps for banks with under $5 billion in assets, which has a positive and significant coefficient for bank size (Table 5, Column 2). It will be recalled that swaps are over-the-counter instruments, where barriers to entry may indeed be present for smaller banks, while the other regression categories (options, and futures and forwards) include both the exchange-traded and the over-the-counter instruments.

A somewhat unexpected result of the regressions is the negative relationship between the intensity of derivative use and bank size, with the exception of swaps for banks with under $5 billion in assets.

The relationship between the equity-to-asset ratio and the use of derivatives is ambiguous. For both the small and the large bank subsamples, the relationship is negative and statistically significant for futures, but positive and significant for swaps. It is possible that swaps are perceived as more risky and invite greater scrutiny from the regulators in weaker-capitalized banks. This may allow better-capitalized banks to participate in the swap market to a greater extent.

Among large banks, those with weaker asset quality (as measured by a higher ratio of nonperforming assets to assets and a smaller ratio of loan-loss reserve to loans) appear to be bigger users of derivatives than banks with relatively stronger asset quality. In the large bank subsample, the coefficient for nonperforming assets is positive and significant, while the coefficient for loan-loss reserves is negative and significant for futures, swaps, and all derivatives.

Table 5
The Determinants of Derivative Use: Commercial Banks with Assets of Less Than $5 Billion[a]
Estimation Method: Fixed Effects, 1988:I to 1993:IV

Independent Variable	Futures/Assets	Swaps/Assets	Options/Assets	All Derivatives/ Assets
Log Assets	−.002*	.011**	−.020**	−.003
	(2.17)	(10.2)	(5.00)	(1.04)
Equity/Assets	−2.74E-4**	6.50E-4**	−6.31E-4	6.26E-4*
	(2.52)	(5.27)	(1.28)	(1.67)
Nonperforming Assets/Assets	2.99E-5	9.38E-6	−.001**	−1.93E-4
	(.293)	(.081)	(2.51)	(.551)
LLR/Nonperforming Loans	−9.88E-10	−1.15E-8	−3.14E-8	−3.80E-8
	(.025)	(.259)	(.243)	(.281)
LLR/Loans and Leases	2.42E-5	2.16E-4	.001*	.001*
	(.163)	(1.28)	(1.70)	(2.14)
Gap—3 months	3.34E-5	−1.03E-4**	−3.75E-4**	−3.70E-4**
	(1.41)	(3.85)	(3.83)	(4.54)
Gap—3 to 12 months	1.59E-5	5.90E-5*	7.26E-5	1.53E-4*
	(.605)	(1.99)	(.607)	(1.70)
Gap—1 to 5 years	−4.78E-5*	2.12E-5	−3.42E-4**	−2.53E-4**
	(1.96)	(.768)	(3.36)	(3.01)
Gap over 5 years	−3.64E-6	−3.50E-4**	−9.12E-5	−4.05E-4**
	(.120)	(10.2)	(.757)	(3.90)
R2	8.27E-4	.026	.003	.008
SSR	72.3	92.4	448.9	853.8
SER	.034	.038	.102	.116
Number of banks	4,185	4,185	3,834	4,185
Number of observations	68,118	68,118	46,699	68,118

[a]And more than $100 million.
Absolute values of t-statistics in parentheses.
*Significant at the 5% confidence level.
**Significant at the 1% confidence level.

To summarize, while these results do not explain much of the variation in bank derivative use, particularly for small banks, certain patterns emerge. First, the study found a positive relationship between bank size and the use of swaps for the small-bank subsample. Second, well-capitalized banks appear to use swaps more intensively, but not futures. This is not surprising given that creditworthiness of swap counterparties is an important consideration for market participants, while it is not a concern for futures, where the exchange stands behind the transactions. Third, large banks with weaker asset quality are bigger users of swaps and futures than banks with stronger asset quality, possibly because they are more capital-constrained or have more taste for risk. Fourth, derivative use had no consistent relationship to the bank's gap profile. While hedging is consistent with a positive relationship, even if such a relationship were found, it could not be considered to be explicit evidence of hedging. The available data are not, in fact, sufficient to determine if a bank uses derivatives to reduce the interest rate risk inherent in its balance sheet position, or to increase it.

V. Conclusion

This study has used the quarterly Call Report data to shed some light on the pattern of derivative use by U.S. commercial banks. The study has found

Table 6
The Determinants of Derivative Use: Commercial Banks with Assets of $5 Billion or More[a]
Estimation Method: Fixed Effects, 1988:I to 1993:IV

Independent Variable	Futures/Assets	Swaps/Assets	Options/Assets	All Derivatives/ Assets
Log Assets	−.162**	−.135**	−.093*	−.510**
	(6.61)	(5.28)	(2.18)	(7.93)
Equity/Assets	−.012**	.010**	−.001	.009
	(3.17)	(2.46)	(.151)	(.839)
Nonperforming Assets/Assets	.010**	.007*	−.003	.029**
	(3.63)	(2.25)	(.537)	(3.95)
LLR/Nonperforming Loans	5.01E-5	−1.32E-5	1.39E-5	7.63E-5
	(1.13)	(.284)	(.220)	(.653)
LLR/Loans and Leases	−.041**	−.022**	.010	−.090**
	(9.27)	(4.78)	(.999)	(7.72)
Gap—3 months	2.26E-4	.001	−.003**	.001
	(.338)	(1.53)	(2.88)	(.816)
Gap—3 to 12 months	−5.38E-4	−1.58E-4	2.72E-5	−2.15E-4
	(.547)	(.153)	(.017)	(.083)
Gap—1 to 5 years	3.63E-4	.003**	6.75E-4	.005**
	(.502)	(4.29)	(.568)	(2.56)
Gap over 5 years	4.85E-4	−2.44E-4	−.003**	−.004*
	(.712)	(.342)	(3.06)	(1.96)
R2	.103	.190	.064	.196
SSR	45.4	49.9	47.7	314.0
SER	.145	.152	.181	.382
Number of banks	147	147	142	147
Number of observations	2,329	2,329	1,627	2,329

[a]Excluding top seven U.S. dealer-banks.
Absolute values of t-statistics in parentheses.
*Significant at the 5% confidence level.
**Significant at the 1% confidence level.

that for banks with less than $5 billion in assets, larger banks tend to use interest rate swaps more intensively, while there was no clear relationship between size and other interest rate derivatives. In addition, the study has found that for banks with more than $5 billion in assets, those with weaker asset quality tend to be more intensive users of derivatives than banks with better asset quality. These results, while intriguing, do not give a clear indication of how derivatives are used to manage interest rate risk, particularly whether they are used to increase or reduce that risk. Given that banks and the federal regulatory agencies spend time and effort to collect and process financial data through the Call Report system, it is disappointing that Call Report data are not more revealing. Call Reports are changed periodically to make the information in them more relevant, and a few modifications to the way derivative activities currently are reported would allow a clearer assessment of bank derivative activities and their risk.

First, Call Reports should distinguish the short and the long positions in futures and forwards, call and put options written and bought, and fixed versus floating sides in interest rate swaps. In addition, swaps and forward contracts should be broken down into the same maturity brackets currently used for loans and securities. This would allow one to adjust gap analysis for derivatives and gain a clearer picture of the relationship between interest rate risk and derivative use.

Rather than providing a definitive measure of risk, the purpose of the Call Report is to give analysts

and supervisors a screening mechanism that might point to the need to gather more detailed information. Expanding the reporting of off-balance-sheet derivatives mentioned above would go further in making the risk of derivative activities more transparent and highlighting potential problems requiring the supervisors' attention. It is important to emphasize, however, that the Call Report is not a substitute for a bank examination, and gap analysis is not a meaningful measure of interest rate risk in any but the simplest of cases. Large banks active in derivative trading have developed more sophisticated models to gauge the risk exposure arising from their trading activities. Even smaller banks' balance sheets are usually too complex to be amenable to a simple gap analysis. This is because even banks that do not use the derivative contracts discussed here, namely swaps, futures, and options, have assets on their balance sheets that have imbedded derivative characteristics. In particular, certain mortgage securities and "structured notes," that is, debt securities whose cash flow characteristics depend on one or more indices and/or that have embedded forwards or options, have risks not reflected in their maturities and have proved especially volatile in the current interest rate environment.

While improving Call Reports would be useful for bank analysts, the federal and state regulatory agencies, and others concerned with the health of the nation's banking system, it is only a small step in the direction of meaningful derivative disclosure. Even if disclosure were improved, however, some uncertainty would always remain for outsiders about the risks of the positions taken by market participants. Nevertheless, as financial innovation continues to spread, a wider spectrum of banks will begin using derivatives for asset–liability management. This makes it especially important to develop comprehensive and uniform reporting methods that will permit meaningful disclosure of interest rate risk for all financial institutions.

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Financial Innovation and Standards for the Capital of Life Insurance Companies

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Since their inception, insurance companies, banks, and other financial institutions have played prominent roles in our capital markets. These intermediaries have fostered saving and investment by issuing liabilities that appeal to savers in order to purchase the obligations of investors on attractive terms. Among financial intermediaries, life insurance companies traditionally have distinguished themselves by attracting long-term savings and by providing long-term financing for investment in real estate and durable equipment by businesses.

Because financial intermediaries must bridge the often disparate interests of savers and investors, the evolution of these institutions and their products depends on the opportunities created by the needs of their customers. To a degree, financial intermediaries have been coping throughout this century with the consequences of their own success. By supplying much of the financing needed to build our modern industrial corporations and by giving capital markets a good foundation, financial intermediaries have helped create enterprises that no longer depend so greatly on intermediaries for funds. Furthermore, as the nation has become wealthier and credit markets have become deeper, savers have become more willing to assume more risk in pursuit of a greater share of the returns from their investments. These demands, coupled first with rising interest rates between the late 1960s and the early 1980s, then with the capital gains that subsequently accompanied falling rates, precipitated many of the financial innovations of the last three decades. As rising interest rates depressed their profits, the capital per dollar of assets of many intermediaries fell for a time as they attempted to offer competitive terms for savings. Some, seeking to earn higher yields or to maintain their share of savings, also made riskier investments or sold riskier liabilities. In time, many adopted a "mutual fund" approach to their business as they unbundled their services.

After profits and capital ratios subsided for financial intermediaries during the 1970s, those who supervise and regulate these enterprises

adopted new methods of measuring and controlling the risks arising from financial intermediation. Regulators increasingly favored enforcing capital requirements that rise with an intermediary's holdings of certain risky assets, appraising risky assets according to their market values, and imposing prompt remedies when capital ratios become too low. These steps, of course, reinforce intermediaries' interest in redesigning their liabilities to resemble mutual funds, wherein savers implicitly provide the capital to support their investments. The returns on investments in many popular life insurance and annuity contracts, for example, depend on the performance of funds offered by life insurance companies to their policyholders.

Because the risks borne by an intermediary depend on the mix of its assets and liabilities, prudent standards for capital should weigh the characteristics of an intermediary's entire portfolio.

More stringent standards for capital may reduce the risk of insolvency, but they also can impose greater costs on financial intermediaries. For intermediaries that hold assets not traded consistently in public markets, the strategy of tying capital to holdings of certain risky assets, marking these assets to market, and requiring the sale of these assets when capital appears to be deficient can entail costs that exceed the benefits. The success of this strategy for managing risk depends greatly on the nature of the risks inherent in those assets deemed risky. The conflation of risk-based capital requirements and of marking risky assets to market is a conservative policy when the values of these assets tend to follow random walks. If, on the other hand, these values tend to revert to trends over time, this policy can increase rather than diminish the risks inherent in financial intermediation. In either case, requiring intermediaries to sell risky assets into illiquid markets tends to dissipate rather than preserve their capital. Finally, the linking of capital requirements to investments in specific assets and the marking of these assets according to their disposal values take a very narrow view of the risks inherent in financial intermediaries' balance sheets, a view that can either exaggerate or diminish the magnitude of these risks. Because the risks borne by an intermediary depend on the mix of assets in which it invests and the liabilities it issues to finance these assets, prudent standards for capital should weigh the characteristics of an intermediary's entire portfolio of assets and liabilities.

This article opens by briefly discussing the role of financial intermediaries in capital markets. The next three sections describe in more detail the distinctive features of life insurance companies. This discussion first examines how insurers have reshaped their liabilities to cope with the consequences of rising interest rates and increasing competition for savings during the past three decades. It also examines how insurers have restructured their assets. This discussion then analyzes the consequences of these financial innovations for the capital of the industry as well as the distribution of capital among life companies.[1] The following section examines the issues relevant for measuring and controlling the capital of life companies, describing when some of the more common approaches are likely to work best and when their costs are likely to exceed their benefits. The final section offers the conclusions.

I. Capital Markets and the Role of Financial Intermediaries

Economic development depends on the efficient transfer of resources from savers to investors. Although savers may finance investments by making loans directly to investors or by purchasing investors' offerings of stocks and bonds,[2] much of this financing passes through financial intermediaries. Insurance companies, banks, thrift institutions, pension funds, finance companies, and other intermediaries issue their own liabilities to savers, using the proceeds to acquire the debt and equity issued by investors.

Financial intermediaries create derivative securities, essentially transforming the obligations of investors into financial assets that appeal to savers. In doing so, intermediaries encourage capital formation by fostering saving on terms that entail a lower cost of capital for investors. Without intermediation, each financial contract between savers and investors must

[1] See also Kopcke and Randall (1991), for additional studies.

[2] Retained earnings, an important source of financing for investment, are purchases of equity undertaken for shareholders by established businesses.

