Risk and Regulation in Derivative Markets

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ABSTRACT: The debate about risks and regulation in the markets for derivatives has failed to provide a clear analysis of what the risks are and whether regulation is a useful tool to address these risks. The debate is most confusing in the area of what has been termed ‘systemic’ risk. This paper provides a clear analysis of the risks associated with derivative transactions, systemic risk, and the appropriate role for regulation in reducing these risks.

KEYWORDS: Default, derivatives, futures, forwards, hedging, options, risk management, regulation, speculation, swaps.

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1 Introduction

The current public debate about derivatives has failed to provide either a systematic analysis of their risks or a convincing assessment of the likely effectiveness of regulation in limiting such risks. A major source of confusion in the popular debate is the proliferation of names to describe the various risks. Besides the “price risk” of losses on derivatives from changes in underlying asset values, there is “default risk” (sometimes referred to as “counterparty risk”), “settlement risk” (or, a variation thereof, “Herstatt risk,”) “liquidity (or funding) risk,” and “Operations risk.” Last, but certainly not least, is the specter of “systemic risk” that has captured so much Congressional and regulatory attention.

In analyzing the risks associated with derivatives, we proceed in four stages. We begin with an analysis of price risk—that is, the potential for losses on derivatives from changes in the prices of underlying assets such as Treasury bonds, foreign currencies, and commodity prices. Second, we examine the risk of default by either party to a derivatives contract—a risk that has been largely misunderstood and hence overstated (Although the reality of price risk has been demonstrated by a number of large, highly publicized losses, there are remarkably few examples of default in derivative markets—and we show why that trend can be expected to continue.) Third, we argue that systemic risk is simply the aggregation of the default risks faced by individual firms in using derivatives. Fourth and finally, we review various provisions of current regulatory proposals and assess their probably benefits and costs to the financial system.

In brief, we argue that the possibility of widespread default throughout the financial system stemming from the use of derivatives has been exaggerated, principally because of the failure to recognize the low default risk associated with derivatives. For example, regulators as well as defenders of derivatives have observed that traditional measures of derivatives’ exposure—notably, the notional principal of outstanding swaps—vastly overstate the amounts of capital at risk. These same observers argue that the actual “net” credit exposure on swaps amounts to no more than about 1% of notional principal. In this paper, we argue that even this figure is misleading because it fails to acknowledge that the probability of default for most derivatives is significantly lower than the default
probability associated with investment-grade corporate bonds.

In large part because of this overstatement of default risk, the many proposals for regulating derivatives now being contemplated in the U.S. and abroad should be viewed with some skepticism. But there is another reason for urging caution. The authors of such proposals assure us that new regulations can be put in place with minimal costs. Yet, of all the risks described in this paper, the “regulatory risk” arising from the proposals themselves may well represent the most serious threat to domestic and international capital markets.

2 Price Risk

The theory of option pricing, pioneered by Fischer Black, Myron Scholes, and Robert Merton, is one of the cornerstones of modern finance theory and practice. The central insight of the Black–Scholes option pricing model can be described as follows: The payoff from stock options (say, on 100 shares of IBM) can be replicated by the payoff on a portfolio consisting of the “underlying asset” (shares of IBM) and risk-free bonds (Treasury bills). The same Wall Street arbitrageurs who ensure that identical securities sell in different markets for the same prices also see to it that the prices of traded stock options respond rapidly, and in predictable fashion, to changes in underlying stock and T-bill prices.

The finance profession’s current understanding of the value of broad classes of “contingent claims”—everything from LYONs and other convertible bonds to loan commitments and letters of credit—rests on this foundation of valuation by arbitrage. Moreover, this analysis has provided Wall Street with a set of practical tools that has resulted in more effective market-making in the options markets, as well as the creation of new instruments, markets, and strategies.

By building upon and extending the theory of option pricing, such arbitrage-based derivatives pricing models have also had considerable success in valuing most other derivatives (including the large and growing variety of futures, swaps, caps, and collars). As with option pricing theory, derivatives pricing models are based on the ability of arbitrageurs to replicate the cash flows from the derivative contract with a portfolio of other securities that includes Treasuries in combination with the underlying asset (whether a given currency, bond, or
commodity). For example, a forward contract to buy 1,000 barrels of light sweet crude can be replicated with a certain proportion of oil and Treasuries.

To be sure, the proportions of the assets in the replicating portfolios can vary considerably over time; and maintaining these replicating portfolios could involve extensive and costly trading. This means that derivatives, although "redundant" in the perfect markets of finance theory, usually cannot be replicated costlessly in real-world practice. (In fact, it is primarily the transactions-costs savings provided by most derivatives that justify their existence.)

But even if such trading costs introduce a degree of imprecision into the pricing process, virtually all derivatives can be valued with these arbitrage models. This ability to use arbitrage valuation methods in pricing derivatives has an important bearing on the current public debate on derivatives: Because derivatives are equivalent to combinations of already trading securities, they cannot introduce any new, fundamentally different risks into the financial system. What derivatives can and do accomplish, however, is to isolate and concentrate existing risks, thereby allowing for the more efficient transfer of such risks among market participants. Indeed, it is precisely this ability to isolate quite specific risks at low transactions costs that makes derivatives such useful risk-management tools.

2.1 Revisiting the S&L problem

To see that derivatives can be effective tools in managing price risk, consider the predicament of Hometown Savings & Loan back in the early 1980s. Like most S&Ls, Hometown Savings was carrying 30-year mortgages with an average yield well under 10%, while funding itself with deposits whose costs had suddenly jumped well above 10%. Besides this mismatch between the maturities of its assets and liabilities, the fact that Hometown writes and refines fewer

\(^{1}\)Note that the trading required to replicate the payoffs depends critically on the other outstanding positions the firm is managing. Required trading costs for a market maker with an extensive derivatives book is generally dramatically less than the sum of the trades required to replicate the individual contracts.

