If a firm manages its financial price risk, it follows that the volatility of the value of the firm or of the firm’s real cash flows will decline. This general relation is illustrated in Figure 4–1.

**FIGURE 4–1  The Impact of Risk Management Hedging Is to Reduce the Variance in the Distribution of Firm Value**

Since the value of a firm is sensitive to movements in interest rates, foreign exchange rates, or commodity prices, a tantalizing conclusion is that the value of the firm will necessarily rise if this exposure is managed. But however appealing, this conclusion does not follow directly. That a firm is confronted with strategic

---

*This chapter is adapted from Rawls and Smithson (1990).
risk is a necessary condition for the firm to manage that risk. The sufficient condition for a firm to manage risk is that the strategy increase the present value of the expected net cash flows, $E(NCF_{jt})$, where $r_{jt}$ is the discounted rate.

$$V_j = \sum_{t} \frac{E(NCF_{jt})}{(1 + r_{jt})}.$$

This equation provides the insight that if the market value of the firm is to increase, the gain must result from either an increase in expected net cash flows or a decrease in the discount rate.

Whether risk management will have an impact on the discount rate—the firm’s cost of capital—is an issue we defer until Chapter 19. One special case should be mentioned now, however. For firms in which the owners do not hold well-diversified portfolios (such as proprietorships, partnerships, and closely held corporations) the risk aversion of the firm’s owners can provide an important risk management incentive. At this point, we want to focus on how risk management could increase the value of the firm by increasing the firm’s expected net cash flows. Hence, the question that must be answered is, how can hedging, or any other financial policy, have any impact on the real cash flows of the organization?

The relation between the firm’s real cash flows and its financial policies was established by Franco Modigliani and Merton Miller in 1958 in what has come to be called the M&M proposition. The M&M proposition would imply that in a world with no taxes, no transaction costs, and a fixed investment policy, investors can create their own “homemade” risk management by holding diversified portfolios. However, the message of the M&M proposition for practitioners becomes evident only when the argument is turned upside down:

If financial policies matter . . . if risk management policies are going to have an impact on the value of the firm,

then risk management must have an impact on the firm’s taxes, transaction costs, or investment decisions.

**Risk Management Can Add Value by Decreasing Taxes**

For risk management to produce tax benefits, the firm’s effective tax schedule must be convex. As illustrated in Figure 4–2, a convex tax schedule is one in which the firm’s average effective tax rate rises as pretax (financial statement) income rises. If the firm’s effective tax function is convex and if the firm is subject to financial price-induced volatility in its pretax income, it is a mathematical certainty that hedging will reduce the firm’s expected taxes.2 However, instead of resorting to a mathematical proof, we think that this point is demonstrated in the following illustration.
Consider a firm that is exposed to financial price risk; its pretax income is related to interest rates, foreign exchange rates, or some commodity price. Suppose that if the firm does not hedge, the distribution of its pretax income will be as shown below: for any given year, the firm’s pretax income might be low or high, either with a probability of 50 percent.
If the firm implements an effective risk management program, the volatility in its pretax income will decline. In the context of our simple distribution, a reduction in volatility means that the pretax income LOW and pretax income HIGH will both move toward the mean. For purposes of illustration, suppose that the firm hedges completely; in such a case the distribution of the firm's pretax income would be a single point, MEAN.

If the firm has the low pretax income, it will pay tax \( T(LOW) \); if the firm's pretax income is high, the tax will be \( T(HIGH) \). Hence if the firm does not hedge, its expected tax will be the average of these two taxes. In other words, the firm's year-on-year taxes would be on the straight line connecting \( T(LOW) \) and \( T(HIGH) \), halfway between \( T(LOW) \) and \( T(HIGH) \).

And as the next illustration shows, the firm will pay a tax that is strictly less if it hedges than if it does not hedge.
If the firm's effective tax function is convex, risk management can reduce the firm's expected taxes. And the more convex the tax schedule is, the greater the tax benefits are. The obvious question then is, why would my firm's effective tax function be convex?