Table 1
Total Domestic Wealth[a]

	1955	1965	1977	1985	1991
Trillions of Current Dollars:					
Total Domestic Wealth	1.5	2.5	8.3	16.7	21.4
Percent of Total Domestic Wealth:					
Residential Structures	23.2	22.5	23.7	22.9	24.4
Private Nonresidential Capital	20.9	21.9	23.7	24.6	25.5
Equipment	9.2	9.9	10.8	11.1	11.6
Structures	11.7	12.1	12.9	13.5	13.9
Inventories	8.1	7.2	6.2	5.4	5.1
Consumer Durables	10.2	9.5	8.7	8.3	10.0
Government Capital	17.1	17.0	14.6	13.3	13.4
Defense	5.8	4.5	2.2	2.1	2.4
Nondefense	11.3	12.5	12.5	11.2	11.0
Land	20.5	21.8	21.9	25.7	22.2
Net U.S. Invested Assets Abroad[b]	n.a.	n.a.	1.1	−.1	−.6
U.S. Assets Abroad	n.a.	n.a.	2.0	1.4	2.0
Foreign Assets in U.S.	n.a.	n.a.	.8	1.5	2.5

[a]Total Domestic Wealth includes only wealth within the borders of the United States for 1955 and 1965, owing to data limitations.
[b]Includes plant, equipment, and inventories.
n.a. = not available.
Source: Board of Governors of the Federal Reserve System, Flow of Funds; Data Resources, Inc.; U.S. Bureau of Economic Analysis, Foreign Direct Investment in the United States, and U.S. Direct Investment Abroad, various years.

reconcile their frequently disparate motives. Savers, who seek more than an attractive yield from their financial assets, also value attributes such as liquidity, assurance of their family's well-being in the event of sickness or death, or an annuity for the remainder of their lives after they retire. Investors, on the other hand, ordinarily seek obligations that conform more closely to the life spans of their assets or the patterns of their earnings and cash flows. While households have had limited interest in accumulating savings in 30-year debentures, steel manufacturers have had less interest in financing furnaces by issuing demand debt or options tied to the lender's life span. Intermediaries also serve savers and investors by evaluating investors' prospects, monitoring their performance, and providing both savers and investors a dependable access to funds on terms commensurate with their risks and returns.

Mismatched Books and the Role of Capital for Financial Intermediaries

The nation's tangible assets generally have a long life span (Table 1). During the past four decades, real estate—residential structures, nonresidential structures, and land—has represented about three-fifths of tangible assets. Business equipment and consumer durable goods represent about one-fifth of this wealth. Except for inventories, which now represent about one-twentieth of total assets, the stock of tangible assets is inherently illiquid. The nation as a whole cannot sell a substantial share of these assets very quickly, except perhaps at greatly depressed prices.

Although the nation essentially is committing itself to its fixed investments in real estate and durable goods, individual investors nonetheless may "liquidate" their investments by selling them to others at "fair" prices when a market exists and when buyers and sellers are equally well informed. These transfers are most facile, and investments appear to be most liquid, when incentives for installing new assets are most inviting. This apparent liquidity often diminishes greatly for many assets, especially those lacking dependable public markets, when business activity slumps.

The nation's tangible assets are essentially financed by households' savings. Some of this financing is direct, such as the ownership of residences or

Table 2
Composition of Household and Nonprofit Organizations' Assets

	1952–1955	1956–1960	1961–1965	1966–1970	1971–1975	1976–1980	1981–1985	1986–1990	1991–1993
Percent of Total Assets:									
Real Assets	36.2	35.9	34.0	34.1	38.0	42.1	41.8	39.5	37.0
Financial Assets	63.8	64.1	66.0	65.9	62.0	57.9	58.2	60.5	63.0
Percent of Financial Assets:									
Primary Securities	69.0	68.5	66.0	61.6	52.8	51.0	47.4	44.1	44.6
Equity	55.9	55.9	54.4	50.6	43.8	42.8	38.3	31.7	31.1
Corporate Equity	21.4	26.8	30.5	28.8	18.7	14.3	12.8	12.8	17.1
Noncorporate Equity	34.5	29.1	23.9	21.8	25.1	28.5	25.5	18.9	14.0
Debt Securities	12.5	11.5	10.0	9.2	7.7	7.4	8.0	9.3	8.6
Government Securities	7.7	6.1	4.6	4.0	2.9	3.0	3.5	3.3	2.8
Tax-exempt Securities	1.7	2.2	2.1	1.7	1.3	1.4	2.0	3.0	3.1
Corporate and Foreign Bonds	.6	.7	.6	.9	1.5	1.2	.3	.5	.6
Mortgages	2.3	2.4	2.5	2.1	1.6	1.6	1.5	1.3	1.0
Open Market Paper	.2	.2	.3	.5	.3	.3	.6	1.2	1.0
Intermediated Funds	30.3	31.5	34.6	39.1	47.3	48.4	52.2	57.1	58.4
Deposits	17.7	17.5	19.0	20.6	24.6	25.4	24.1	21.7	17.3
Money Market Mutual Funds	.0	.0	.0	.0	.0	.4	2.2	2.5	2.7
Pension Fund Reserves	4.7	6.3	8.0	9.4	11.7	14.1	18.3	23.5	26.9
Life Insurance Reserves	7.3	6.6	6.0	5.3	4.9	4.0	3.0	2.6	2.7
Mutual Funds	.6	1.1	1.6	1.8	1.3	.8	1.2	3.1	4.9
Bank Personal Trust	.0	.0	.0	1.9	4.7	3.8	3.4	3.6	3.8

Note: Columns do not add 100% because miscellaneous assets and security credit are not included.
Source: Board of Governors of the Federal Reserve System, Flow of Funds.

durable goods (Table 2). Most is indirect, taking the form of financial assets, which constitute about two-thirds of households' savings. In turn, about one-half of these financial assets are the liabilities of financial intermediaries, most of which are managed by depository institutions, life insurance companies, and pension plan advisors that frequently offer savers and investors contracts with guarantees of cash values or returns.

By design, many financial intermediaries bear risks in running mismatched books, risks arising from their writing liabilities with specific commitments that, in turn, are backed by their investments (directly or indirectly) in durable tangible assets. In order to fulfill their obligations to their customers, the return to and, therefore, the value of the investments behind intermediaries' assets must generally fulfill investors' expectations. In addition, savers may not attempt to withdraw a significant amount of their savings from these intermediaries when the earnings on their assets may be depressed too greatly or when new opportunities offer savers greater yields.

Financial intermediaries customarily diversify or hedge some of their risks. For example, life insurance companies purchase a variety of assets to achieve a stream of income that more closely matches the outlays required to meet their obligations. These companies also generally issue different types of insurance or investment contracts as well as maintaining other lines of business in order to manage better the volatility of their cash flows. Indeed, much of the financial innovation of the 1970s and 1980s reflected intermediaries' efforts to diversify their businesses and hedge their risks better through broader portfolios of assets and liabilities.

Other things equal, an intermediary's capacity for bearing risk diminishes as its capital diminishes or the difference between the yields on its assets and liabilities diminishes. Capital is the difference between the value of an intermediary's assets and that of its liabilities. The less capital per dollar of liabilities and hence per dollar of assets, the greater is the chance that relatively low returns on investments will prevent the intermediary from meeting its contractual obligations.

Intermediaries also expect to earn a sufficiently great margin between the yields they earn on their assets and the yields they offer savers—a portion of which may be regarded as an insurance premium—to accommodate the risks they bear. Mutual fund advisors, for example, invest negligible capital in their funds, earn a comparatively small margin, and retain relatively few risks.[3] Except for fees and commissions to defray the costs of selling their shares and managing their assets, mutual funds essentially pass the returns on their assets and the risks inherent in those assets to their shareholders. Insurance companies, on the other hand, maintain considerably more capital, anticipate earning substantial margins, and retain more risk by offering savers and investors contracts with specific guarantees and options. The more savers value competitive yields and the more investors can avail themselves of competitive terms for funds in public capital markets, the more intermediaries' potential profit and capacity for bearing risk shrink.

Much of the financial innovation of the 1970s and 1980s reflected the strategies taken by intermediaries in order to offer savers competitive returns.

In the past two decades, their mismatched books have taken a toll on many financial intermediaries. Rising interest rates depressed their margins as the returns offered on new investments exceeded those on many of their existing investments. Much of the financial innovation of the 1970s and 1980s reflected the strategies taken by intermediaries in order to offer savers competitive returns. As intermediaries sought assets with the greatest promise, their fortunes frequently flowed and ebbed with the value of investments in less developed countries, oil and gas enterprises, farm land, and commercial real estate. Assets increased more rapidly than capital for many intermediaries as they tried to maintain their share of the nation's savings despite the comparatively small margin between the yields on their assets and liabilities. During the 1970s and 1980s, as analysts became more concerned that the capacity for bearing risk was dwindling for many financial intermediaries, those who supervised these intermediaries adopted more formal capital requirements or increased existing requirements.

II. Liabilities of Life Insurance Companies

Since their inception, life insurance companies have managed substantial portfolios of long-term assets on behalf of those holding their life insurance, health insurance, annuity, and pension contracts. Currently, life insurers hold approximately $1.5 trillion in reserves to back the $11 trillion of life insurance in force in the United States and their other obligations (American Council of Life Insurance).

The life insurance industry comprises both stock and mutual companies. Mutual companies tend to be older and larger than stock companies, and they manage about two-fifths of the industry's assets. The financial capital of these companies, their surplus, comprises contributions by policyholders and retained earnings. Consequently, policyholders of mutual insurers generally receive shares of the earnings or surplus that these companies may approve for distribution. Stock companies tend to be younger than mutuals, and the assets of stock companies have grown more rapidly than those of mutuals in recent decades. The financial capital of stock companies comprises the proceeds from sales of equity and retained earnings. Accordingly, those who hold policies with stock companies are not buying an equity stake in the company, and the management of stock companies divides the net investment income from their assets between the interests of policyholders and stockholders.

Insurance Contracts and Savings

Since their inception, life insurers have cultivated their capacity for managing assets by offering savers a range of products, some of which verge on pure investment contracts. Although basic term or health insurance policies entail relatively little saving, policyholders may accumulate substantial savings in whole life policies, annuities, and investment contracts. The appeal of life insurers' contracts often depends on prospective yields on the investments

[3] Mutual funds and custodians cannot avoid all risks. Unavoidable errors in handling instructions or settling transactions, for example, create risks. Also, funds that value their reputation or that face savers' complaints may bear some of the risks arising from disappointing investments (credit, liquidity, or market risks).

backing them. Not only do the revenues and profits of insurers ordinarily increase with the yields on their assets, but policyholders also tend either to earn greater dividends or to pay lower net premiums as these yields rise.

That insurers' products are regarded, often greatly so, as investment contracts is both inevitable and proper. Insurers' assets both account for a substantial share of personal wealth and finance much of businesses' investment in plant and equipment. When yields are comparatively great, insurers are more willing to promote and customers are more willing to buy those contracts that accumulate assets most rapidly. Accordingly, life insurance companies, acting as financial intermediaries, help regulate the flow of financing for tangible investments depending on the yields businesses are willing to pay and the returns that savers require. By paying sufficient attention to the yields on their assets, insurers and their customers may allocate funds most efficiently to the most promising enterprises.

Insurers' assets both account for a substantial share of personal wealth and finance much of businesses' investment in plant and equipment.

Term Life and Health Insurance

Even term life and health insurance policies, which verge on pure options contracts, reflect the returns insurers earn on the funds they collect when they sell these contracts. Because of the lag between the collecting of premiums and the payment of claims, insurance companies hold these premiums on behalf of their customers until claims are paid. The premiums of policy owners, therefore, produce a portfolio of assets representing an accumulation of savings to defray the cost of future contingent liabilities. With popular group health plans, for example, if sponsors and insurers are reasonably certain of the magnitude and timing of claims, premiums are essentially the discounted values of the costs of paying these future claims and administering the plan. The rate of discount generally reflects the insurers' return on assets.

The premiums on term insurance contracts mostly depend on the probability of the insured's dying and the expenses for servicing the contract. For example, a company selling $100,000 annual term contracts to 35-year old males may expect 2 of every 1,000 clients to die during the year, an expected obligation of $200 for each such contract. To cover this obligation, expenses, commissions, and profit margin, the premium for these policies might be $250 (see, for example, Gregg and Lucas 1973). If the company collects the full premium at the inception of the contract, the reserve for this policy initially is $200. As the company pays its death benefits during the course of the year, this reserve falls to zero.

A company issuing many such term insurance contracts during the course of the year will tend to hold a fairly stable quantity of reserves, averaging $100 for each contract throughout the year, which engenders a stable portfolio of assets for the company to invest. Insurers ordinarily return a share of the yield on these assets to their policyholders by charging lower premiums than described in the foregoing example or by paying rebates and dividends on their policies.

Permanent, Universal, and Variable Life Insurance

The yield on life insurers' assets is of greater importance for permanent insurance contracts than it is for term policies, because these contracts combine life insurance with saving program that allows policyholders to accumulate wealth. Permanent life insurance contracts maintain a constant death benefit over many years without charging premiums that rise as the probability of death increases by setting a premium that initially is greater than that required by term insurance policies. During the early years of a permanent insurance contract, the policy accumulates cash value mainly because the premium exceeds the cost of insurance. In later years, the accrued earnings on previous years' cash values contribute to the growth of future cash values. As the cash value rises, the amount of pure insurance the company must provide diminishes. A $100,000 policy's premium is intended to achieve a cash value of $100,000 at the time the insured is 100, thereby eliminating the element of insurance. The greater the return on assets that insurers expect they will earn, the lower they need set their premiums to fund their permanent insurance contracts.

The premium on a permanent insurance policy entails a guarantee: policyholders' savings in the con-

tract will accrue income at a rate no less than the yield assumed by the insurer to set the premium. To limit the risk created by this guarantee, insurers ordinarily set their premiums by assuming they will earn returns nearer the lower range of their forecasts of prospective yields on their assets. Insurers also typically credit their policy owners with yields in excess of these guaranteed rates of return, so permanent insurance policies usually attain full funding well before the insured reaches 100 years of age. If the yields on the cash values of a company's permanent insurance policies were not competitive, new customers would favor other contracts, and existing policyholders would consider withdrawing their cash values. The more successful are the company's investments, the greater are its dividends or rebates, and the more attractive are its policies.

Life insurance companies, acting as financial intermediaries, help regulate the flow of financing for tangible investments, depending on the yields investors are willing to pay and the returns that savers require.

Basic whole life is only one form of insurance that accumulates cash values in addition to paying for pure insurance coverage. Life paid-up at 65, policies paid-up in 20 or 10 years, and single-premium policies charge greater premiums than whole life to build cash values more quickly, thereby increasing policyholders' commitment to an investment program. Conversely, modified life policies charge comparatively low premiums during their first few years, compensating for the loss of cash value by charging greater premiums in subsequent years.