\(^{2}\)In fact, to the extent transactions costs introduce a degree of imprecision into derivatives pricing models, the derivatives themselves are likely to provide more effective hedges than the “synthetic” derivatives sometimes used to hedge the same risks. A prime case was the performance of “synthetic puts” on the S&P 500 during the stock market crash of 1987. The puts were replicated by a dynamic futures trading strategy that was intended to provide “portfolio insurance” for stock market investors. Although actual put options would have protected
mortgages in a high-interest-rate environment means that its fee income is also exposed to interest rates. In short, rising interest rates mean higher costs and lower revenues for this S&L and, hence, a reduction in its value.

Hometown’s interest rate exposure—that is, the expected change in the S&L’s market value for every 1 percent change in interest rates is illustrated by the downward-sloping line in Figure 1. When interest rates increase (that is, as you move right from the origin), the value of the S&L’s assets declines sharply, the value of its liabilities remains largely unchanged (because deposits are short term and repriced frequently), and so the market value of Hometown falls.

As Figure 1 also illustrates, if interest rates were to rise by as much as 200 basis points, net interest margins would shrink to the point where Hometown

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3 This doesn’t mean that the market value will necessarily change by that amount, only that a certain change in interest rates is expected to change its value by the amount. Factors other than interest rates also affect the S&L’s value. For example, even in a very low interest rate environment, a Texas S&L could find an unusually high proportion of its loans going bad if oil prices go down. Thus, there is uncertainty, or a distribution of values, around this expected value.

4 More precisely, the figure shows the effect of unexpected changes in interest rates on firm value, since all expected changes should be incorporated into current prices.
Now, let’s imagine the same S&L facing the interest rate environment of a year ago (fall of 1993). With 30-year mortgage rates as low as 7%, Hometown was flooded with applications for new mortgages and refinancings. But what if, soon after Hometown put all these new low-rate 30-year mortgages on its balance sheet, interest rates then increased by 200 basis points (as in fact they did the next year)? Would Hometown’s current exposure still be large enough to make it insolvent?

As shown in Figure 2, Hometown has significantly reduced that exposure with an interest rate swap that pays fixed and receives floating (the exact reverse of the S&L’s “natural” position of floating-rate liabilities and fixed-rate assets). The payoff to Hometown on the swap (as represented by the dashed, upward-sloping line in Figure 2) is designed to rise with increases in rates, thereby offsetting part of the decline in its market value.

The reduction in Hometown’s exposure achieved by hedging with a swap is

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5 As noted in footnote 4, unexpected positive or negative developments could delay or hasten insolvency.
reflected in the less negative slope of the line in Figure 2. By reducing (though not eliminating) the S&L’s exposure to rates, the use of derivatives has materially reduced the probability of insolvency.\(^6\) As shown in Figure 2, interest rates would now have to rise by more than 400 basis points to push Hometown into insolvency.

But what about the risk of losses on the swap? After all, if interest rates fall sharply instead of rising, Hometown would be committed to making payments instead of receiving them. In these circumstances, it’s important to recognize, Hometown’s net interest margins would widen as the cost of its liabilities fell, and its origination and refinancing fees would increase. Thus, barring a wave of defaults by its borrowers caused by some factor other than interest rates, the S&L would be in a strong position to meet the payments required by the swap.

As this example illustrates, potential losses on derivatives are not a matter of concern provided companies are using derivatives to offset core business exposures and not to amplify them by taking “views” on interest rates. To the extent companies are using derivatives to hedge rather than to speculate, losses on derivatives will be more than offset by gains in operating values. (For this reason, complaining about losses on a swap used to hedge a firm’s exposure is like objecting to the costs of a fire insurance policy if the building doesn’t burn down.)

Whether companies are hedging or speculating becomes an even more important consideration in evaluating the default risk of derivatives—the subject to which we now turn.

Complaining about losses on a swap used to hedge a firm’s exposure is like objecting to the costs of a fire insurance policy if the building doesn’t burn down.

3 Default Risk

As noted earlier, part of the confusion in the current debate about derivatives stems from the profusion of names associated with default risk. Terms such as

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\(^6\) There are other ways for S&Ls to hedge their interest rate risk. For example, they could sell many of the mortgages. But there are limits to the percentage of its mortgages that a mortgage originator can sell without recourse.
“credit risk” and “counterparty risk” are essentially just synonyms for default risk. “Settlement risk” and “Herstatt risk” refer to defaults that occur only at a specific point in the life of the contract—the date of settlement. These last two terms do not represent independent risks; they just describe a different occasion or cause of default.

As also mentioned earlier, one of the greatest concerns voiced by regulators is “systemic risk” arising from derivatives. Although such risk is typically undefined and almost never assessed in quantitative terms, the “systemic risk” associated with derivatives is often envisioned as a domino effect in which default in one derivatives contract spreads to other contracts and markets, threatening the entire financial system.

But if derivatives are to cause widespread default in other markets, there first have to be large defaults in derivatives markets. And because significant defaults on derivatives are a necessary (though by no means sufficient) condition for systemic problems, it is important to understand the probability of default on individual derivatives contracts before considering the possibility that such defaults could spread to other markets.