The obvious factor that would make a tax schedule convex is progressivity, a tax schedule in which the statutory tax rate rises as income rises. Greater progressivity results in a more convex tax schedule. However, since the range of progressivity for corporate income taxes in the United States is relatively small, this factor would not be a significant source of convexity for most large, public industrial corporations.

Another cause of convexity in the effective tax function is the existence of tax preference items—for example, tax loss carryforwards and investment tax credits (ITC). Since a firm will always be induced to use the most valuable tax preference items firms, these tax shields will result in the firm's effective tax function being convex.

Finally, in the United States, firms that are subject to the alternate minimum tax (AMT) provision face convex effective tax functions. The AMT gives the tax authorities a claim that is similar to a call option on the pretax income of the firm, so the AMT puts a "kink" in the effective tax function, making it convex.

While the impact of hedging on the firm's taxes is driven by a mathematical relation—the convexity of the effective tax function—the underlying logic is simple, perhaps easiest to see in the case of the tax preference items. If the firm does not hedge, there will be some years in which the firm's income is too low to use (or use completely) the tax preference items, so the firm would lose a benefit. By reducing volatility in pretax income, hedging reduces the probability that the firm will not be able to take advantage of its tax preference items. In a similar fashion, hedging reduces the probability that the firm pays the higher tax rates specified under a progressive tax schedule or AMT provision.

**Risk Management Can Add Value by Decreasing Transaction Costs**

As illustrated in Figure 4–1, risk management reduces the volatility of the value of the firm. Figure 4–3 goes further to show that by reducing volatility, risk management reduces the probability of the firm's encountering financial distress and the consequent costs.

How much risk management can reduce these costs depends on two obvious factors: the probability of encountering distress if the firm does not hedge and the costs if distress occurs. The greater the probability of distress or distress-induced costs, the greater the firm's benefit from risk management through the reduction in these expected cost.

Default results when a firm's income is insufficient to cover its fixed claims. The probability of financial distress and subsequent default, therefore, is deter-
mined by two factors: *fixed-claims coverage* (because the probability of default rises as the coverage of fixed claims declines) and *income volatility* (because the probability of default rises as the firm’s income becomes more volatile).

The cost of financial distress has two major components. The first is the direct expense of dealing with a default, bankruptcy, reorganization, or liquidation. The second is the indirect costs arising from the changes in incentives of the firm’s various claim holders. For example, if the firm files for bankruptcy and attempts to reorganize its business under Chapter 11, the bankruptcy court judge overseeing the case is unlikely to approve nonroutine expenditures. The judge receives little credit if the activities turn out well, but is criticized by creditors with impaired claims if the efforts turn out badly. Thus, firms undergoing reorganizations are likely to pass up positive net-present-value projects systematically because of the nature of the oversight by the bankruptcy court.

But even short of bankruptcy, financial distress can impose substantial indirect costs on the firm. These indirect costs include higher costs to the firm in contracting with its customers, employees, and suppliers.

The impact of financial distress on the cost of contracting with customers is perhaps the easiest to observe. Firms that provide service agreements or warranties make long-term contracts with their customers. As illustrated in the following example, if the firm is less viable, consumers place less value on the service agreements and warranties and are more likely to turn to a competitor.

If the firm can convince potential consumers that the likelihood of financial distress has been reduced, the firm can increase consumers’ valuation of its service agreements and warranties. And this perceived increase in value will be reflected in
How Risk Management Can Increase the Value of the Firm

Illustration 4–2

The Impact of Financial Risk on Sales: The Case of Wang*

As reported in The Wall Street Journal, “The biggest challenge any marketer can face is selling the products of a company that is on the ropes.”

For purchasers of computers, manufacturers’ guarantees and warranties (both explicit and implicit) are extremely important. As the Journal put it, “Customers... want to be sure that their suppliers will be around to fix bugs and upgrade computers for years to come.” Not surprisingly, when Wang’s leverage got to the point that earnings volatility could put the firm into financial distress, sales turned down. A potential Wang customer put it best when she noted that “before the really bad news, we were looking at Wang fairly seriously [but] their present financial condition means that I’d have a hard time convincing the vice president in charge of purchasing. ... At some point we’d have to ask ‘How do we know that in three years you won’t be in Chapter 11?’”