Although life insurance contracts that accumulate cash values are nominally long-term agreements, they commonly allow policyholders to withdraw their cash value, either by taking policy loans or by surrendering their policies, which can be a valuable option. Older policies, in retrospect, often priced this option too cheaply by fixing the rate of interest on loans, often at 5 or 6 percent, and by not adjusting a policy's dividends to reflect the income on outstanding loans. Newer life insurance policies frequently charge prevailing rates of interest on such loans and adjust the return on a policy's cash value to reflect the rate of interest on any of its loans. Furthermore, those policies that quickly accumulate substantial cash values (such as single-premium contracts) also may impose redemption fees on early withdrawals of funds.

In addition to these traditional forms of permanent insurance, universal, variable, and universal-variable life policies have become more common since the 1970s. These newer contracts allow policyholders either a role in managing their cash values or freedom to alter their policy's terms, essentially by separating to a greater degree the insurance features and the investment features of the contract. With variable life, a portion of the cash value is invested in separate accounts—including equity, bond, or money market funds—rather than placed in the company's general investment portfolio; the death benefit varies with the value of these investments, but does not fall below a minimum guaranteed by the policy. Universal life allows policyholders to alter their death benefits comparatively easily and to vary the amount or timing of their payment of premiums; the rate of return accruing to cash values depends on prevailing rates of interest. Universal-variable life, combining features of universal and variable contracts, allows policyholders to choose, within limits, both the timing of payments and the funds in which the assets are invested.

Annuities and GICs

Life insurance companies also offer other financial services to their customers, including guaranteed investment contracts and annuities. Guaranteed investment contracts (GICs) are similar to medium-term notes. A saver might be offered a return of 9 percent for three years. These contracts most frequently are sold to pension and retirement plans sponsored by employers. The appeal of GICs rests on their high yields combined with their guarantee of principal, and their maturities force purchasers to review these investments comparatively frequently.

Annuities promise to pay their beneficiaries an income for a specific interval of time, often from retirement until death. Annuities may be funded by making installment payments over several years or by making a single payment (often by transferring funds from other investments, such as balances in permanent insurance policies or employers' thrift and pension plans). The value of annuities depends very much on the return that an insurer earns on its assets. The greater the yield, the smaller are the installments

required to fund a given annuity, and the greater are the income payments resulting from any given investment in an annuity. Annuities often allow policyholders the option to withdraw all or a portion of their cash values before the beneficiary begins receiving income payments from the contract. Though not so common in the past, annuities today generally impose redemption fees for early withdrawals, and the assets backing the annuities may be marked to current prices to value customers' withdrawals.

III. The Composition of Insurance Companies' Liabilities

During the first half of this century, the main business of life companies was the selling of life insurance, and the whole life policy was their most popular contract. By the mid-1950s, reserves against life insurance contracts accounted for almost three-quarters of the total reserves of life companies, and term insurance represented one-sixth of ordinary life insurance in force. The commitment to whole life insurance was sufficiently great that life insurance companies managed about one-fifth of all financial assets held by financial intermediaries, a share second only to that of commercial banks. Mutual life insurance companies, in turn, managed most of the industry's assets, having written nearly two-thirds of the life insurance in force.

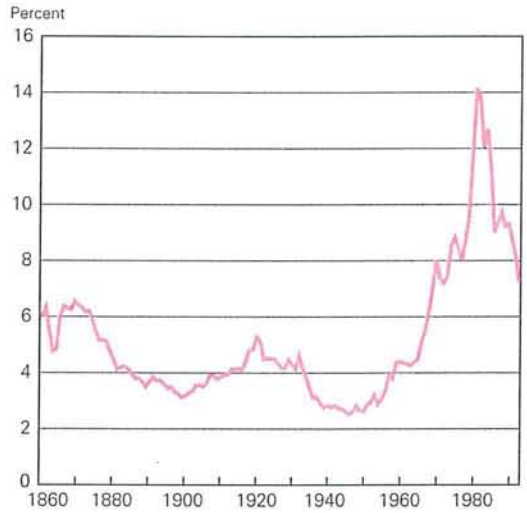
Between the 1950s and the 1980s, the competition that accompanied rising interest rates reshaped the life insurance industry. Today, as measured by reserves, the selling of annuities has supplanted the selling of permanent insurance policies. Reserves backing life insurance account for only about three-tenths of the total reserves of life companies, and term insurance accounts for just under one-half of ordinary life insurance in force. Although the assets backing annuities and other products have grown much more rapidly than life insurance reserves, life companies now manage only about one-eighth of all financial assets held by financial intermediaries, a share exceeded by those of commercial banks and pension fund advisors. Furthermore, stock companies, which currently manage about three-fifths of the life insurance industry's assets, have overtaken the mutual companies.

Life Insurance

Before the 1960s, interest rates generally varied between 3 and 6 percent in the United States (Figure 1). Insurers generally priced their permanent life contracts by assuming the return on their assets would average 3 or 4 percent over the life of the contract. This return was comparatively attractive for policyholders, partly because their returns were not taxed as income as they accrued, and partly because other, more lucrative means of accumulating wealth were lacking. The mutual fund industry was negligible, people's investing directly in stocks and corporate bonds had been limited,[4] the certificate of deposit had not yet been introduced, and savings accounts at banks and thrift institutions yielded little more if any than insurance contracts.

Figure 1

Interest Rate on Corporate Bonds



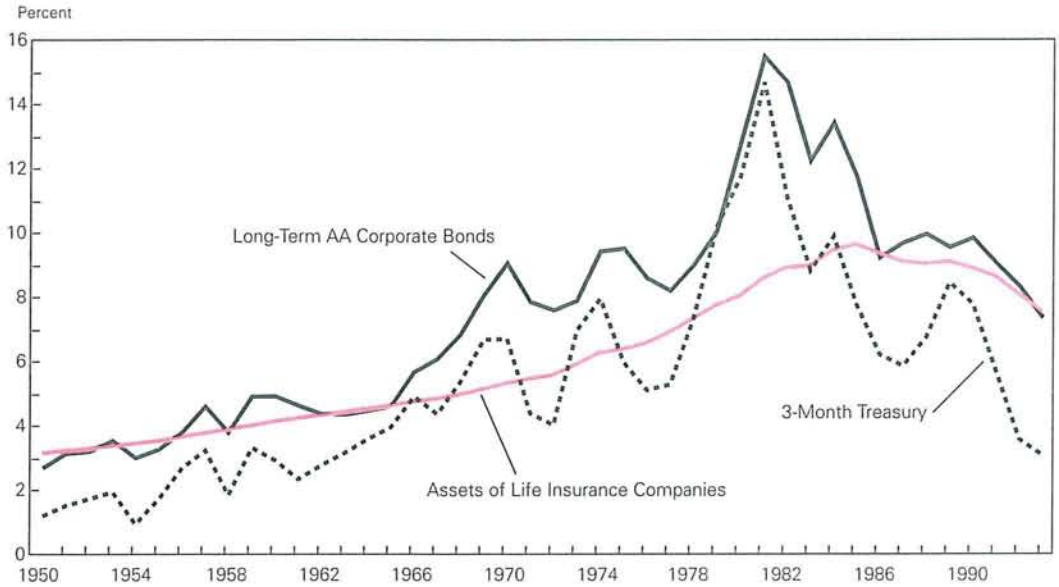
Note: For 1860 to 1900, the interest rate is for high-grade railroad bonds. For 1901 to 1940, the interest rate is for prime corporate bonds. For 1941 to 1993 the interest rate is for Moody's Aaa corporate bonds.
Source: Kopcke and Randall (1991) and Data Resources Incorporated.

As interest rates began ascending in the 1960s, the admonition to "buy term and invest the rest" became more compelling. The cash values of a new policy would be invested in the company's general account, and the return to these cash values would be dictated by the yields of the assets in this account. Accumulat-

[4] By the late 1920s, the proportion of the population directly owning bonds had risen to only 12 percent; about 8 percent for stocks (Carosso 1970, Baskin 1988). By comparison, the number of life insurance policies was almost 90 percent of the population, implying that many more savers held life insurance policies than held stocks and bonds. Direct investment in private securities advanced little during the Great Depression and World War II.

Figure 2

Returns on Life Insurance Company Assets



Note: Returns on long-term AA corporate bonds are based on reoffering yields of new corporate bonds rated AA by Moody's having original maturity of at least 20 years. Return for life insurance companies includes separate accounts after 1965. The annual data from 1950 to 1959 are linearly interpolated from the 1950, 1955, and 1960 levels.
Source: American Council of Life Isurance, *1994 Life Insurance Fact Book*; Data Resources Incorporated; and *The Analytical Record of Yields and Yield Spreads*, published by Salomon Brothers.

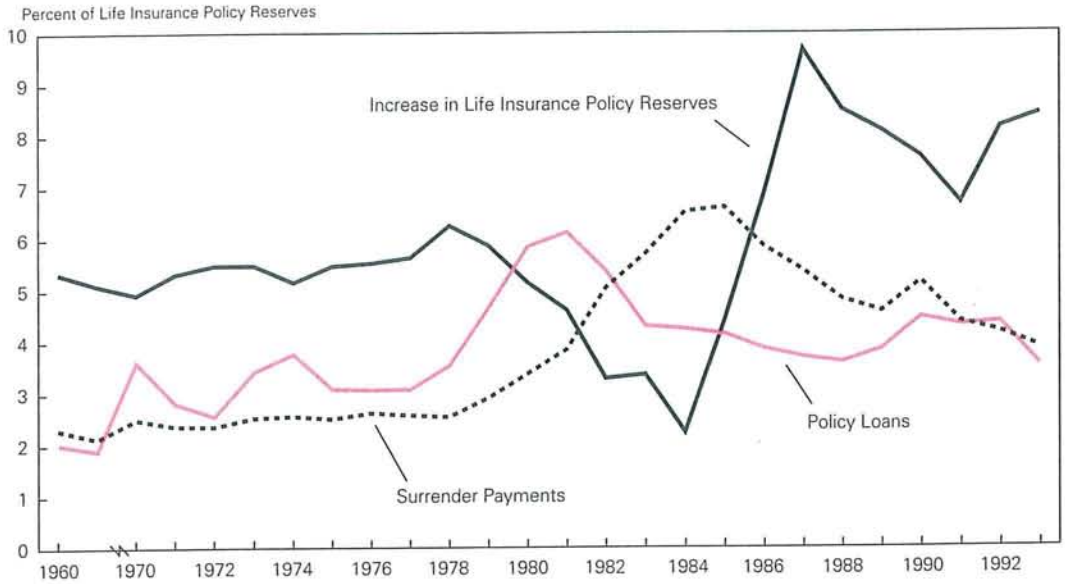
ing savings in permanent life policies lost its appeal because the yield on the seasoned bonds in life companies' general accounts could not match the returns available from other intermediaries (Figure 2). Between the mid-1960s and the early 1980s, the difference between the yield on insurance companies' investments and prevailing rates of interest on bonds tended to increase, culminating at almost 7 percentage points in 1981. Surplus and capital grew more slowly than assets for many established life insurance companies as interest rates rose. Nevertheless, newly formed and rapidly growing stock companies, which were unencumbered with sizable investments in low-yielding bonds, gained the advantage of promoting contracts that offered high yields coupled with the traditional benefit of deferred income taxes.

If their policyowners were to "invest the rest," then insurers would compete for these savings. Life companies promoted new policies in the 1980s that offered more competitive yields. During the early 1960s, insurers were allowed to establish separate accounts distinct from their general account. These accounts resemble mutual funds inasmuch as they ordinarily do not require the company to contribute capital, and the net income accruing to the accounts belongs to those who hold the contracts that are backed by the assets in these separate accounts. With the sales of universal and variable insurance policies linked to separate accounts, insurers allowed customers to invest their premiums at prevailing rates of return and to decide the allocation of their investments among accounts invested in money market securities, bonds, or equities. In 1982, universal and variable life policies represented a negligible proportion of the ordinary life insurance in force in the United States; by the early 1990s, their share had risen to more than three-tenths. In addition, many insurance agents became licensed to sell directly to their clients mutual funds and other securities, including those underwritten by subsidiaries of life companies.

Not only did rising interest rates deter sales of new permanent life contracts, they also encouraged

Figure 3

Reserves, Loans, and Surrender Payments



Source: *1994 Life Insurance Fact Book.*

some policyholders either to surrender or to withdraw funds from existing contracts. During the 1960s, policyholders generally could borrow against the cash values in their life insurance at fixed rates, less than 6 percent in most policies, while the returns on their accumulated cash values would continue to accrue at a rate dictated by the overall return on insurers' general accounts. In other words, those who wished to withdraw funds from their policies possessed an inexpensive option: they could borrow cheaply in order to acquire other assets without reducing the yield on their cash values noticeably.[5] Similarly, with rising interest rates, policies could be surrendered on comparatively favorable terms.

Triggered by high interest rates, policy loans and surrenders have reduced significantly life companies' cash flows. Policy loans rose from almost 4 percent of assets in 1955 to almost 8 percent of assets by 1970. During the 1970s, life companies increasingly tied their rates for policy loans to prevailing yields on bonds in order to deter the demand for loans against new policies. Nevertheless, in the 1970s the flow of policy loans and surrenders helped depress the growth of other investments by insurance companies, During the early 1980s, policy loans increased after interest rates rose sharply (Figure 3 and Figure 2); consequently, outstanding loans rose above 9 percent of insurers' assets. At nearly the same time, surrenders rose considerably, peaking in 1985. This greater volume of loans and surrenders diminished the growth of insurers' other assets between 1978 and 1986.

Although rising interest rates stanched life insurers' investing, falling rates have not yet fully restored this flow of funds. The volume of loans and surrenders has remained relatively high since the early 1980s, suppressing the flow of funds available for other investments. Falling interest rates have produced substantial capital gains in the stock and bond markets over much of the last 10 years. The prospect of these gains, made more accessible by flourishing mutual funds, attracted savings from life insurance companies as well as other intermediaries. Furthermore, some mutual funds, banks, and brokerage

[5] A single policyholder's borrowing alters the return on assets in the general account and the return on his policy's cash value insignificantly. Should many borrow, the company's investment income would fall substantially, thereby reducing the returns to all policyholders, including those who do not borrow.

houses now offer savers variable life insurance and annuity contracts with relatively low fees; the fund, bank, or broker manages the assets, while purchasing only the necessary coverage and administrative services from insurers.