3.1 Default risk on a swap

To begin our analysis of default risk, let’s return to the case of Hometown Savings and its use of an interest rate swap. Note what happens if interest rates do rise to the point where they endanger the S&L. A 400-basis-point increase, although much less probable than a 200bp increase, is still possible. But if interest rates do rise by 400 basis points and Hometown does become insolvent, the S&L will not default on its swap, even if the government forces it to close. Why? Because Hometown’s swap will be “in the money”—that is, the S&L will then be receiving net payments from the swap.

As this example is designed to illustrate, there are two conditions that must hold simultaneously for Hometown to default on its derivative contract. The term Herstatt risk derives from the name of a German bank that defaulted on contracts with foreign counterparties after receiving payments but before making them. The default exceeded the net payments due to different business hours.

8 The right to default can be viewed as a “compound option,” one whose value depends
interest rates must fall so that Hometown owes money on the swap contract. (This occurs only to the left of the origin in Figure 2.) If rates rise, Hometown will instead receive payments. Second, the solvency (or at least liquidity) of Hometown must be sufficiently impaired that it is not able to make required payments on the contract. (This occurs only in the shaded region below the insolvency line “I” in Figure 2.) In short, Hometown is expected to default on its swap only if both interest rates and its own net asset value fall at the same time—an unlikely combination of events.\(^9\) (And therefore the probability of default on the swap is represented by just the shaded area to the left of the origin in Figure 2.) What small probability of default remains can be attributed entirely to uncertainty about how Hometown’s net asset value will actually change in response to interest rate declines. For if the negative correlation between Hometown’s value and interest rates predicted in Figure 2 could be assumed to hold with complete confidence, the probability of its defaulting on the swap would be zero!

As this example is meant to suggest, then, \emph{even if Hometown is the riskiest S&L in the industry, the default risk associated with its interest rate swap is likely to be negligible, given the following:} (1) the S&L’s principal exposure has been correctly identified as interest rates (that is, there are no other major exposures—such as the risk of falling oil prices facing a Texas S&L—that would override the effect of interest rates on firm value); and (2) the swap position is being used to reduce, not to enlarge, the S&L’s exposure to interest rates.

\subsection*{3.2 Counterparty risk}

What about Hometown’s exposure to the party on the other side of the swap, the party that pays floating and receives fixed? Higher interest rates may make Hometown’s counterparty unable to make good on the contract.

\footnote{In our discussion of default we generally ignore technical default since it has no direct cash flow consequences. However, many derivative contracts have cross-default clauses which can place a party into technical default. Should the counterparty try to unwind the contract under the default terms but fail, then default occurs.}

One potentially important consideration in evaluating counterparty risk is, of course, the credit rating of the counterparty. If the counterparty has a AA or AAA credit rating (as most swap dealers do), then any interest rate swap it enters in to with Hometown will pose little counterparty risk for the S&L. The capital backing of AA-rated counterparties (and we will have more to say about swap dealers later) provides strong guarantees of performance.

But what if the counterparty is an industrial firm with a credit rating of Baa or lower? As we just saw in the case of Hometown, the most important consideration in evaluating counterparty risk in such cases (that is, holding credit rating constant) is likely to be the correlation between the replacement cost of the counterparty’s swap position and the value of the counterparty’s net assets. If there is a strong negative correlation—that is, if the counterparty (like Hometown) is also using its swap position to offset its own well-defined exposure—then again, the default risk on the swap will be minimal.

To illustrate this point, let’s begin with the (clearly unrealistic) assumption that Hometown does not use a swap dealer as its counterparty but instead enters into its swap with either one of two companies: (1) GoldCo, a commodity producer whose value rises with increases in interest rates; and (2) SpecCo, a trading firm whose value falls with increases in rates. Assume also that both GoldCo and SpecCo would have the same Baa credit rating after entering into this swap with Hometown. And let’s begin with the case of GoldCo: Under what circumstances might it be expected to default?

Because the value of GoldCo is positively correlated with inflation and interest rates, its exposure to interest rates (as illustrated in Figure 3) is essentially the opposite of the S&L’s. By exchanging their opposite exposures through an interest rate swap, both GoldCo and Hometown reduce their net exposures to interest rates, thereby reducing the probability of insolvency and default on any outstanding liabilities.

Moreover, as we saw in the case of Hometown, GoldCo will default on the swap only if both of the following conditions hold: (1) interest rates must change in such a way (in this case, rise) that GoldCo owes a net payment on the swap; and (2) the decline in GoldCo’s net asset value (when combined with the cash-
flows on the swap) is sufficient to make the firm insolvent.

As in the case of Hometown, the probability that both of these conditions will hold at the same time is low; if interest rates do rise, GoldCo’s core business will most likely be prospering. Thus, the likelihood that GoldCo will default on the swap is also low. (In fact, as we demonstrate below, the probability that GoldCo will default on the swap is appreciably lower than the probability that it will default on its outstanding debt.)

But consider what happens if SpecCo instead of GoldCo is the counterparty to the swap with Hometown. In contrast to GoldCo (but like Hometown), SpecCo’s exposure is essentially the same as Hometown’s as represented in Figure 1. By entering into this swap, SpecCo is effectively magnifying its own exposure to interest rates (it will be required to make net swap payments when interest rates rise—exactly when it can least afford it), thereby increasing the probability that it will default on its debt. Thus, Hometown’s counterparty credit risk would be significantly higher in a swap with SpecCo than with GoldCo—again, even if the two firms had the same credit rating after entering into the swap.

It is in this sense, then, of reducing or enlarging core business exposures that we speak of hedging and speculating with derivatives. Hometown and GoldCo may both retain some of their basic exposures to interest rates, but they reduce
part of their exposure by means of the swap. SpecCo, by contrast, increases its exposure by entering into the swap.