*This illustration is from Bulkeley (1989).

Risk Management Can Add Value by Avoiding Investment Decision Errors

The M&M proposition implies that if hedging policy increases firm value, it does so by reducing contracting costs, by reducing taxes, or by controlling investment incentives. We now turn to this last general motive for corporate hedging—dysfunctional investment incentives.
Incentives to turn down positive net present value projects also can arise in firms that avoid bankruptcy. These incentives arise because of the conflict between the bondholders and the shareholders resulting from differences in the kind of claims each hold. Bondholders hold fixed claims, while shareholders hold claims that are equivalent to a call option on the value of the firm. The conflict results in a constraint on the debt capacity of the firm (or in the firm's having to pay a higher coupon on its debt).

The severity of the conflict between the shareholders and bondholders is determined primarily by the debt-equity ratio. As debt level in the capital structure rises, the conflict becomes more significant. But other factors, such as the range of investment projects available to the firm, also affect the severity of the bondholder-shareholder conflict. As with any other option, the value of shareholders' equity rises as the variance in the returns to the underlying asset increases. If shareholders switch from low-variance investment projects to high-variance projects, they could transfer wealth from the bondholders to themselves.

Basically, bondholders, or rather, potential bondholders, are concerned about the probability that they will be left holding the bag, that the value of the firm's assets will be insufficient to cover the promised payments in the indenture. In addition to concerns about future market conditions, potential bondholders are concerned about opportunistic behavior on the part of shareholders who might declare a liquidating dividend, burden the firm with extra debt, or select risky investments. Potential bondholders, however, recognize the possibility of opportunistic behavior and protect themselves by lowering the price they are willing to pay for the firm's bonds.

To convince potential bondholders to pay more for bonds, shareholders must assure them that wealth transfers will not occur. These assurances frequently have been given by attaching restrictive covenants to debt issues (restrictions on dividends and debt coverage ratios), issuing a mortgage bond (to preclude asset substitution), making the debt convertible (to align the interest of bondholders with those of the shareholders), and issuing preferred stock instead of debt (to reduce the probability that future market conditions will lead to default).

The shareholder-bondholder conflict can also be reduced through risk management. Figure 4–2 shows that risk management reduces the probability of default, so potential bondholders will be willing to pay more for the bond. Hence, risk management can increase the debt capacity of the firm. Likewise, risk management can decrease the coupon the firm will have to pay on its debt.

In addition to increasing the financing cost for investment projects undertaken, volatility in the firm's earnings can even cause the firm to pass up positive net-present-value projects. Textbook "underinvestment" occurs when the firm is highly levered and the value of the firm's assets is volatile: shareholders may opt not to undertake a positive NPV project because the gains accrue to the bondholders. Perhaps the simplest way to understand this rather complex theoretical argument is with an example.
The Impact of Volatility on Debt Capacity*

As *Corporate Finance* reported, a number of firms realize that "hedging techniques can stabilize a company's net worth and keep it from tripping into technical default ..." and by doing so, the firm can increase its debt capacity. As a case in point, "Kaiser has effectively increased its debt-carrying capacity by removing volatility from its cost and revenue stream. . . ."

*This illustration is based on "Kaiser and Union Carbide Hedge Their Bets With Their Banks," which appeared in the June 1991 issue of *Corporate Finance.*

Cutting Rate Risk on Buyout Debt: Reducing Shareholder-Debtholder Conflict on the RJR Nabisco Deal*

When Kohlberg, Kravis, Roberts and Co. got ready to issue the senior bank debt for the RJR Nabisco deal, they ran into the shareholder–debtholder conflict head-on. But by using risk management, they were able to reduce the conflict and increase their debt capacity.

The market was concerned about the interest rate risk such a large amount of debt would entail. If the debt carried a floating-rate coupon, and if rates rose substantially, the probability of default would rise dramatically. Therefore, to reduce the shareholder–debtholder conflict, KKR was required to purchase interest-rate insurance. As the vice chairman of Chase Manhattan explained, before committing any money to finance a corporate takeover, Chase insists that steps be taken to reduce the interest rate risk.