Annuities and GICs

As rising interest rates depressed the demand for permanent insurance policies, the need for the investment program inherent in these policies also became less compelling with the growth of individual annuities and pension plans sponsored by employers. After World War II, businesses increasingly established defined-benefit pension plans for their employees. These plans may be managed by their sponsors, banks and trust companies, life insurance companies, or other investment advisors. Sponsors of these plans typically review their contracts with their managers frequently, and disappointing performances eventually entail a change of managers.

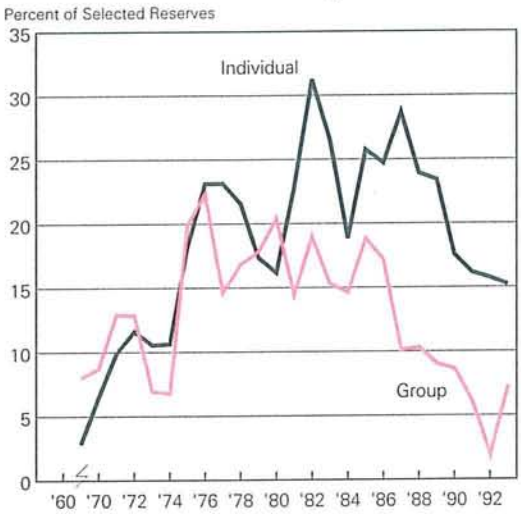
Life insurers initially attracted a comparatively small share of the funds flowing into pension plans, partly because regulations limited insurance companies' ability to invest in certain assets, including common stock. After legislation in most states allowed life insurance companies more latitude for the investments in their separate accounts for pension plans, and after the Employee Retirement Income Security Act (ERISA) of 1974 required most employers to increase the funding of their defined-benefit pension plans, the growth of reserves for group annuities with life insurers increased significantly (Figure 4). During the late 1970s and the early 1980s, the GICs issued by insurers helped attract a substantial flow of funds into defined-contribution plans sponsored by employers.

ERISA also allowed people not already covered by a pension plan to establish their own individual retirement account (IRA). In 1981, federal legislation both increased the maximum contributions permitted for IRAs and allowed people covered by an employer's pension plan to establish IRAs. During the early 1980s, insurers' sales of individual annuity contracts, especially single-payment deferred annuities, also increased rapidly, as insurers promoted the advantages of tax-deferred investments that earned the relatively high returns prevailing at that time. Consequently, the growth of reserves for IRAs and individual annuities at life insurance companies surged in the mid-1970s and again in the early 1980s.

Since the mid-1980s, sales of annuities have subsided. The growth of reserves for individual annuities has fallen much less than that of group annuities, partly because individual contracts are sold much like tax-sheltered mutual funds to people whose group coverage may no longer look so generous or so secure. But life insurers are not the sole vendors of these contracts. Mutual fund advisors, banks, and brokerage houses also are promoting their IRAs and annuities.

Figure 4

Increase in Annuity Reserves



Source: *1994 Life Insurance Fact Book.*

Increasing interest rates, greater competition, the termination of some group defined-benefit plans, and tax reforms have taken a toll on sales of annuities, especially group contracts. As interest rates rose in the late 1970s and early 1980s, employers increasingly turned from insured pension plans to trusteed plans as banks and other investment advisors offered more appealing returns at competitive fees. By the mid-1980s, insurers had successfully promoted GICs offering attractive yields, but by 1991 the sales of GICs had stalled after sponsors of pension plans became concerned about the safety of these investments.[6] The

[6] Insurers issued GICs bearing yields that often exceeded the average yield on assets in their general accounts. Nevertheless, insurers invested their proceeds from selling GICs in assets that promised returns that exceeded the cost of the GICs, assets such as commercial mortgages and junk bonds. The "collapse" of prices of real estate and junk bonds during the late 1980s and early 1990s raised fears about the condition of insurers that had issued GICs.

growth of reserves backing group annuities also fell as the number of people covered under group annuity contracts first grew more slowly during the late 1980s, then began to fall by the 1990s as a result of layoffs and the termination of some defined-benefit plans.

IV. Assets and Capital of Life Insurance Companies

Since their inception, life insurance companies have invested most of their assets in mortgages and bonds, which have long been regarded as suitable investments for the reserves and cash values backing permanent life insurance policies. By matching the predictable cash flows of long-term securities with the flows promised in long-term insurance and annuity contracts, insurers could confidently anticipate meeting their obligations as they came due. Furthermore, inasmuch as yields on longer-term securities generally exceed those of shorter-term securities, insurers could price their contracts most attractively by investing in bonds and mortgages, provided yields remained relatively stable. Investing predominantly in shorter-term securities would allow the company to profit should interest rates rise, but should interest rates decline, the return on assets would not be sufficient to provide adequate profits and to service the obligations to policyholders. Insurers investing predominantly in equities or in real estate would bear similar risks; a substantial slump in the value of these assets would diminish insurers' surplus and, possibly, their ability to fulfill their obligations to their policyholders.

Before 1900, the mortgage obligations of farmers and homeowners along with the bonds issued by railroads, canals, and governments accounted for most of the assets held in the general accounts of life insurance companies. During the last three decades, bonds gradually surpassed mortgages, while commercial mortgages displaced farm and residential mortgages, as employment shifted, in stages, from agriculture to manufacturing and then to service industries (Table 3). Also, as life companies promoted their variable insurance and annuity products, assets held in separate accounts have increased significantly since the late 1970s.

Bonds and Mortgages

Before the 1980s, mortgages represented just over one-third of insurers' assets, but, by the early 1990s, they had fallen to nearly one-sixth of assets. At the same time, insurers' investments in bonds rose from just over two-fifths to more than one-half of their assets. These figures overstate the shift from mortgages to bonds, however. Since the mid-1970s, insurers have increased greatly their investment in the mortgage-backed securities issued by agencies sponsored by the federal government, which are classified as bonds on insurers' balance sheets.[7] Life companies also have purchased mortgage-backed securities from other underwriters. Accordingly, almost three-tenths of insurers' assets, directly or indirectly, were invested in mortgage loans in the early 1990s, while bonds not backed by residential mortgages represented just over four-tenths of assets.

This commitment to bonds and mortgages also is evident in credit markets. Life insurance companies hold about one-third of the corporate bonds issued in the United States (Table 4, upper panel), and in the past 15 years, they have supplied about three-tenths of the net new funds raised through bonds issued by corporations (lower panel). Since the 1960s, the share of outstanding residential mortgages held by life companies has fallen significantly, as they have essentially ceased acquiring these securities directly. Instead, as insurers turned to mortgage-backed securities, their holdings of the outstanding issues of federally sponsored credit agencies have increased substantially since the 1970s. Insurers recently have supplied about one-fifth of the net new funds for these securities.

While the importance of residential mortgages waned during the 1960s and early 1970s, life insurance companies increased their investments in commercial mortgages (Table 3). Since the late 1970s, commercial liens have represented about one-sixth of their assets. Despite this relatively constant share during the past 15 years, insurers' holdings of commercial mortgages essentially doubled between 1984 and 1990 as assets also doubled. The growth of the volume of life companies' investments in commercial mortgages closely matched that of the market for these loans over the past three decades, because insurers have held about three-tenths of outstanding commercial mortgages since the early 1960s (Table 4, upper panel).

[7] The consequences of competition and financial innovation are not limited to the liabilities of insurance companies. With the ascendancy of thrift institutions and mortgage pools after World War II, mortgage-backed securities became less expensive than the mortgage loans themselves for insurance companies to acquire, manage, and trade.

Table 3
Balance Sheet of Life Insurance Companies
Percent of Total Assets

	1960–1964	1965–1969	1970–1974	1975–1979	1980–1984	1985–1989	1990–1993
Assets, Billions of Current Dollars	134.1	178.0	237.1	357.6	594.1	1045.8	1577.7
Bonds	47.4	42.6	40.2	43.4	40.9	47.2	52.3
Government Bonds	9.2	6.4	4.8	6.2	8.7	13.0	15.8
US	n.a.	n.a.	n.a.	n.a.	5.0	8.5	7.8
Special Revenue	n.a.	n.a.	n.a.	n.a.	1.9	3.1	6.5
Corporate Bonds	38.2	36.2	35.5	37.2	32.2	34.1	36.5
Utility	n.a.	n.a.	n.a.	n.a.	9.2	7.9	7.1
Industrial	n.a.	n.a.	n.a.	n.a.	21.8	25.4	28.9
Corporate Stock	4.8	5.6	6.5	6.4	5.6	3.8	3.0
Preferred Stock	n.a.	n.a.	n.a.	n.a.	2.1	.9	.6
Common Stock	n.a.	n.a.	n.a.	n.a.	3.5	2.9	2.4
Industrial	n.a.	n.a.	n.a.	n.a.	1.6	1.2	.9
Affiliates	n.a.	n.a.	n.a.	n.a.	1.4	1.3	1.3
Mortgage Loans	35.5	37.5	33.3	28.2	24.0	20.1	15.8
Commercial Mortgages	9.2	11.3	13.3	15.4	15.6	15.5	12.6
Real Estate	3.1	2.9	3.0	2.9	2.5	2.4	2.4
Policy Loans	4.6	5.8	7.9	8.0	8.5	5.4	4.2
Separate Account Assets	n.a.	1.2	3.5	5.1	9.1	10.9	14.3
Common Stock	n.a.	1.0	2.8	3.2	3.5	4.6	6.3
Bonds	n.a.	.2	.5	1.4	3.7	3.8	4.4
Mortgages	n.a.	.0	.1	.1	.4	.4	.3
Other Assets	4.5	4.8	5.5	6.0	9.4	10.3	8.0
Liabilities							
Reserves	81.4	80.2	81.0	81.6	68.9	72.7	73.5
Other Liabilities	10.2	11.0	11.0	11.4	14.6	10.2	6.0
Separate Accounts	n.a.	n.a.	n.a.	n.a.	9.1	10.8	14.2
Capital and Surplus	8.4	8.8	7.8	6.9	7.5	6.3	6.4

n.a. = not available.
Source: For data from 1969 to 1979, *Life Insurance Fact Book*, various years. From 1980–1993, *Best's Aggregates and Averages*, various years.

Capital and Surplus

The assets of life insurance companies are investments made on behalf of their policyholders and owners. The owners' stake is the capital and surplus, or simply capital, which essentially is the difference between the value of the companies' assets and their liabilities.[8] This capital also is a financial insurance reserve that protects the interests of policyholders. With more capital per dollar of assets in their general fund, life companies more likely can meet their obligations to their policyholders despite possible losses on their investments. Although the average capital-asset ratio for the industry has remained fairly constant, near 9 percent, during the past two decades, companies with capital ratios no greater than 6 percent held approximately one-half of the industry's assets from 1984 to 1990 (Table 5). By 1993, this median capital-asset ratio had risen to 7.7 percent.

For most of this century, the principal source of new capital for established life insurance companies and the life insurance industry has been retained earnings. During much of the past two decades, however, the growth of insurers' assets exceeded the capacity of their retained earnings to accumulate capital commensurately. For example, since 1984, insurers' assets have grown about 11 percent annually. Yet, the contributions of retained earnings would have allowed capital to grow less than half this rate (Figure 5, upper panel). Consequently, the capital ratios for

[8] Capital, as defined here, is the capital and surplus of insurers' general accounts plus asset valuation (previously, security valuation) reserves.

Table 4
Life Insurance Companies' Holdings of Selected Financial Assets
Percent of Total Value Outstanding of Each Security

Assets	1960–1964	1965–1969	1970–1974	1975–1979	1980–1984	1985–1989	1990–1993
Treasury Securities	2.5	1.7	1.2	.9	1.8	2.9	2.9
Agency Securities	1.0	.9	1.1	2.6	5.2	7.4	10.4
Tax-Exempt Bonds	4.7	2.9	2.0	2.1	1.8	1.2	1.1
Corporate Bonds	51.5	44.6	34.7	33.8	34.1	31.1	32.4
Corporate Equities	1.2	1.3	2.5	3.4	3.2	2.9	2.4
Commercial Mortgages	29.7	30.8	28.8	29.0	30.0	26.4	27.7
Multifamily Mortgages	18.6	25.5	22.2	16.7	12.5	8.6	9.3
Home Mortgages	15.9	11.9	6.5	2.6	1.5	.7	.4

Life Insurance Companies' Purchases of Selected Financial Assets
Percent of Total Purchases of Each Security

Assets	1960–1964	1965–1969	1970–1974	1975–1979	1980–1984	1985–1989	1990–1993
Treasury Securities	−6.5	−7.0	−1.0	.5	5.1	1.4	5.3
Agency Securities	.9	.9	1.1	6.5	9.3	8.6	19.4
Tax-Exempt Bonds	2.1	−1.4	.6	2.1	1.0	.1	2.5
Corporate Bonds	36.8	22.4	21.1	41.3	28.1	33.0	30.5
Corporate Equities	18.7	31.9	26.6	27.3	n.m.	n.m.	6.5
Commercial Mortgages	28.6	34.0	24.4	33.9	22.0	29.7	n.m.
Multifamily Mortgages	22.5	37.6	11.3	−1.2	−.5	6.6	n.m.
Home Mortgages	6.9	−1.1	−5.4	−.7	−.4	−.2	−.2

n.m. = not meaningful (both numerator and denominator are negative).
Source: Board of Governors of the Federal Reserve System, Flow of Funds.

some established insurers subsided by the mid-1980s, and the issues of new equity by stock companies became an important source of capital for the industry. During the 1980s, insurers also increasingly sold variable contracts, which accumulate assets in separate accounts rather than general accounts, thereby lessening their need to raise capital. Recently, some mutual companies also have either converted to stock companies to raise new capital or explored the merits of doing so.