Even if Hometown is the riskiest S&L in the industry, the default risk associated with its interest rate swap is likely to be negligible.

3.3 Quantifying default risk

Default risk on a swap of other derivatives contract is the risk that losses will be incurred if a counterparty defaults. Default risk on swaps has two primary components: (1) the expected exposure (that is, the expected replacement cost of the swap at default less any expected recovery); and (2) the probability of default. Although these two components are generally not independent, we begin by discussing each separately and then consider their interaction.

3.3.1 The expected exposure

To estimate the default risk of swaps, then, one must begin by estimating how much capital is likely to be at risk when a firm defaults on a swap. As we noted in our introduction, the notional principal amounts used to estimate swap volumes grossly overstate the actual credit exposure. No principal is paid in an interest rate swap, and it is only price movements after the contract is initiated that cause one party to owe net payments to the other. In fact, as noted earlier, the U.S. General Accounting Office (GAO) estimates that the “net” credit exposure on swaps runs on the order of only 1% of notational principal.

As noted above, however, the expected loss depends not only on the expected value of the swap at the time of default, but also on the amount of the expected recovery after the default. The GAO estimate effectively assumes the expected recovery is zero—an assumption that generally leads to a material overstatement of the expected loss. It’s true that, in bankruptcy, most swaps are unsecured financial claims. But typical recoveries on even unsecured (senior) claims average about 50% of the claim. For those swaps that are collateralized (about 5% of the total, according to the GAO), average recoveries run on the order of 80%.

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3.3.2 Probability of default

Perhaps the best way to quantify the probability of default associated with derivatives is to begin by looking at historical default rates on corporate bonds. Edward Altman’s 1989 study of corporate bond defaults reported that slightly under 1% (on a dollar-weighted basis) of all A-rated bonds issued between 1971 and 1987 defaulted during their first ten years. Converted into an annual figure, Altman’s estimate thus suggests an annual average default probability of roughly 0.1%.\textsuperscript{11}

How is the probability of default on a swap related to the probability of default on debt? As we have seen earlier, given the credit rating of the swap counterparty, the default probability of the swap relative to the same firm’s debt depends principally on the use of the swap—that is, whether it is reducing or enlarging the firm’s exposure. But, as we will not demonstrate, the probability of default on a swap depends not only on whether it is being used to hedge, but also on the size of the swap, or, more precisely, on the percentage of the firm’s exposure that is being hedged.

As a first step in this analysis, recall that the probability of default on a firm’s swap can never be greater than the probability of default on its debt. Default on debt requires simply that the firm become insolvent. For a firm (rationally) to default on a swap, it must both be insolvent and owe payments under the swap.

Because both of these two conditions must hold simultaneously, the probability of default on the swap (Pr(Ds)) can be expressed as the product of two probabilities: (1) the probability of insolvency, Pr(I) (which is also the probability of default on the firm’s debt); and (2) the probability of default on the swap given that the firm is insolvent (Pr(Ds|I)). (The latter is referred to as a conditional probability.) In the form of an equation:

\[ Pr(D_s) = Pr(I) \times Pr(D_s|I). \]

Thus, the probability of default on a swap rises with increases in both the probability of insolvency and the conditional probability of default on the swap. But

the correlation between these two variables, as we now demonstrate, is far from a simple (or linear) one.

As illustrated in Figure 4, both the probability of insolvency \((Pr(I))\) and the conditional probability of default on the swap \((Pr(D_S|I))\) depend on the two factors cited above: (1) whether the firm is using the swap to hedge or to speculate; and (2) the percentage of the firm’s exposure that is being hedged. With the aid of Figure 4, we now present a series of propositions about the relation between the default probabilities of debt and swaps.

Panel A of Figure 4 shows how the probability of insolvency (and thus default on debt) varies with the use and size of the swap. Given that the firm is using the swap to hedge (that is, the percentage of the firm’s exposure hedged in Figure 4 ranges between 0 and 100%), we can conclude the following: \textit{The larger the percentage of its exposure a firm hedges, the lower is the volatility of the firm’s value and hence the lower is the probability of insolvency.} Either decreases in the percentage hedged below 0% (which means the firm is speculating) or increases above 100% (the firm is “overhedging”) cause the probability of insolvency to increase.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure4.png}
\caption{Probability of Default on a Swap}
\end{figure}
To the extent that swaps and other derivatives are used to reduce exposures and not to enlarge them, they have significantly lower default probabilities than the debt issued by the same firm.

Panel B of Figure 4 shows how the conditional probability of default on the swap varies with the use and size of the swap. As in the case of Panel A, if the firm is either speculating or overhedging with the swap (that is, as the percentage exposure hedged falls below 0% or rises above 100%), the conditional probability of default on the swap rises along with the probability of insolvency and approaches “.0” (at which point the probability of default on the swap would equal the probability of default on the debt). By contrast—and this may seem surprising—given that the firm using the swap to hedge, the smaller the percentage of its exposure a firm hedges, the lower is the probability of default on the swap if the firm becomes insolvent.

To see why this last proposition holds, consider a firm that hedges exactly 100% of its exposure to interest rates. In this case, the expected default of the swap will be exactly one half the default probability of the firm’s debt. This is true for the following two reasons: One, assuming that the firm is using an “at-market” swap and that future interest rates are equally likely to fall above or below the interest rate built into the swap, the firm is likely to owe payments on the swap in 50% of the cases where the firm might default. Two, the probability of insolvency (and thus default on the firm’s debt) is not only reduced by the swap, but is now completely independent of rates—that is, rate changes have no effect on the probability of default, which is not equally likely across all interest rate outcomes.