Consequently, KKR agreed to keep interest rate protection (in the form of swaps or caps) on half the outstanding balance of its bank debt. In this way, KKR was able to borrow $13 billion. Without the rate insurance, the amount the banks would have been willing to lend would have been substantially less.

*Based on Quint (1989).
Controlling Underinvestment with Hedging*

Let's consider a 100 percent equity firm whose value is positively related to oil prices—a small oil producer, for example. The value of the firm in the initial period, Period 1, will be higher if oil prices are high than if they are low. For simplicity, let's suppose that there are only two outcomes, each with a 50 percent probability.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Probability</th>
<th>Value of Firm in Period 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price of oil high</td>
<td>.5</td>
<td>1000</td>
</tr>
<tr>
<td>Price of oil low</td>
<td>.5</td>
<td>200</td>
</tr>
</tbody>
</table>

While this initial value belongs completely to the shareholders—our simple firm begins as all equity—suppose that the shareholders plan to issue, in Period 1, bonds with face value of $500. All the proceeds of the debt issue will be passed directly to the shareholders.

Now suppose that the shareholders of the firm are presented with a riskless investment opportunity: if the shareholders make an outlay of $600 in Period 1 (before the issue of the debt), the investment project will result in an income to the firm of $800 in Period 2 with certainty. Logic would suggest that shareholders will always accept a riskless opportunity with a return above the riskless rate, but that's not necessarily how it will work.

As shown in Table 4–1, if the price of oil is low, the shareholders of this firm will pass up this positive NPV project. In other words, if the value of the firm in Period 1 is $200, the shareholders will not undertake the riskless investment project.

The reason for this surprising result is that the volatility in the value of the firm, coupled with a large debt-equity ratio, could transfer wealth from the shareholders to the bondholders if the shareholders elect to undertake the positive NPV project.

The total value of the shareholders' wealth position is the sum of their equity value in the firm at Period 2 plus the monies they receive from the debt issue. Note that while the face value of the debt is $500, the market value of the debt—what the potential bondholders will actually pay the shareholders for the debt—is equal to the expected value of the debt,

\[ \frac{1}{2}(\$500) + \frac{1}{2}(\$200) = \$350. \]

The expected value of the shareholder's equity in the firm is \( \frac{1}{2}(\$700) + \frac{1}{2}(0) = \$350 \); the total value of the shareholders' holdings—the value of shareholders' equity in the firm plus the monies they received from the debt issue, is $350 + $350 = $700.

Now let's look at the impact of risk management on this situation. Suppose the shareholders of the firm hedged its exposure to the price of oil by entering into a simplified commodity swap agreement:

Price of oil high: This firm pays $400.
Price of oil low: This firm receives $400.

Now the value of the firm is hedged against oil price fluctuations. No matter what happens to oil prices, the value of the firm is $600.

As Table 4–2 indicates, with the value of the firm hedged against oil price fluctuations, the positive NPV project will always be undertaken.
### Table 4-1

<table>
<thead>
<tr>
<th>Value of Firm</th>
<th>Value of Firm</th>
<th>Value of Debt</th>
<th>Value of Equity</th>
<th>Will the Positive NPV Project Be Undertaken?</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undertake project</td>
<td>$1200</td>
<td>$500</td>
<td>$700</td>
<td>Yes</td>
</tr>
<tr>
<td>Do not undertake project</td>
<td>1000</td>
<td>500</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>$200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undertake project</td>
<td>400*</td>
<td>500*</td>
<td>-100*</td>
<td></td>
</tr>
<tr>
<td>Do not undertake project</td>
<td>200</td>
<td>200</td>
<td>0</td>
<td>No</td>
</tr>
</tbody>
</table>

*If the firm is worth only $200 initially, the shareholders would have to put up another $400 to get the $600 necessary to invest in the riskless project. In Period 2, the firm’s treasury would contain the $800 proceeds from the investment project; but, $400 of these dollars would be earmarked for return to the shareholders.

†Even though the firm would be worth only $400, the treasury would contain the $800 proceeds from the investment (see * note above). Since the bondholders would have the senior claim, they can take the full $500 face value of the bond from the treasury.