Table 5
Capital Asset Ratio For Life Insurance Companies

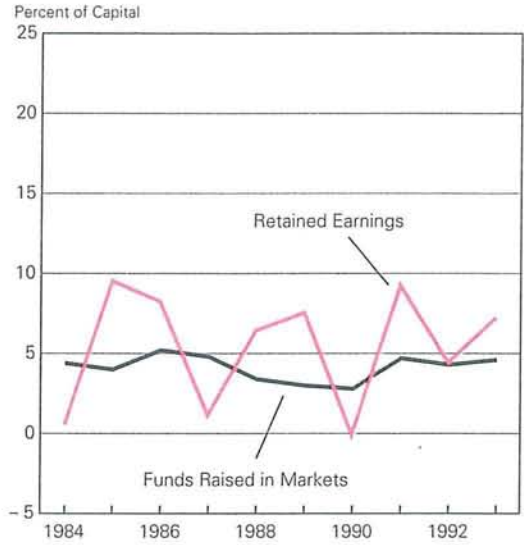
	Median	Mean
1984	5.6	8.6
1985	5.8	8.9
1986	6.2	9.2
1987	6.3	9.0
1988	6.0	8.9
1989	6.1	9.0
1990	5.9	8.6
1991	6.7	9.5
1992	7.1	9.7
1993	7.7	10.2

Source: See Appendix.

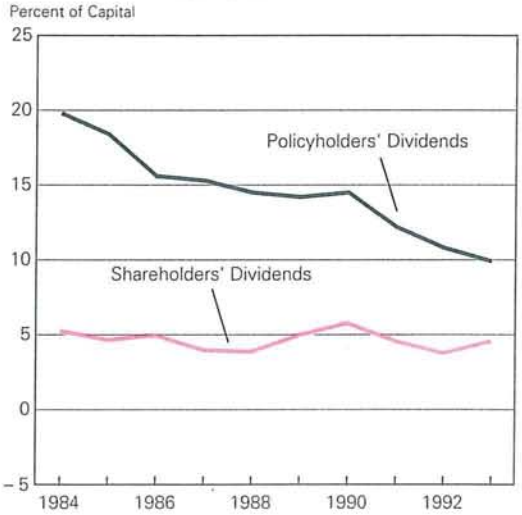
Insurers might have increased their retained earnings by increasing their premiums or by reducing the dividends paid to policyholders and stockholders, but the exigencies of competition deterred this approach (Figure 5, lower panel). Shareholders' dividends remained fairly constant throughout the 1980s, while policyholders' dividends only declined as interest rates fell. If insurers could attract at least their customary share of households' savings—by offering competitive prices and returns, especially on annuities—then the resulting accumulation of assets bearing higher yields eventually might boost both retained earnings and capital ratios. During much of the 1980s, insurers promoted GICs, which were popular with defined contribution pension plans. Although a liability of insurers' general accounts, GICs bore a competitive rate of interest which often matched or exceeded the average rate of return on the assets in general accounts. Nevertheless, these investment contracts would profit insurers if the yields on new assets added

Figure 5

A. Sources of New Capital for Life Insurers



B. Dividends Paid to Policyholders and Shareholders



Source: See Appendix.

to general accounts exceeded the yields on GICs. Accordingly, GICs often financed the acquisition of commercial mortgages, lower-grade bonds, and other investments that promised particularly high returns.

Distribution of Capital and Assets

That the discrepancy between the average and the median capital-asset ratios for the life insurance industry became substantial by the 1980s, then diminished during the early 1990s, indicates that the distribution of capital ratios among companies changed markedly over the past two decades.

In the 1980s, the distribution of capital among life insurance companies had become skewed. Although the average capital ratio was almost 10 percent in 1986, companies with capital ratios at least as great as 10 percent held only about one-fifth of the industry's assets, while companies with capital-asset ratios below 5 percent also held about one-fifth of assets.[9] As insurers promoted new liabilities backed by the assets in their general accounts between the early 1970s and the late 1980s, many did not increase their capital commensurately. As liabilities and assets increased more rapidly than capital, insurers could have diminished their risks either by purchasing "safer" assets or by selling "safer" liabilities. Some companies took neither step.

During the late 1980s insurers had increased their investments in assets regarded as risky for backing contracts with fixed commitments, particularly those issued by companies whose capital ratios (and capacity for absorbing losses on their investments) were comparatively low. In 1990, the companies with the least capital tended to hold more of these risky assets per dollar of capital (Figure 6, upper panel, and Table A1 in the appendix). The companies with capital-asset ratios below 7 percent and risky assets at least five times capital (those near the back left corner of the chart) held nearly one-half of the industry's assets. For these companies, the median ratio of mortgages to assets was nearly 30 percent; the median for the remainder of insurers was only 16 percent. This additional investment in mortgages accounted for most of the relatively high ratios of risky assets to capital.

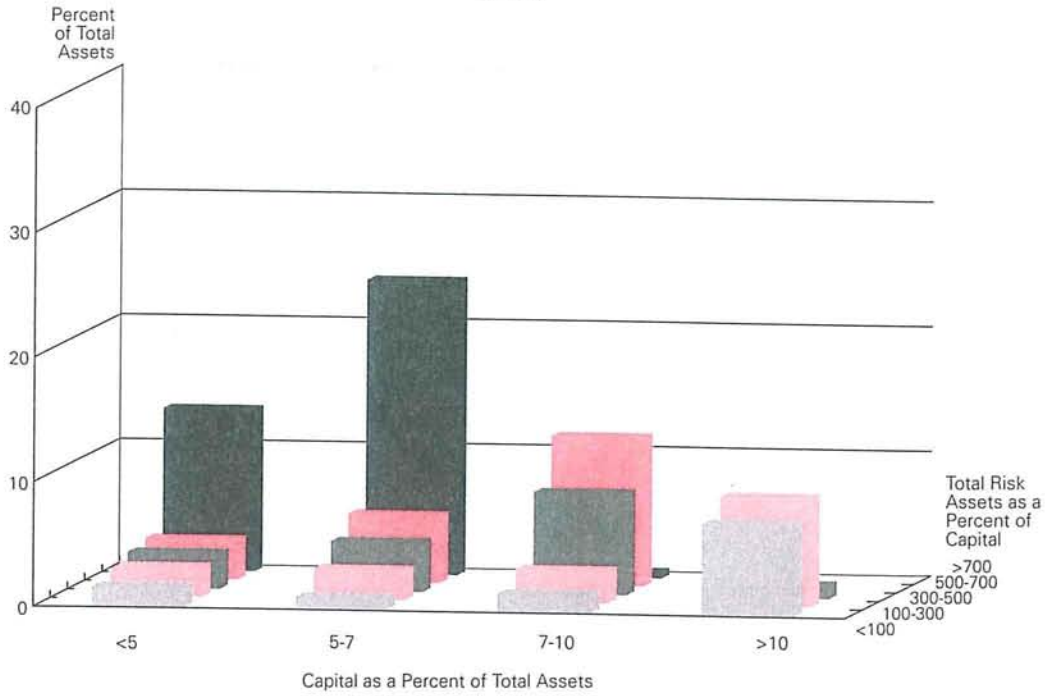
Many of the companies for which assets increased more than capital during the 1980s also relied on the sale of liabilities that, under the circumstances, were considered risky. For example, by 1990, companies

[9] The average capital ratio is the industry's capital divided by its assets, which equals the weighted mean of the capital ratios for each insurer with weights equal to each company's share of the industry's assets. This average ratio is much greater than the median because almost 40 percent of the companies, holding only 1 percent of the industry's assets, have capital ratios exceeding 50 percent. These outliers raise the average without altering the median.

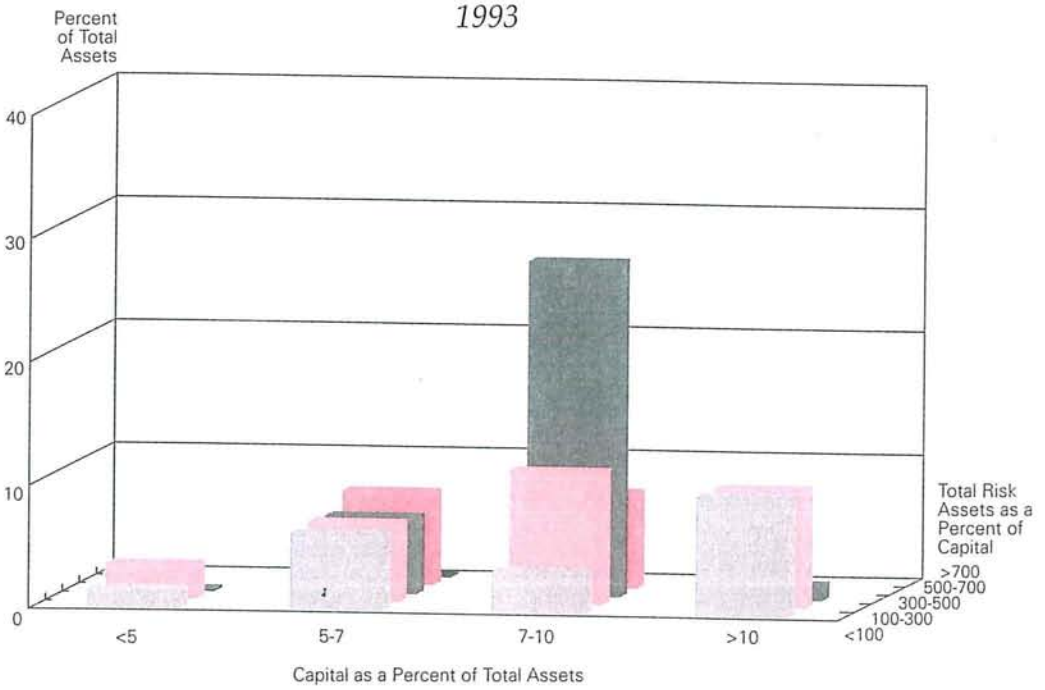
Figure 6

Capital and Risk Assets of Life Insurance Companies

1990



1993



Source: See Appendix.

issuing GICs with capital-asset ratios below 7 percent held almost 40 percent of the industry's assets (Figure 7, upper panel). Within this group, companies for which GICs also were more than three times capital held about one-quarter of the industry's assets. For most of the companies issuing GICs, these relatively short-term liabilities were more than twice as great as their holdings of short-term assets, thereby raising concerns about liquidity for those companies that could not replace their GICs as they matured.

The distribution of capital ratios among life insurance companies has changed markedly over the past two decades, as evidenced by the discrepancy between average and median capital-asset ratios.

As many insurers issued more GICs, they also increased their investments in commercial mortgages—assets with stated maturities similar to those of GICs. Just over one-quarter of the industry's assets were held by companies for which GICs exceeded three times capital and for which risky assets exceeded five times capital. Should the return on commercial mortgages fall short of expectations and should insurers not find other lenders to take over their loans at maturity, then insurers might be compelled to renew their GICs, paying yields which could be too great compared to their return on assets. About one-half of insurers' commercial mortgages were acquired after 1983. From 1983 to 1986, indices of commercial property values and rents rose substantially. By the early 1990s, many of these indices had fallen 20 percent or more below their values of 1983, indicating that both the value of the collateral and the return on the property backing insurers' mortgages had fallen significantly (Shulman 1990 and Borman 1991).

By 1993, after the median capital ratio for the industry had risen nearly 2 percentage points, the distribution of capital among insurers became less skewed. Although insurers were able to retain more earnings and issue more equity as interest rates fell in the late 1980s and early 1990s (Figure 5), capital ratios rose mostly because the rate of growth of their reserves and assets subsided after the mid-1980s (Figure 4). Capital per dollar of assets for many companies, especially those with the lowest ratios, had risen significantly and their blends of assets and liabilities appeared to entail less risk. Most companies, especially those with relatively low capital, reduced their investments in mortgages, real estate, and low-quality bonds. By 1993, companies for which risky assets exceeded five times capital and for which capital-asset ratios were less than 7 percent held less than one-thirteenth of the industry's assets (Figure 6). Moreover, the outstanding GICs of most companies were no longer so great compared to their capital (Figure 7). Only about one-fifteenth of the industry's assets were held by companies for which GICs exceeded three times capital and for which risky assets exceeded five times capital.

V. Standards for the Adequacy of Capital

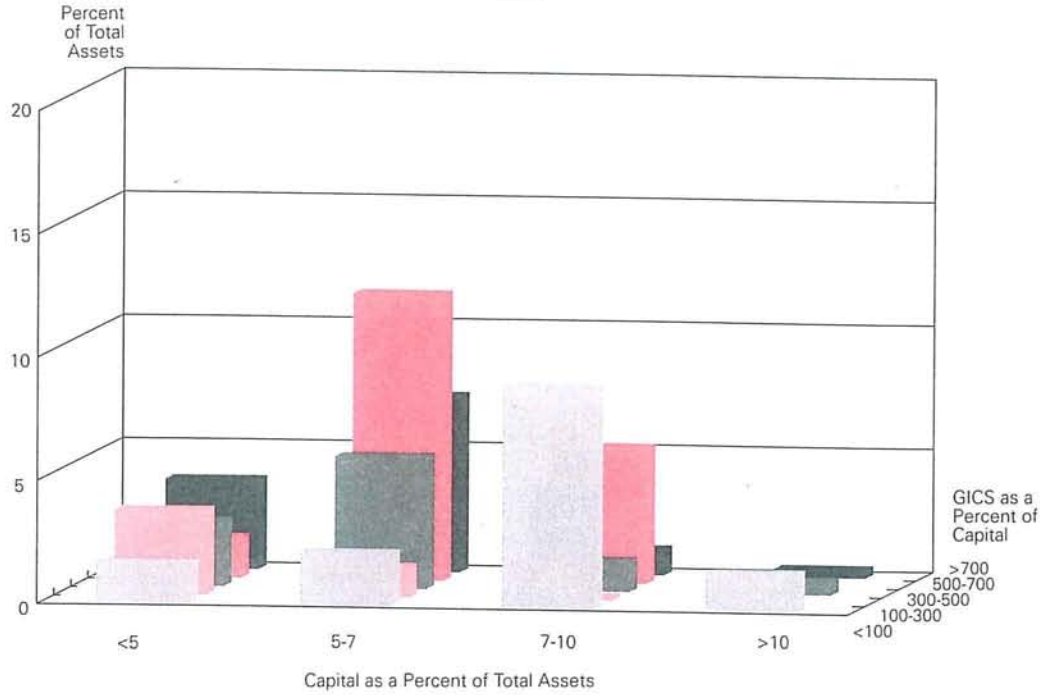
Probability theory has long observed that the risks inherent in forecasting mortality and morbidity threaten the solvency of any insurer whose access to capital is limited (Peirce 1878). During the past century, both theory and practice have shown that these failures can be infrequent, isolated events when insurers maintain adequate capital and underwrite their policies prudently. As financial intermediaries, insurers also bear risks arising from their issuing guaranteed liabilities backed by assets whose returns are not guaranteed. With adequate capital and a prudent matching of their assets to their liabilities, these risks, too, may seldom threaten the solvency of insurers.