But now let’s go back to the original case where Hometown (or GoldCo) was hedging only part of its interest rate exposure. Under these conditions (which, we will argue later, are more representative of actual corporate behavior), the default risk on Hometown’s (or GoldCo’s) swap is less than half the default risk on its debt. This is because in the interest rate environment in which the firm is most likely to be insolvent, the firm is receiving payments under the swap.

By putting together Panels A and B, we come up with the following propositions. Firms that hedge more than 100% (overhedge) or less than 0% (speculate)
increase both the probability of insolvency and the conditional probability of default on their swap. And, as firms move further outside this range, the probability of default on the swap approaches the probability of default on the debt.

For firms hedging between 0 and 100% of their exposures, the two probabilities have offsetting effects. For example, in the case of an at-market swap, as the firm increases the percentage of its exposure hedged, the effect on the swap’s default probability of the increase in $Pr(D_S|I)$ dominates the effect of the increase in $Pr(I)$, and so the probability of default on the swap actually increases.

3.3.3 Summing up

In the special case where a firm hedges 100% of its exposure, the credit risk on a swap is simply the product of two factors: the expected loss on the swap times the probability of default.\footnote{In general, the relation is more complicated; but if a perfect hedge makes firm value independent of interest rates, this simple product is appropriate.} Based on this reasoning, and using Altman’s 0.1% default estimate for single A firms cited earlier, a good working estimate of the average annual default rate of an A-rated firm that completely hedges its interest rate exposure is 0.05%, or $\frac{1}{20}$ of one percent, of the expected exposure. And if we accept the GAO’s estimate of that exposure as 1% of notional principal and assume that the expected recovery is 50%, then credit risk is .00025% of notional principal.

To the extent, then, that swaps and other derivatives are used to reduce exposures and not to enlarge them, they have significantly lower default probabilities than the debt issued by the same firm. And, if we assume that most companies are using derivatives as only partial hedges of their exposures, even this .00025% is too high.

At the same time, though, swaps and other derivatives that are used in attempts to convert the treasury into a profit center generally succeed only in adding financial risk to business risk. Yet, even in the cases where companies double up their exposures and increase the likelihood of insolvency, the probability of default on the swap cannot exceed the probability of default on its debt. And, given the default probability of debt of .1% cited earlier, the credit risk on
swaps in such cases is still likely to be only on the order of .0005% of notional principal.\(^{13}\)

### 3.4 Evidence on the corporate use of derivatives

This brings us, then, to the critical question: Are firms using derivatives to hedge or to speculate? Although the evidence is admittedly preliminary at this point, the answer appears to be. “Yes—for the most part.”

Perhaps the most comprehensive survey to date of the corporate use of derivatives was conducted by Walter Dolde in 1993.\(^{14}\) The overwhelming majority of the 244 Fortune 500 companies that responded to Dolde’s questionnaire reported that their policy it to use derivatives primarily to hedge their exposures. At the same time, however, only about 20 percent of the responding firms reported that they aim to hedge their exposures completely. Moreover, as theory would suggest, smaller firms—those likely to have lower credit ratings and hence greater default risk—reported hedging larger percentages of their exposures than big companies.

About 90% of the firms in Dolde’s survey also said they sometimes had a view on the market direction of interest rates or exchange rates. And although roughly one in six of even these companies hedged their exposures completely, the rest claimed to modify the extent of their hedging to accommodate their view. For example, if they expected rates to move in a way that would increase firm value, they might hedge only 30 percent of their exposure. On the other hand, if they expected rates to move in a way that would increase firm value, they might hedge as much as 100 percent of their exposure. Moreover, only two of the 244 firms responded that they choose hedge ratios outside the 0–100% range. In effect, this means that less than one percent of the firms said they would use derivatives to enlarge an existing exposure.

Of course, some companies—particularly those in which the treasury operates as a profit center—might be reluctant to respond to a survey admitting that they

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\(^{13}\)This assumes that the speculative use of derivatives is confined largely, if not exclusively, to firms with high credit ratings.

use derivatives to increase an existing exposure. Moreover, some firms could be using derivatives in a way that introduces new exposures; that is, a firm that has no interest rate exposure may create one by, say, taking the floating side of an interest rate swap. But treasuries that operate as profit centers are the exception rather than the rule (and, given the recent focus of the business press on derivative losses by industrial firms, profit-center treasuries are likely to become even more scarce).

In sum, the companies that use derivatives to hedge appear to outnumber significantly those that use them for speculative ends.15

4 Systemic Risk From Derivatives

4.1 What is systemic risk?

We define systemic risk as widespread default in any set of financial contracts that can be linked to default in derivatives. While this interpretation of systemic risk is consistent with most others, we believe that default is the most useful criterion because it has definite cash flow consequences and can be readily observed.16

System-wide derivative risk is simply the aggregation of the underlying risks faced by individual firms. But because the underlying risks are not independent, one cannot simply sum them to find the total. Indeed, in the case of derivatives, the underlying default risks are likely to be correlated through two channels.

First, default within derivative contracts is negatively correlated. That is, at any point in time, only the side of a derivative contract that is in the money can lose from default. Because the net supply of derivatives is zero, a simply summation of derivatives positions across the economy grossly overstates the total default risk.

15Other preliminary academic evidence on hedging also bears out this corporate propensity to hedge rather than speculate. For example, a recent study by one of the present writers in collaboration with Charles Smithson and Deana Nance concludes that firms with tax or operating characteristics which theory suggests should make hedging more valuable in fact use more derivatives. If derivatives were used primarily to speculate, no such associations should be expected. See Deana Nance, Clifford Smith and Charles Smithson, “On the Determinants of Corporate Hedging.” Journal of Finance (91993), pp. 267-284.