‡The treasury would “owe” $400 to the shareholders (see * note above); but, after the bondholders took their $500 from the treasury, only $300 is left.

### Table 4-2

<table>
<thead>
<tr>
<th>Value of Firm</th>
<th>Value of Firm</th>
<th>Value of Debt</th>
<th>Value of Equity</th>
<th>Will the Positive NPV Project Be Undertaken?</th>
</tr>
</thead>
<tbody>
<tr>
<td>$600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undertake project</td>
<td>$800</td>
<td>$500</td>
<td>$300</td>
<td>Yes</td>
</tr>
<tr>
<td>Do not undertake project</td>
<td>600</td>
<td>500</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
With the hedge against oil prices, the total value of the shareholders’ wealth is $500 (the proceeds of the debt issue), plus $300 (the value of their equity at Period 2) to give them a total of $800. By hedging, the shareholders would increase the value of their wealth by $100.

*This illustration is based on Mayers and Smith (1987).

†For tractability, we have created this example with no transactions costs and no taxes and a risk-free interest rate equal to zero. These simplifying assumptions in no way influence the qualitative outcome of the example; but they make the exposition immensely more simple.

An instance in which risk management can avoid this type of underinvestment problem occurs in the long-term debt market. As we have noted, if a firm issues long-term debt, its shareholders have the incentive to pass up positive net-present-value projects or to shift from low-risk to high-risk projects. Recognizing this incentive, bondholders demand a large premium on long-term debt. However, this “opportunistic-behavior premium” is lower for firms with higher bond ratings, presumably because higher-rated firms have established reputations. Lower-rated firms can avoid this premium by issuing short-term debt. But short-term debt could expose the firm to interest rate risk. If, however, the firm issues short-term debt and then swaps the debt into a fixed-rate, the lower-rated firm can control the agency problem while avoiding interest rate risk.†

Illustration 4–6

The Impact of Earnings Volatility on Investment: The Case of Merck*

Since Merck’s earnings are denominated in U.S. dollars, its pretax income fluctuates with the value of the dollar. If the dollar is weak, the dollar value of net income received from foreign operations will be high; if the dollar is strong, Merck’s dollar income will be low. Looking at its behavior in the past, Merck discovered that this volatility in earnings had impacted its investment decision. When the dollar was strong and pretax income was low, Merck had cut back the rate of growth of R&D spending.

*This illustration is based on Lewent and Kearney (1990).
But even without excessive leverage, volatility in earnings can lead to a form of underinvestment.

Since there is a well-established relation between R&D activity and value for pharmaceutical firms, there was a clear reason Merck would want to manage its foreign exchange risk. However, this form of the underinvestment problem is one that a number of firms have encountered. And if risk management permits the firm to undertake positive NPV projects that would otherwise be deferred, its net cash flows will necessarily rise.

Notes

1. The original M&M proposition focused on the firm’s debt/equity ratio [Modigliani and Miller (1958)]. The rationale is that, because (under their assumptions) leverage by an individual is a perfect substitute for corporate leverage, an investor will not pay the firm for corporate leverage. The M&M proposition was extended to dividends in Modigliani and Miller (1961), with the argument that “homemade” dividends can be created as the investor sells the firm’s stock.

2. Indeed, the mathematical paradigm that makes this happens even has a name: Jensen’s Inequality.

3. A substantial body of evidence demonstrates that tax preference items will result in the effective tax function being convex. For example, see Siegfried (1974), Zimmerman (1983), and Wilkie (1988).

4. The work of Jerry Warner suggests that the direct costs of bankruptcy are small in relation to the value of the firm (Warner 1977b). However, his evidence suggests that there are scale economies in this cost function, so avoiding these costs is potentially more important for smaller firms.

5. This conflict has been discussed under the rubric of agency problems. The agency problem refers to the conflicts of interest that occur in virtually all cooperative activities among self-interested individuals. The agency problem was introduced by Jensen and Meckling (1976).

6. The problem referred to as asset substitution is a case in point. A firm can increase the wealth of its shareholders at the expense of its bondholders by issuing debt with the promise of investing in low-risk projects and then investing the proceeds in high-risk projects.