To measure and control properly the risks arising from financial intermediation, regulators and risk managers increasingly favor risk-based capital requirements, appraising assets according to their market values and taking prompt remedies when capital ratios become too low. If, for example, an intermediary holds only bonds with a negligible risk of default and with cash flows that closely match those entailed by its obligations, then its capital per dollar of assets need only satisfy some minimum capital requirement. If, instead, the intermediary invests in designated risky assets, then it would hold additional capital in proportion to its investment in these assets. Risk-based capital requirements essentially increase the price of holding those assets designated as risky. This price is greatest when these requirements force intermediaries to raise more capital. It is least when intermediaries easily can accommodate these requirements within their customary capital positions.

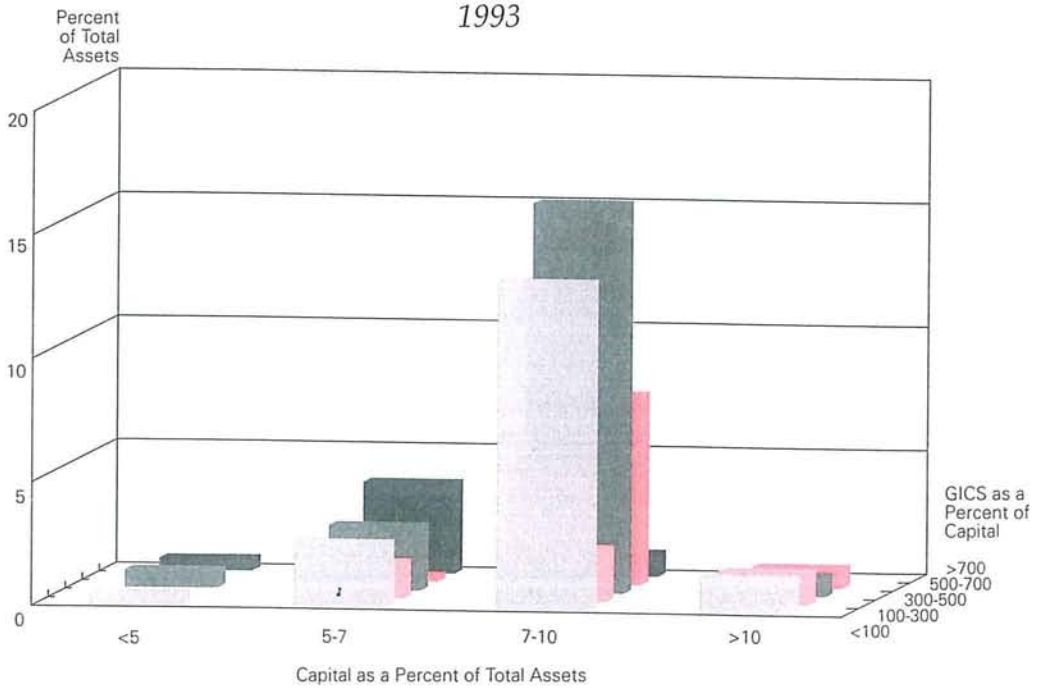
Figure 7

Capital and GICs of Life Insurance Companies

1990



1993



Source: See Appendix.

The details of statutory capital requirements for life insurance companies often vary from state to state. Nonetheless, the asset valuation reserves as defined in the Annual Statement adopted by the National Association of Insurance Commissioners generally apply uniform standards for risk-based capital to life insurance companies. These reserves equal a prescribed proportion of a company's investment in various assets, a proportion which varies by type of asset and by the rating of the asset. In 1988, companies maintained mandatory valuation reserves against equities and bonds. By 1993, valuation reserves were extended to mortgages, real estate, and other invested assets. Reserve ratios varied from 1 percent on highest quality bonds to 20 percent on the lowest quality; from 3 percent on the highest quality preferred stock to 22 percent for the lowest quality; from 15 percent to 30 percent on common stock, depending on the nature of the investment; and from 1.75 percent to 10.5 percent on mortgages, depending on the life company's past experience. Reserves were generally 7.5 percent against real estate and 20 percent against certain other assets, such as venture capital funds and limited partnerships. For life insurance companies, the additional burden of posting these reserves is relatively modest. In 1993, for example, the asset valuation reserve accounted for approximately one-sixth of the capital of the life insurance industry.

The success of any rule defining capital requirements depends greatly on the characteristics of the risks inherent in so-called risky assets.

The success of any rule defining capital requirements depends greatly on the characteristics of the risks inherent in so-called risky assets. Greater capital requirements ultimately impose greater costs on insurers' policyholders and shareholders, costs that can exceed the benefits of holding more capital once requirements become sufficiently great compared to the risks embedded in insurers' balance sheets. The case for substantial capital requirements is strongest when insurers hold unhedged risky assets for which: (a) returns are driven by random walks, (b) expected returns are low relative to the volatility of returns, and (c) dependable markets or appropriate hedges are lacking, trading is at best sporadic, and prices either are difficult to obtain or are potentially very volatile. Should the values of risky assets tend to revert to trends, however, then the case for maintaining substantial capital requirements and for marking these assets to market becomes less compelling.

When the Values of Risky Assets Are Governed by Random Walks

If the values of risky assets are driven by random walks, then the consequence of "news" is no more likely to increase the value of these assets more than previously expected than it is likely to decrease their value more than expected.[10] Accordingly, after a sequence of unexpected losses, these assets are no more due for redeeming gains than they are due for continuing losses (Cootner 1964, Merton 1990).[11]

A very conservative policy for managing the risk inherent in these assets might require that capital equal 100 percent of the value of risky assets (Friedman 1959, Tobin 1985, and Litan 1987). Only shareholders' funds would be invested in risky assets. Whenever a company's investment in risky assets exceeds its capital, the company has placed some of the funds backing its obligations to its policyholders in these assets. In this case, should the value of the risky assets fall sufficiently, the company's obligations would exceed its resources. If none of a company's obligations to its policyholders is invested in assets that follow random walks, the company's assets almost surely will exceed the value of its obligations over time. Therefore, a 100 percent capital requirement essentially would eliminate the risk of insolvency with minimal monitoring and intervention.

[10] A pure random walk would be symmetric: the odds that the value of the asset would increase 5 percent in the next year, for example, equal the odds that its value would decrease 5 percent. The discussion here allows for a colored random walk with drift. The value of an asset is expected to increase at a specific rate each year (its expected return), and the news may add or subtract 5 percentage points, for example, from this return with equal probability. Furthermore, the news that raises (or lowers) the asset's return in one year also may raise (or lower) returns in subsequent years, albeit by an amount that diminishes with time.

[11] Investments in specific equities, new ventures, or real estate are traditional examples of assets whose values are capable of rising very high or of vanishing over time. The returns on low-grade bonds are not governed by random walks, strictly speaking, unless they are convertible into equity. Nevertheless, these bonds share many of the risks of equity, and the odds of low-priced junk bonds' reverting to par are not comparable to those for high-grade bonds (Rosengren 1993).

The need for 100 percent capital requirements against the values of assets governed by random walks diminishes as risk managers monitor the performance of these assets more frequently and, when necessary, promptly require the company to raise new capital, to hedge its risks, or to sell some of these risky assets. Should substantial losses on these assets greatly reduce a company's capital-asset ratio, the chance that especially high returns on these assets subsequently would raise this ratio might be little greater than the chance that especially low returns would lower this ratio further.[12] Accordingly, as the value of a company's assets approaches that of its obligations, the odds of imminent insolvency increase, and conservative risk managers justifiably might require that risky assets be replaced by safer assets. Although shareholders would sacrifice relatively little by retaining the risky assets and taking the chance that their value will appreciate, this reduction of risk is prudent from the viewpoint of policyholders, because there is little to gain and much to lose by retaining these assets.[13]

With this strategy of prompt intervention, the magnitude of capital requirements depends on the frequency with which risky assets are reassessed according to their market prices or their disposal values. The more frequently these assets are appraised and the less volatile are the prices of these assets, the more capital requirements might be reduced. For example, if the value of a portfolio of assets seldom changes more than 10 percent between reviews and its assets always may be sold promptly at their prevailing prices, then a 20 percent capital requirement might provide adequate security.

Capital requirements also may be reduced to the degree the expected returns on risky assets are great compared to the volatility of their returns. (See Box.) The random walks of assets typically comprise two elements: a volatility describing the magnitude of random gains and losses, and a drift describing the expected rate of appreciation. As the drift increases compared to the volatility, the odds diminish for accumulating a given net loss during a specific interval of time. Consequently, an insurer requires less capital per dollar of assets, other things equal, to maintain a given degree of security as the expected return on its portfolio increases relative to the volatil-

[12] Because the values of risky assets are expected to increase with time (the drift), the odds that capital erodes further are less than the odds that capital increases. The greater is the drift, the greater the odds favoring an increase in capital.

[13] In many states policy owners are covered by guaranty plans: unsatisfied claims are covered to a substantial degree by assessing other insurers. Often, these other insurers can claim tax credits for their assessments. To the degree policy owners are protected in this way, the burden of losses is transferred to other insurers, state governments, and taxpayers.

Risk and Standards for Capital

Suppose a financial intermediary manages $1 billion in assets; $100 million represent the shareholders' stake, and $900 million represent the contributions of savers who hold the contracts of the intermediary. The intermediary invests $600 million in safe assets, yielding 7 percent. The remaining $400 million is invested in risky assets whose unconditional expected rate of return is 10 percent. Savers expect to earn a competitive rate of return, 7 percent annually, on their contracts. The expected return on assets (.6 times 7 percent, plus .4 times 10 percent) less the yield paid to savers (.9 times 7 percent) is 1.9 percent of assets annually. Therefore, the rate of return on capital is expected to be 19 percent.

In every year, the intermediary's liabilities increase at least 7 percent, reflecting the rate of return credited on savers' contracts. As time passes, the gains and losses on risky assets will alter the intermediary's ratio of capital to assets as well as its ratio of risky assets to total assets. After favorable returns increase the values of risky assets, thereby raising the capital-asset ratio above 10 percent, the intermediary sells more contracts in order to restore a 10 percent capital-asset ratio. The intermediary also invests the proceeds from savers as required in order to restore the 40 percent risk-asset ratio. After unfavorable returns depress the capital-asset ratio below 10 percent, the intermediary sells no new contracts. It also neither purchases nor sells any risky assets. If the intermediary increases its liabilities even modestly faster than 7 percent when its capital ratio is below 10 percent, then the frequency of its insolvency increases greatly in both of the simulations discussed below.

Risky Assets Follow a Random Walk

The returns on risky assets (r_t) follow a colored random walk. One year's news (η_t) not only alters

returns in that year, but also alters returns in future years, albeit this influence decays 40 percent per year (an autocorrelation parameter of 0.6). The unconditional standard deviation of the effect of news on each year's return (the volatility of ϵ_t) is 6 percent:

$$r_t = .10 + \epsilon_t$$
$$\epsilon_t = .6\epsilon_{t-1} + \eta_t$$
$$\eta_t \sim N(0, .06^2(1 - .6^2)).$$

Because of the autocorrelation parameter, the return on risky assets tends to follow a smoother cycle rather than a sharp zig-zag pattern around 10 percent from one year to the next. The value of the intermediary's risky assets (V^r) follows a lognormal random walk that is determined by the returns on these assets,

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

Given the initial conditions described above, Figure B1 shows a simulation of the capital-asset ratio for this intermediary. In longer versions of this simulation, the capital-asset ratio reaches zero, on average, about once every 150 years.

If the target capital-asset ratio is doubled to 20 percent, thereby reducing the ratio of risky assets to capital from 4 to 2, the capital-asset ratio reaches zero only about one-third as frequently as it does in the initial simulation. The consequence of increasing this target is tantamount to shifting the graph in Figure B1 up by 10 percentage points.

The capital-asset ratio also reaches zero about one-third as frequently as it does in the initial simulation if the difference between the expected return on risky assets and the return on safe assets is doubled (holding the ratio of the volatility on risky assets to their expected return constant at 0.6).

The intermediary's capital-asset ratio almost always remains above zero if, when the values of risky assets fall sufficiently, it sells enough risky assets to prevent its ratio of risky assets to capital from rising above the initial value of 4.

If, in the preceding case, the intermediary's sales of risky assets temporarily reduce their prices almost 10 percent, then the capital-asset ratio reaches zero no less frequently than in the initial simulation. In this case, when the capital-asset ratio declines as risky assets suffer a sequence of losses, it does not fall as much as that shown in Figure B1, but this ratio also recovers less quickly in subsequent years.

If the autocorrelation parameter is zero, then the capital-asset ratio does not reach zero as frequently as it does in the initial simulation unless the volatility of returns (the common standard deviation of η_t and ϵ_t) is nearly as great as the expected rate of return, 10 percent.

Risky Assets Revert to Trends

The underlying value of risky assets increases 10 percent annually, but the value of these assets in any year may be greater or less than this trend, depending on the news (ϵ_t, as described above).

$$V_1^r = V_0^r \exp(.1) \exp(\epsilon_1)$$
$$V_2^r = V_0^r \exp(.2) \exp(\epsilon_2)$$
$$V_3^r = V_0^r \exp(.3) \exp(\epsilon_3)$$
$$V_t^r = V_{t-1}^r \exp(.1) \exp(\epsilon_t - \epsilon_{t-1}).$$

Because of the influence of past news lingers in ϵ_t, the values of risky assets tend to cycle around their underlying values: once the values of risky assets fall below trend in any year, they likely will remain below trend in the next year. The standard deviation of $\epsilon_t - \epsilon_{t-1}$ is 5.4 percent.