16The Bank for International Settlements (1992), for example, defines systemic risk to include “widespread difficulties.” While this definition agrees with ours in spirit, it is not operational.
The second channel is more complex. Some observers argue that widespread corporate risk management with derivatives increases the correlation of default among financial contracts. If risks are borne by more and different investors than before, the argument goes, more participants will be affected by the underlying shocks to the economy that occur from time to time. After all, even firms that use derivatives will be affected by such shocks.

What this argument fails to recognize, however, is that the adverse effects of such shocks on individual investors or firms should be smaller precisely because the risks are spread more widely. More important, to the extent firms are using derivatives to hedge their existing exposures, much of the impact of shocks is being transferred from corporations and inventories less able to bear such shocks to counterparties better able to absorb them. For this reasons defaults in the economy as a whole, and hence systemic risk, are unambiguously reduced through the operation of the derivatives market.

As an illustration of a recent shock and how derivatives cope with it, consider the 200-basis point increase in most interest rates that took place between October 1993 and October of 1994. Before the securitization of mortgages (which was made possible in part by interest-rate derivatives), S&Ls and other originators would have experienced large losses, and perhaps a wave of defaults. But this time there has been no rash S&L or commercial bank failures, in large part because so many financial institutions have chose to lay off part of their interest rate risk to investors with opposite interest rate exposures.

Perhaps the best evidence that such risks have been transferred are the handful of highly publicized instances in which mutual and pension funds have reported significant losses on “hedge funds” using mortgage-backed securities. Although the popular response is to deplore such losses, they can also be viewed as confirmation of a positive economic development: the shifting of rate risk from highly leveraged financial institutions like S&Ls to investors with longer-term liability structures such as pension funds and insurance companies. As long as 30-year, fixed-rate mortgages are available to the homebuying public, the risk of sharp increases in interest rates will be borne by some firms or investors (although there are ways for investors to hedge such risks using mortgage
Institutional investors such as pension funds, mutual funds, and insurance companies are likely to prove better able to bear these interest rate risks once concentrated almost entirely on federally insured depositary institutions.

In sum, as a result of the expanded risk-sharing that has been achieved with derivatives, a shock of a given size might affect more firms; but the average effect on each firm will be significantly less. And because fewer firms default in response to any given shock, systemic risk has been reduced.

To the extent firms are using derivatives to hedge, much of the impact of shocks is being transferred to investors and firms better able to absorb them. For this reason, defaults in the economy as a whole, and hence systemic risk, are unambiguously reduced through the operation of the derivatives market.

4.2 How bad is it likely to be?

It is certainly conceivable that financial markets could be hit by a very large shock. Take the stock market crash of 1987. If such a disturbance were to affect a large number of participants in the derivatives markets, it could expose them to systemic risk. The effects of such a disturbance on derivatives markets and participants in these markets will likely depend, however, on the duration of the shock.

4.2.1 Temporary disturbances

If the shock were large but temporary—the liquidity effects of the stock market crash of 1987 are perhaps a good example—many derivatives would be largely unaffected. Forwards, options, and swaps make relatively infrequent payments. Forwards and European options make payments only at maturity; and, although swaps make periodic payments, standard swaps require payments only once every six months. A temporary disturbance would primarily affect only contracts with required settlements during this period. And, even if swap payments were literally impossible for some time, a temporary reduction in liquidity would mean than only a small fraction of the total payments would be missed.

\(^{17}\) See, in this issue, Charles Stone and Anne Zissu, “The Risk of Mortgage Backed Securities and Their Derivatives.”
Of course, this does not mean that temporary disturbances have no adverse consequences. In response to the resulting uncertainty, market makers are likely to increase substantially the spreads they quote in order to receive sufficient compensation for the risk they assume by carrying an inventory. Indeed, such behavior was evident during the 1992 upheaval in the European Monetary System, when many market makers reportedly stopped quoting forward prices altogether for some European currencies for several hours. Such an increase in trading costs makes the arbitrage between underlying instruments and derivatives more costly, which in turn is likely to slow the origination of new derivatives contracts.

4.2.2 Longer-term problems
If a shock persists for a long time, as did some of the valuation effects of the 1987 crash, it will affect derivatives in much the same manner that it affects other markets. If an underlying price falls substantially, positions that were effectively long in the underlying security will lose; on the other hand, the corresponding short positions will gain. And, as noted above, since all derivatives contracts exist in zero net supply, the gains will exactly equal the losses. As a group, therefore, participants in the derivatives markets will be no worse off than they were before.

Nevertheless, for sufficiently large disturbances, there will—and probably should—be defaults. Defaults followed by bankruptcies (and asset sales or, in some cases, piecemeal liquidations) are an important means by which the economy squeezes out excess capacity or eliminates otherwise inefficient operations. Moreover, the more costly it is (in terms of economic growth forgone through excessive regulation) to reduce the probability of default, the larger is the optimal number of defaults. As is true of all financial markets, regulators and other economic policymakers should aim to reduce the probability of default only if the benefits of fewer defaults exceed the costs of preventing them.

4.3 Independent and correlated disturbances
The critical question in evaluating systemic risk, however, concerns the extent to which defaults across derivative markets, and financial markets in general, are likely to be correlated. In the analysis that follows, we begin by assuming
that the derivatives defaults that could trigger systemic problems are largely independent across dealers, and then go on to explain the reasoning behind this assumption.