Figure B2 shows a simulation of the capital-asset ratio, assuming the value of risky assets revert to trend as given above. Compared with Figure B1, this second graph of capital-asset ratios seldom strays very far from its target of 10 percent for very long. Longer versions of this simulation show that the odds of this ratio's falling below 4 percent are almost negligible.

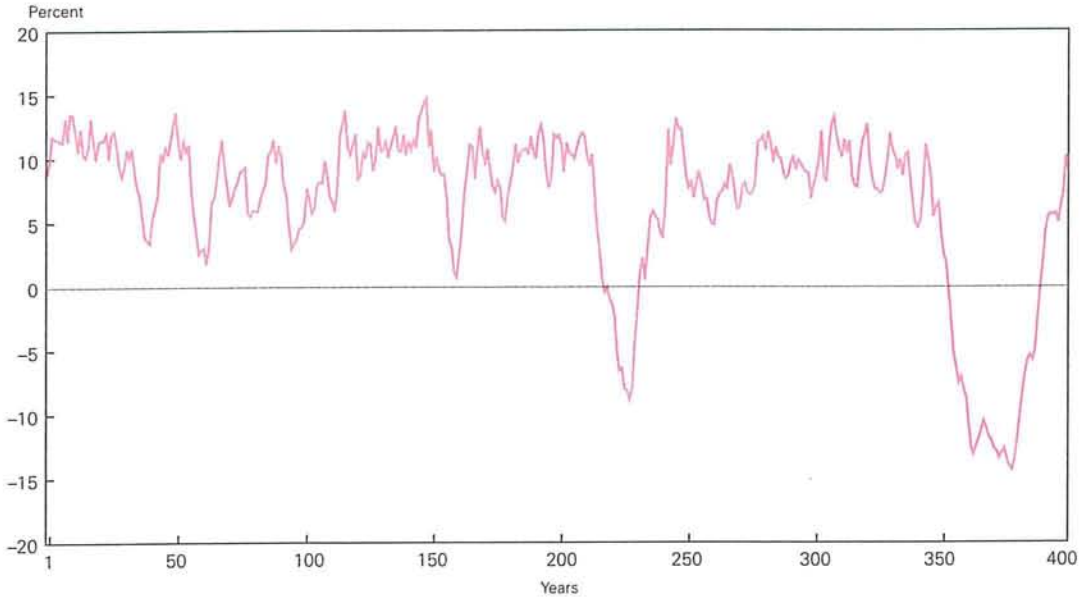
Even if the target capital-asset ratio is halved to 5 percent, thereby increasing the ratio of risky assets to capital from 4 to 8, the capital-asset ratio very rarely reaches zero.

The capital-asset ratio also seldom falls to zero if the difference between the expected return on risky assets and the return on safe assets is reduced to only 1 percentage point by reducing the unconditional expected return on risky assets to 8 percent (the ratio of the volatility on risky assets to this expected return remains constant at 0.6).

If the volatility of returns on risky assets is doubled, 12 percent rather than 6 percent, then the capital-asset ratio falls to zero as frequently as it does for the simulation shown in Figure B1.

Figure B1

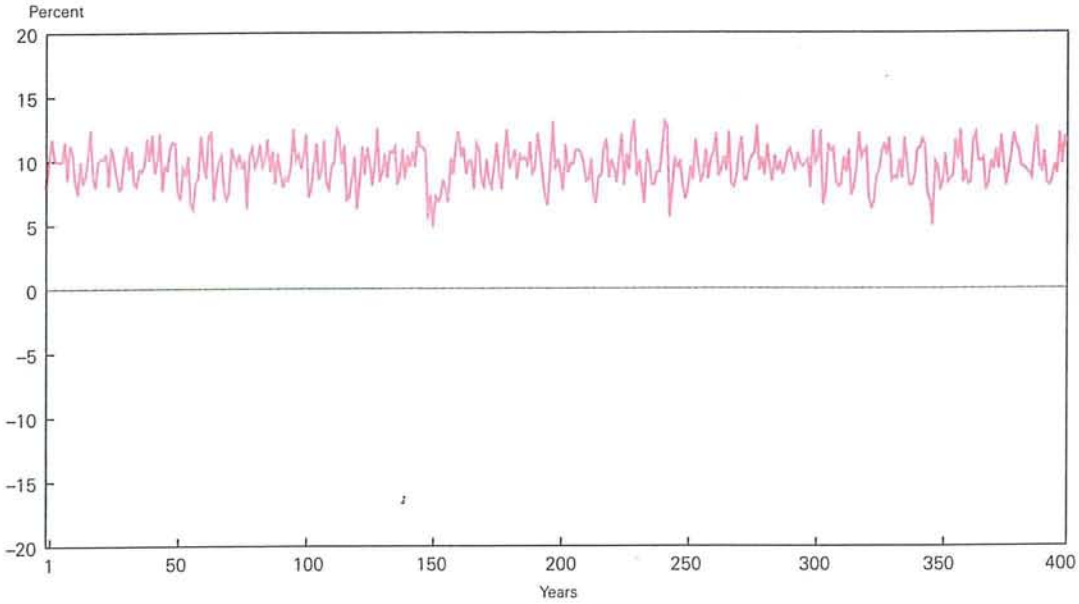
Capital-Asset Ratio with a Random Walk



Source: Author's calculations.

Figure B2

Capital-Asset Ratio with Trend Reversion



Source: Author's calculations.

ity of its returns. Finance theory predicts that assets with greater expected returns ordinarily have greater undiversifiable risks; otherwise, investors would bid up the prices, thereby bidding down the returns of assets offering unusually high returns. But, financial intermediaries presumably exist partly to acquire assets and to issue liabilities that are not priced efficiently in capital markets, perhaps for want of adequate public information, or perhaps because these assets are less suitable for other portfolios.[14]

Financial intermediaries presumably exist partly to acquire assets and to issue liabilities that are not priced efficiently in capital markets.

A comprehensive measure of the capital of financial intermediaries comprises both the funds contributed by shareholders (the capital reported on their books) and the value of any additional margin they may earn from buying assets and issuing liabilities that are not priced efficiently in public markets. The lower is this margin, other things equal, the greater book capital must be in order to maintain the same degree of financial security for those holding the liabilities issued by financial intermediaries. A principal concern of regulators and risk managers, supporting their interest in greater capital requirements, is that the competition accompanying recent financial innovations has diminished both book capital and margins for most intermediaries, including many life insurance companies.

When the Values of Risky Assets Revert to Trends

Although the return on assets whose values revert to trends may be very volatile in the short run, over longer periods their returns may be predicted with much greater certitude than the returns on assets driven by random walks. Unlike the case for random walks, once the value of a trend-reverting asset deviates from its trend, the odds of its returning increase with time, while the odds of its straying further diminish. Other things equal, capital requirements for insurers financing these assets with suitable liabilities need not be as great as those warranted for assets governed by random walks. Furthermore, should capital fall, the need to mark assets to market and to enforce remedies to rebuild capital promptly becomes much less compelling when the values of risky assets do not stray off course indefinitely.

The value of a diversified portfolio of real estate investments, for example, might revert to trend more than it might follow a random walk.[15] Because developers and investors tend to err when forecasting rents and the demand for space many years in advance, the supply of space at times exceeds demand at prevailing rents; at other times, it may fall short of demand. Following a surfeit of building, rents tend to fall, and the value of existing real estate can fall well below the construction costs for new real estate for several years. Nevertheless, after a hiatus in new development, the existing space is absorbed, and rents eventually recover. As long as new construction is expected to resume in the future to satisfy new demand, the value of existing real estate is more likely to rise to match its replacement cost than it is to fall a commensurate amount.

In the long run, the rate of return to patient investors reflects the rate of change of replacement costs and the cost of capital more than it reflects the vagaries of the real estate cycle. Investors who acquire real estate when values exceed trend risk earning below-average returns. Those who invest when values are comparatively low may earn above-average returns. But, the rates of return to all investors converge to the trend rate of return as their holding periods increase.[16]

[14] The assets that different intermediaries may purchase and the liabilities that they may issue often are limited by regulations, by contracts, or by customs. Also, because neither all investors nor all investments are treated the same in federal, state, and municipal tax codes, not all investors view all investments in the same way after allowing for taxes. Even the prices of assets traded in public markets apparently may not be priced efficiently from the viewpoint of all investors (Abel 1991).

[15] Tobin's q is the ratio of the value of businesses' tangible assets in financial markets (the value of their stocks, bonds, and loans) to the replacement value of these tangible assets. Once q has fallen well below unity or risen well above unity, the odds of its straying further away from unity apparently diminish over time. In other words, the replacement value of the nation's tangible assets may anchor the values of financial assets in broadly diversified portfolios. See also Poterba and Summers (1988) or Fama and French (1988).

[16] The replacement value of tangible assets is not necessarily known with great certainty in advance. Although the trend returns for these assets vary with economic conditions, uncertainty in forecasting these trends is small compared to the uncertainty in forecasting the market values for these assets. Moreover, the replacement value of tangible assets relative to the overall prices of goods and services is unlikely to follow a random walk: very high prices for these assets, for example, tend to attract new producers, which ultimately increases the odds of falling relative supply prices compared to the odds of prices' rising further.

The distinction between assets whose values are governed by random walks and assets whose values revert to trends is not sharp. The values of some assets may exhibit characteristics of both processes, and the enforcement of capital requirements can determine the degree to which one or the other dominates. For example, financial intermediaries often hold assets that lack dependable public markets, assets whose values also might be driven by random walks. If, in the normal course of events, these values should happen to fall enough to depress the capital of intermediaries, thereby triggering substantial sales, this divestiture could temporarily elicit "fire sale" prices in illiquid markets. Once the liquidation by intermediaries is complete and transactions recover, the values of these assets would revert to "normal."

Other things equal, capital requirements need not be as great for trend-reverting assets as for assets governed by random walks in order to achieve the same amount of protection for policyholders. (See Box.) The longer the interval of time, the closer the correspondence between actual and expected returns on these assets tends to become. Accordingly, when insurers match trend-reverting assets to policies with sufficiently long maturities (including the terms of any embedded put options extended to policyholders), they bear comparatively little risk provided their policies' guaranteed yields are fixed according to the longer-run yields they expect to earn on their assets.[17]

The need to mark assets to market and to enforce the prompt sale of assets when capital falls also is less urgent for managing the risks inherent in trend-reverting assets. Should the value of these assets fall substantially, thereby reducing an insurer's capital-asset ratio, the chance that especially high returns eventually would raise this ratio increase with time, while the chance that especially low returns would reduce the ratio further diminishes with time. Therefore, when the value of a company's assets approaches that of its obligations and its liabilities are of sufficiently long duration, the expected losses due to insolvency may be low compared to the expected gains from retaining these assets. Whereas measuring the value of a company's capital by marking risky assets to market might be a fair appraisal when assets follow random walks, this strategy can substantially understate the value of the company when assets tend to return to trends. Indeed, if the conflation of capital requirements and market valuation force insurers to sell or hedge risky assets when their values are lower than average, then these techniques for managing risk, which are conservative for contending with random walks, can reduce the expected value of capital and policyholders' investments when the values of risky assets tend to be governed by trends (DeAngelo, DeAngelo, and Gilson 1994). If the requisite sales are too great or the markets too illiquid, then these techniques may increase rather than diminish the risks inherent in financial intermediation. These techniques also tend to increase the volatility of returns on risky assets, undermining the contribution of intermediaries to financial markets.

Risky Assets and the Value of Capital

In principle, no single asset is inherently risky or safe. An apparently risky asset, when held in properly diversified portfolios, can increase investors' expected rates of return while not increasing the volatility of their returns. Moreover, an apparently risky portfolio of assets, when matched with suitable liabilities, can promise attractive returns on capital at relatively low risk.

Therefore, insurers' capital requirements should take into account the characteristics of a company's entire portfolio of assets and liabilities. These requirements ought not depend only on the expected returns, variances, and covariances for the various assets held by an insurer; they also should depend on the characteristics of the liabilities used to finance or hedge these assets. The capital required for the assets and liabilities allocated to separate accounts or mutual funds—wherein policyholders are granted minimal, if any, guarantees of the value of their investments—can be negligible even though these assets might be invested in equities. Similarly, the capital required for the general account's portfolio, other things equal, should diminish as the characteristics of the account's liabilities correspond better with those of its assets. For example, a portfolio of bonds, which can be risky for a company issuing short-term investment contracts, is not so risky for an insurer issuing longer-term fixed-rate contracts with adequate protection from policyholders' exercising their put options (including policy loans).

[17] The duration of liabilities must be "sufficiently long." A policyholder who can borrow against his policy may be inclined to do so whenever the current values of even strongly trend-reverting assets are low compared to the values of the company's liabilities. Funds withdrawn are "insured" against losses. If the penalties for these withdrawals are not very great, neither is the cost of taking this insurance. Should many so insure themselves, they could create a run that could impair the company's performance or threaten its solvency.

To assess the capital of insurers, their entire portfolio should be marked to market. The marking of risky assets to market values while reporting the values of other assets and liabilities according to other rules misstates the capital of insurance companies. If insurers held only high-grade bonds, and if these investments produced cash flows that matched closely the cash flows entailed by their obligations, then this misstatement might not be important. In these circumstances, if the prices of high-grade bonds fell with rising interest rates, the present value of an insurer's liabilities would fall by a matching amount, and the lower prices of bonds would not reduce the capital of insurers.[18] Nevertheless, not marking all assets and liabilities to market can bias the measurement of capital. If, for instance, the values of risky assets fall when interest rates rise, then ignoring the decline in the value of liabilities while marking down the value of risky assets understates capital. Also, even if insurers hold only high-grade bonds, to the degree the cash flows of these bonds do not correspond closely with the cash flows of insurers' obligations (taking into account any policyholders' put options), the value of capital changes with interest rates.