If we assume that defaults in derivatives markets are largely independent across market makers, then available data on corporate default rates can be used to provide a crude estimate of the likelihood of large-scale disturbances. Recall that, on that basis of Altman’s estimate of the average annual default rate of A-rated corporate bonds, we earlier used 0.05% or \( \frac{1}{20} \) of one percent, as the expected annual default rate on swaps. (In using this number, one should keep in mind that Altman’s default rates are for industrial firms; such rates are likely to be too high for the major financial firms that are active market makers in derivatives. In fact, they are likely to be much too high for the market makers in these instruments, because such firms typically have AA or AAA credit ratings.) We will not use this 0.1% estimate of annual corporate default probability on debt as a crude indicator of the probability that a large number of dealers default at the same time.

If default is independent across dealers and over time, then assessing the probability of defaults by dealers as a “coin tossing” experiment—except that the coin is heavily loaded. Based on our estimate of the default probability, we will load the coin to come up with “default” \( \frac{1}{20} \) of one percent of the time—that is, only 5 times in 10,000 throws.\(^{18}\) Probability theory can then be used to compute the probability that at least a certain number of firms default.

Just how quickly the numbers become incomprehensibly small can be illustrated with the following example. Consider the probability that several of the major dealers could default at the same time. If there are 50 major dealers, and we are worried about five or more defaulting during the same year (not the same quarter or month), the odds are one in 650 billion.

What grounds do we have for assuming that the risks are independent? First, we need to remember the private incentives that are at work in these markets. Market makers have strong incentives to do a thorough job of assessing the default risk of their swap partners. As suggested earlier, a very strong credit

\(^{18}\)That is to say, we assume that default has a binomial distribution with a default probability of 0.0005.
rating may be all the assurance a swap dealer needs to take the other side of a transaction. If the dealer receives a call from a AAA credit like DuPont expressing interest in a swap, the dealer is unlikely to care whether DuPont’s treasury is taking a hedging or taking a view; the company has such a strong balance sheet relative to the size of the transaction that default is extremely unlikely in either circumstance. But if, as we also saw earlier, a Baa-rated firm asks about the same kind of swap, the swap dealer is much more likely to investigate the firm’s core business exposure to ensure that the swap is being used to offset, and not to enlarge, that exposure.

Market makers have strong incentives to do a thorough job of assessing the default risk of their swap partners. And, given the capital that dealers devote to the support of their operations and the diversification of their derivatives portfolio, we believe that expected defaults among dealers are not far from being independent events.

Second, as we have already noted, for firms using swaps to hedge their exposures, the interest-rate environment in which these firms are most likely to become insolvent is precisely the environment in which they will be receiving payments on their swaps or other derivatives. For these firms, defaults must be caused by shocks other than interest rate changes. (For example, the few defaults on swaps by S&Ls that have been reported to date occurred primarily among S&Ls in the oil patch. In such cases, the favorable impact of lower interest rates was overwhelmed by the negative effect of low oil prices on the creditworthiness of their loans.)

In this sense, defaults on swaps are significantly more “idiosyncratic”—that is, less predictably associated with systematic, economy-wide factors such as changes in interest rates—than are defaults on loans. For example, a large increase in interest rates is much more likely to lead to a rash of defaults on floating-rate bank loans than on interest rate swaps. And because the correlation among defaults on swaps is thus likely to be significantly lower than the correlation among defaults on loans, diversification is a more effective tool for managing the credit risk of swaps than loans. This is why swap dealers limit (and continuously monitor) their exposures to specific counterparties, industries,
and geographical areas.

Finally, market makers with a carefully balanced book and substantial capital reserves can absorb defaults by their counterparties without defaulting on their other contracts. Swap dealers function somewhat like clearinghouses in futures markets. For a dealer to default, customer defaults would have to impair dealer capital. Moreover, a large number of financial institutions have set up well-capitalized, highly rated special purpose subs to conduct their derivatives businesses. Besides offering protection to the dealers’ derivatives customers, such segregation of derivatives operations also reduced the risk that a wave of derivatives defaults could affect a bank’s other operations.

Given, then, all these risk-reducing arrangements along with the normal incentives for self-preservation in large, well-capitalized financial institutions, independent defaults are not as unlikely as a discussion of systemic risk might at first suggest. Of course, the default probabilities cited above are not intended as precise estimates; the fact that they are so small makes it unlikely that we could ever obtain very precise estimates of these phenomena—simply because we don’t observe enough of them. And our assumption that expected defaults are independent across dealers is also clearly too strong. Nevertheless, given the capital that dealers devote to the support of their operations and the diversification of their derivative portfolio, we believe that expected defaults among dealers are not far from being independent events. Even if we have understated the likelihood of systemic problems by a factor of a million, these default rates illustrate just how small these risks are likely to be.

5 Regulation

Derivatives markets continue to attract a great deal of attention from regulatory bodies. In press accounts and in the popular debate, a few large losses have been cited as evidence that these markets are very risky. Proponents of greater regulation of derivatives then typically proceed to argue that regulations can reduce or eliminate these risks with minimal costs.

Establishing effective public policy, however, requires an accurate assessment of not only the risks associated with derivatives, but also of the benefits offered
by the instruments and the potential costs of regulatory interference. We believe the benefits are substantial. As we have attempted to demonstrate in these pages, the derivatives markets have provided corporations with a powerful (and flexible) set of financial tools that can be used to manage their exposures to financial prices such as commodity prices, interest rates, and exchange rates.

Of course, derivatives (like automobiles) can be used for destructive ends. Witness the recent run of stories in the popular financial press reporting speculative derivatives losses at industrial companies. Nevertheless, in contrast to most press accounts of derivatives, a growing body of academic evidence suggest that these tools are being used by firms primarily to reduce (not to enlarge) their exposures and to reduce funding costs, thereby increasing their competitiveness in global markets.