Proper standards for capital ought to reconcile the demand for financial insurance by policyholders with shareholders' willingness to supply this insurance.

The Cost of Capital

From the viewpoint of policyholders, capital is a kind of financial insurance that protects insurance companies' guarantees to their customers. Shareholders require a greater return on their investment in the company than do policy owners, because this insurance shifts much of the risk of insurers' investments from policy owners to shareholders. This difference in returns essentially reflects the premium that policyholders pay to shareholders for this financial insurance. Proper standards for capital ought to reconcile the demand for financial insurance by policyholders with shareholders' willingness to supply this insurance. Although a company with less capital bears a greater risk of insolvency, a company with too much capital may founder by not offering its customers sufficiently attractive returns.

If the assets and liabilities of life insurance companies were traded in perfect markets among investors who were equally well informed and whose assessments of potential returns on those assets and liabilities were similar, then the overall cost of funds for insurance companies would vary negligibly with capital requirements.[19] Greater capital requirements, other things equal, might force a company to depend more on equity financing and less on funds raised from those holding life, health, and annuity contracts. Although shareholders, who bear greater risks, generally require a greater return on their investment than do policyholders, the weighted average cost of funds need not increase for the company in these circumstances. As long as the company's blends of assets and of contractual commitments remained the same, the potential volatility of returns to shareholders and policyholders would diminish with more capital. Consequently, the rates of return required by shareholders and policyholders would fall enough to offset the consequences of an increasing dependence on equity financing.

Without perfect markets and agreement among investors, however, greater capital requirements can raise the cost of capital for insurance companies. Investors not privy to the information available to insurers assess the expected returns or the volatilities of the companies' portfolios differently than the com-

[18] The gains and losses on bonds resulting from changes in interest rates ordinarily could alter the book value of insurers' capital, because their accounts do not simultaneously recognize the matching gains or losses on their liabilities. Consequently, the National Association of Insurance Commissioners' Annual Statements include interest maintenance reserves (IMR) to capture any such realized gains or losses and to amortize them into investment income over the remaining life of the assets that were sold. In this way, the IMR insulates insurers' current investment income and capital from this accounting for gains and losses on assets only. This use of the IMR is most appropriate if the durations of the assets that are sold match the duration of liabilities.

[19] This essentially is an application of the Modigliani-Miller Theorem: the cost of funds for the insurer does not depend on its leverage, but rather the risks embedded in its portfolio of assets. This conclusion also requires that the returns to equity holders and policyholders be taxed the same. To the degree equity holders' effective tax rates are greater—due to their receipt of unsheltered cash dividends and due to the added burden of capital gains taxes on retained earnings—then the cost of funds rises with capital ratios.

panies' managers. Often the assessments of "outsiders" are too pessimistic, and among outsiders, shareholders often are better informed than policyholders. For this reason, among others, life insurance companies and other financial intermediaries traditionally have profited by transforming the obligations of investors into financial assets that appeal to savers: customers generally value the guarantees and options embedded in intermediaries' contracts more than management believes these features cost. If outsiders are inclined to bid too little for an insurer's assets, the cost of equity financing—the terms at which shareholders are willing to make a leveraged investment in the company—frequently appears too expensive to the company's managers.

Equity financing usually becomes especially expensive at those times when insurers most need new capital, after the returns on insurers' assets fail to achieve expectations or insurers' margins and earnings subside. Therefore, when insurers raise new capital in times of duress, times when outsiders are most inclined to question the past decisions of management, policyholders may pay too great a premium for their financial insurance. The consequences in this case are similar to those that occur with the forced sale of risky assets in illiquid markets.

Greater capital requirements can lower policyholders' expected returns not only by increasing insurers' cost of capital but also by diminishing shareholders' expected rate of return from operations. Life companies derive a share of their profits from the business of underwriting life, health, and annuity contracts. More capital per dollar of assets entails more capital per dollar of liabilities, thereby diminishing the rate of return on capital from their operations, other things equal. Greater capital requirements, consequently, encourage insurers to increase premiums or to write contracts that accumulate fewer assets in their general accounts. Currently, policies that accumulate assets in insurers' separate accounts appeal most to those customers who believe the net premium on variable contracts is comparatively low as a result of the unusually large returns on stocks and bonds that generally have prevailed since the 1970s. These customers, for the time being, essentially are willing to provide capital on comparatively cheap terms by bearing much of the risk from investments in separate accounts. Also, some insurers have reduced their need to raise capital by writing the basic insurance coverage for mutual funds, banks, and others that promote their own variable insurance and annuity contracts.

VI. Conclusion

Since their inception, financial intermediaries have been evolving from specialized businesses to enterprises offering a variety of financial services. Rising interest rates impelled this evolution during the past three decades as most financial institutions promoted new products to remain competitive. As intermediaries attracted new business, their assets grew more rapidly than their net investment income and capital. The life insurance industry was no exception. This erosion of capital per dollar of assets for life insurers, like that of many other intermediaries, concerned those who supervise these companies, because insurers representing much of the industry placed a greater share of their assets in investments commonly regarded as risky. Furthermore, many of these companies had issued liabilities with potentially short maturities to finance their assets.

Since the early 1980s, most financial intermediaries have increased their capital-asset ratios. Many financial intermediaries, including life insurance companies, also implicitly raised capital from their customers by promoting a "mutual fund" business strategy. Beginning with investment advisors and trusts, then spreading to insurance companies, pension funds, and banks, intermediaries have sold accounts wherein savers expect to earn greater returns by bearing more of the risks of the investments backing their contracts.

For the time being, the mutual fund strategy appeals both to insurance companies and savers. Life insurers have not needed to raise so much capital to support contracts whose funds were invested in separate accounts. Savers have held a greater claim on the net income on assets that were acquired mostly after interest rates peaked in the early 1980s. Although this strategy has flourished with the comparatively great returns (at seemingly little risk) on publicly traded securities during the past decade, its roots run deeper. As savers have become wealthier, investors more familiar, and capital markets broader and more resilient, the opportunities for financial intermediaries to earn substantial margins have tended to diminish. In other words, the customers of financial intermediaries are less willing to pay for the services of their capital.

To cope with a diminishing margin between their return on assets and their cost of funds, financial intermediaries also had pursued more aggressively investments that seemingly were not priced efficiently by other investors, particularly investments in real estate, highly leveraged enterprises, and new ven-

tures. Novel investments, of course, pose new risks and new lessons for intermediaries. Even if they could comprehend and control these risks sufficiently well to earn consistently above-average returns, such investments increasingly are subject to criticism by analysts and supervisors who have become wary of financial intermediaries' capacity for bearing risk during the past two decades. During the 1950s most intermediaries resided within granite walls; today, they occupy glass towers.

To measure and control the capital of financial intermediaries, analysts, regulators, and managers increasingly have favored linking capital requirements to investments in risky assets, appraising assets according to their disposal values, and enforcing prompt remedies when capital ratios become too low. The consequences of such policies, however, depend greatly on the characteristics of the assets and liabilities that constitute intermediaries' balance sheets. These policies work best when insurers hold unhedged assets whose values are governed by random walks, assets that may be sold at little cost in liquid markets. These policies work poorly if assets are hedged, if markets for risky assets are illiquid, or if the values of these assets tend to revert to trends over time.

Standards for capital should take into account an insurance company's entire balance sheet, not just its holdings of risky assets. An insurer's need for capital is assessed best by weighing the combined risks in all its assets and liabilities. For example, an insurer that invests in real estate may need to hold somewhat more capital, other things equal, than another that holds only government bonds. But, the need for this additional capital may be very much less for a company that finances its investment in real estate with long-term contracts than it is for a company that relies on short-term contracts or contracts that allow savers to withdraw their funds with little penalty. A lower guaranteed rate of return in a company's long-term liabilities also diminishes its need for additional capital. Just as an insurer's need for capital depends on the risk in its entire balance sheet, proper measures of its capital also depend on the values of all its assets and liabilities. Marking only risky assets according to their disposal values, while reporting other assets and liabilities according to other rules, can greatly misstate the financial condition of life insurance companies.

Capital requirements, other things equal, impose costs on insurance companies and their clients, costs that may be regarded as an insurance premium against insolvency. Critics of supervisory policy contend that these costs were not sufficiently great in the past; they neither deterred the taking of excessive risks by some financial institutions nor compensated for their subsequent losses. Nevertheless, capital requirements that rise with insurers' investments in specific assets increase the cost of holding those assets, thereby discouraging life companies from acquiring those assets that concern supervisors and analysts so greatly. Furthermore, to the degree policyholders are less willing to pay for the services of insurers' capital, insurers become even more likely to shun those assets that require more capital. Often these risky assets are those that are priced least efficiently in public markets, the type of asset that has been the traditional domain of insurers and other financial intermediaries. Consequently, capital requirements linked to investments in specific assets encourage insurers to purchase safer, publicly traded securities or to make loans underwritten according to common rule books. The appeal of these comparatively lucid investments is reinforced by the need to mark risky assets to market and the potential need to sell these assets in times of duress.

To the degree intermediaries increasingly favor more familiar assets, they substitute the capital of investors whose securities trade in public markets for their own capital. Those generally high-grade investors, in turn, assume more of the responsibility for financing the riskier investments of less familiar enterprises through acquisitions, joint ventures, or other arrangements. Ultimately, this line of financial innovation would continue to expand the role of nonfinancial corporations as financial intermediaries who allocate the nation's savings among investors who lack standing in public capital markets.

Appendix

Table A1
Allocation of Assets among Life Insurance Companies, 1990
Percent of Total Assets

Life Insurance Companies, Grouped by Capital as a Percentage of Total Assets	Total	Total Risk Assets					Real Estate, Equity and Other Assets			Bonds Below Investment Grade			Mortgages		
		Percent of Capital													
		<100	100–300	300–500	500–700	>700	<50	50–100	>100	<50	50–100	>100	<100	100–300	>300
<5	22.7	1.4	2.4	2.8	3.2	13.0	11.0	2.0	9.7	6.0	7.4	9.3	4.8	2.9	15.0
5–7	36.1	.8	2.4	3.9	5.4	23.5	4.9	9.6	21.7	21.6	9.7	4.8	4.3	3.9	27.9
7–10	24.4	1.3	2.6	8.1	11.9	.4	4.3	5.3	14.8	13.7	9.7	1.0	2.7	8.4	13.3
>10	16.9	7.2	8.7	1.0	.0	.0	9.5	5.2	2.2	16.1	.7	.0	12.7	4.1	.0
Total	100.1	10.7	16.1	15.8	20.5	36.9	29.7	22.1	48.4	57.4	27.5	15.1	24.5	19.3	56.2

Table A2
Allocation of Assets among Life Insurance Companies, 1993
Percent of Total Assets

Life Insurance Companies, Grouped by Capital as a Percentage of Total Assets	Total	Total Risk Assets					Real Estate, Equity and Other Assets			Bonds Below Investment Grade			Mortgages		
		Percent of Capital													
		<100	100–300	300–500	500–700	>700	<50	50–100	>100	<50	50–100	>100	<100	100–300	>300
<5	4.4	1.4	2.8	.1	.0	.0	3.6	.7	.0	3.8	.0	.6	3.0	1.3	.1
5–7	26.4	6.1	6.4	6.2	7.5	.2	13.5	3.7	9.2	22.5	3.8	.1	6.9	7.7	11.8
7–10	48.8	3.3	10.8	27.1	7.7	.0	6.1	16.3	26.5	47.6	1.2	.0	5.5	33.4	9.9
>10	20.4	9.6	9.6	1.2	.0	.0	9.8	7.6	3.0	20.3	.2	.0	15.8	4.5	.1
Total	100.0	20.4	29.6	34.6	15.2	.2	33.0	28.3	38.7	94.2	5.2	.7	31.2	46.9	21.9

Data Sources

Data for Tables 5, A1, and A2, and Figures 5, 6, 7, come from the National Association of Insurance Commissioners (NAIC) release of company data reported in Annual Statement format. Separate account assets are excluded. The capital and surplus, explicitly stated on the Liabilities, Surplus and Other Funds page of the Annual Statements, are adjusted by adding the asset valuation reserve and the difference between separate account liabilities and assets to create a measure of capital.

For Figure 5, retained earnings equals the sum of income after unrealized capital gains and losses, change in non-admitted assets and related items, and aggregate write-ins for gains and losses in surplus, less dividends to stockholders, from the Summary of Operations page. Payments to shareholders and policyholders are explicitly stated in the Summary of Operations. Capital raised in markets combines capital changes paid in, which take into account face value of capital issues, and surplus adjustments paid in, the amount above face value capital issues receive.

In Tables A1 and A2 and Figure 6, risk assets include common stock, real estate not occupied by the company, mortgages, other invested assets, and bonds below investment grade (class 4 through class 6). These data are explicitly stated on the Assets page of the Annual Statements, except for the bonds, which are taken from Schedule D-Part 1A for 1990 and Schedule D-Part 1A-Section 1 for 1993.

Guaranteed interest contracts, found on the Liabilities, Surplus and Other Funds page, is used as a measure for

guaranteed investment contracts (GICs) in Figure 7. Short-term assets include cash on hand and deposits found on the Assets page, plus collateral loans, mortgage loans, other short-term investment assets and investments in parent subsidiaries and affiliates from Schedule DA-Part 2, and total bonds with maturities of under one year, found on Schedule D-part 1A for 1990, Schedule D-Part 1A-Section 1 for 1993.

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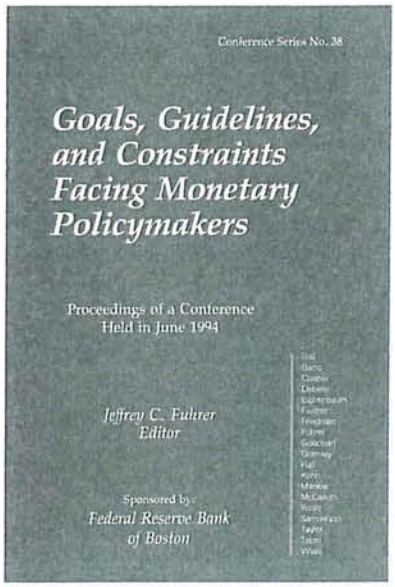

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