Largely for this reason, we believe the risks and hence potential costs of these markets have been materially overstated. To the extent that derivatives are being used primarily to hedge rather than to speculate, as we show in this paper, the default risk associated with derivatives has been significantly overstated. (For example, an interest rate swap used by a B-rated firm to hedge its principal price exposure is likely to have significantly less default risk than even an AAA-rated corporate bond issue.) And, far from increasing systemic risk, we argue that derivatives markets act to reduce systemic risk by spreading the impact of economic shocks among a set of institutional investors and financial intermediaries in a better position (because most are well capitalized and carefully diversified) to absorb them.

Such overstatement of default and systemic risk has led to regulatory proposals that would significantly raise the costs of—and thereby restrict access to—derivative instruments. By providing a clearer analysis of the risks and potential costs, we hope to encourage more productive regulatory initiatives—those designed to limit risks while preserving the efficiency of domestic and international capital markets.

5.1 Proposed regulation of end users

In the U.S., the principal regulatory initiatives that would affect the users of
derivatives involve new disclosure requirements. The proposals now on the table—particularly, those calling for periodic reporting of the market value of derivatives positions—have two obvious shortcomings:

First, they would necessarily be based upon GAAP accounting. Marking derivatives positions to market causes problems for corporations who are using them as economic or “macro” hedges of longer-dated exposures. If the derivatives position used to hedge an exposure is required to be marked to market, but the underlying assets or liabilities being hedged must be carried at historical cost, then reported earnings will become more volatile—even when variability in the firm’s value has been reduced through hedging. For this reason, the accounting system may have to be fixed to make the disclosures more useful to investors.

The second problem with disclosure requirements is that they effectively ignore the private incentives of companies to provide sufficient information to enable investors discount shares for uncertainty, companies can be counted on (eventually, if not immediately) to provide additional information about their derivatives activities as long as the benefits of the new information outweigh the costs.

The good news about mandated disclosure, however, is that its capacity to impose additional costs is limited. Disclosure requirements are inefficient only to the extent they require companies to disclose more than investors are willing to “pay for” in the form of a higher stock price for reduced uncertainty. And, to the extent corporations are now providing less than the optimal amount of disclosure, disclosure requirements might even provide net benefits—at least insofar as they help initiate a beneficial process. The problem with this argument, however, is that disclosure requirements, even if modest at first, have a tendency to proliferate to the point where (like much SEC disclosure imposed on the largest U.S. corporations today) they end up imposing costs that exceed the benefits to investors.

5.2 Proposed regulation of dealers

Potentially more troubling than disclosure statements, however, are the current risk-based capital requirements that affect derivatives dealing at banks and other
regulated financial institutions, and the proposals to extend such requirements to unregulated market makers in derivatives. Without getting into the details of the calculations, the capital guidelines for banks apply a risk weighting to derivatives (as well as other on- and off-balance-sheet assets), and then compare the institutions’ risk-adjusted assets to qualifying capital.

In our analysis, we argued that the credit risk of derivatives depends primarily on two factors: the credit standing of the counterparty and whether the derivative is being used to hedge or speculate. The capital guidelines, however, make no attempt to distinguish between a 10-year old swap to a single-B credit that is using the swap to speculate on interest rates and a 3-year swap to a AAA credit that is hedging. In the first case, the guidelines might be too low; in the second they are almost certainly too high.

Because these capital guidelines are such a blunt tool, their effectiveness in limited the risk of a dealer default is questionable. Derivatives dealers have strong incentives to back their operations with appropriate levels of capital; in fact, a AA credit rating is almost a requirement to compete in the business. To the extent regulations specifying minimum capital amounts to a tax; and, like all taxes, it raises costs and prices, thereby limited access to the market.

In the process of raising costs, moreover, excessive capital requirements also have the potential to create precisely the opposite kind of incentives as those presumable intended by regulators. By burdening safer-than-average derivatives transactions with excessive capital charges, capital requirements that are set too high encourage dealers to book riskier deals in order to justify the capital employed. To offer just one example, the current capital guidelines effectively create an incentive for banks and other dealers to structure the kind of leveraged derivatives that Bankers Trust sold Procter and Gamble (since the guidelines are keyed to notional principal, leveraged derivatives allow the dealer to support a larger effective exposure with the same amount of capital).

Excessive capital requirements have the potential to create precisely the opposite kind of incentives as those presumable intended by regulators. By burdening safer-than-average derivatives transactions with excessive capital charges, capital requirements may encourage dealers to book riskier deals in order to justify
the capital employed.

If you accept our basic contention—that the risks of derivatives have been exaggerated—then the regulatory history of derivatives can be explained simply as cautious responses by well-meaning regulators to rapidly growing markets in complex and unfamiliar products. But there may be a problem in effective constructive policy changes. Just as derivatives dealers and users face important private incentives to manage risks in their operations, politicians proposals to regulate this market. To the extend politicians are able to convince the public that the derivatives markets are fundamentally dangerous and that all that keeps the threat at bay is regulatory vigilance, they gain public and political support and so fortify their own positions.

This view of derivatives regulation reminds us of the story of a gentleman walking along a city street who would periodically stop and blow a whistle. When a policeman asked him why he did so, he replied. “It’s a magic whistle; it keeps the tigers away.” When the officer objected, “But there are no tigers around here,” the fellow winked and said, “See, it works.”

As long as this “tiger whistle” is relatively inexpensive, such political maneuvering will be fairly harmless. But if the regulation that results from the political process becomes too burdensome—which represents a very real risk to the derivatives markets—we will end up reducing the efficiency of the entire financial system.