"Creating Value with Risk Management"

Chapter 3 of

Risk Management and Derivatives

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Chapter 3

Creating Value with Risk Management

Chapter 3 Objectives

At the end of this chapter, you will:

1. Understand when risk management creates value for firms.
2. Know which types of risks a corporation should hedge to create value.
3. Be able to evaluate how much value risk management can create in a corporation.

Mr. Smith is the CFO of Software Inc. He has worked hard to keep up with new developments in finance. He recently attended an advanced executive development program where much time was spent discussing the Modigliani and Miller propositions. Understanding that shareholders can hedge on their own account, he has paid scant attention to risk management. However, looking at his firm's situation, he discovers that it will not be able to make use of a valuable tax shield arising from past losses because exchange rate losses have unexpectedly reduced his firm's net income. The tax shield will be gone forever after this year. Yet, had the firm been profitable this year, the tax shield would have allowed the corporation to reduce its tax bill by $50 million. He realizes that if he had been able to hedge his income against exchange rate fluctuations, Software Inc. would have been richer by $50 million. Instead, because he had not hedged, $50 million of shareholder wealth walked out the door. In this chapter, we show that there are many reasons to hedge.

A risk management program cannot increase firm value when it costs the same to bear a risk within the firm or outside the firm. We established this result, called *the risk management irrelevance proposition*, in Chapter 2. The irrelevance proposition holds when financial markets are perfect. If the proposition holds, any risk management program that a firm puts in place can be replicated by any investor through "homemade" risk management. The risk management irrelevance proposition is useful because it allows us to find out when homemade risk management is not equivalent to risk management by the firm. This is the case whenever risk management by a firm affects firm value in a way that investors cannot mimic. In this chapter, we identify situations where there is a wedge between the cost of bearing a risk within the firm and the cost of bearing it outside the firm. Such a wedge requires the presence of financial markets imperfections (perfect markets have no frictions—no transactions costs, no taxes, perfect competition, no costs of writing contracts).

Chapter 2 uses the example of a gold-producing firm. We continue that example here. Pure Gold Inc. is exposed to gold price risk. It can bear that risk within the firm. This means the firm has lower income if the price of gold is unexpectedly low and higher income if it is unexpectedly high. If the irrelevance proposition holds, the only cost of bearing this risk within the firm is that shares are worth less if gold price risk is systematic risk, because in this case shareholders require a risk premium to compensate them for gold price risk. Similarly, the only cost to the firm of having gold price risk borne outside the firm is that the firm has to pay a risk premium to induce the capital markets to take that risk. The risk premium the capital markets require is the same the shareholders require. Consequently, it makes no difference for firm value whether the gold price risk is borne by shareholders or by the capital markets, which is what the risk management irrelevance proposition states.

For risk management to increase firm value, it must be more expensive to take a risk within the firm than to pay the capital markets to take it. For Pure Gold, risk management creates value if an unexpectedly low gold price entails costs for the firm that it would not have for the capital markets. Suppose that with an unexpectedly low gold price, the firm does not have funds to invest, and hence has to give up valuable projects because it would be expensive for the current

shareholders to raise funds in the capital markets with such a low gold price. Thus, shareholders not only lose income now with unexpected low gold prices, but they also lose future income because the firm cannot take advantage of investment opportunities. Pure Gold bears an extra, indirect, cost or burden from the low gold prices. Indirect costs resulting from financial losses are called **deadweight costs**.

To understand deadweight costs, suppose you asked yourself how Pure Gold could be put back in the situation it would have been in had gold prices not been low. If all it takes is to make up the loss Pure Gold experienced on its sales of gold, then there are no deadweight costs—no additional losses caused by the low gold prices. However, if, in addition, Pure Gold has to be compensated for profits it did not earn because of investments it could not make, there are deadweight costs.

The reason risk management creates value for Pure Gold if there are deadweight costs associated with gold price risk is that risk management reduces or eliminates deadweight costs. If the gold price risk is borne by the capital markets, Pure Gold does not incur additional costs resulting from low gold prices since it makes no losses from low gold prices. In this case, the cost of putting the gold price risk off on the capital markets is less than the cost the firm will pay if it bears the risk within the firm and sacrifices future opportunities by not being able to invest when the gold price is low.

In this chapter, we investigate how a firm can use risk management to increase firm value. We discuss the reasons why a firm might find it more expensive to bear a risk within the firm than pay the capital markets to bear that risk. We thus show the sources of the benefits of risk management.

In the previous chapter, we gave the example of Homestake as a gold mining firm that had a policy of not hedging its gold price exposure. As you saw, management based its policy on the belief that Homestake's shareholders value gold price exposure. We showed that this belief is wrong because investors can get gold price exposure without Homestake on terms at least as good as those that Homestake offers, and most likely better. So, is Hometake's value lower than it would have been with hedging? Throughout this chapter, for each source of value of hedging we document, we investigate whether this source of value applies to Homestake.

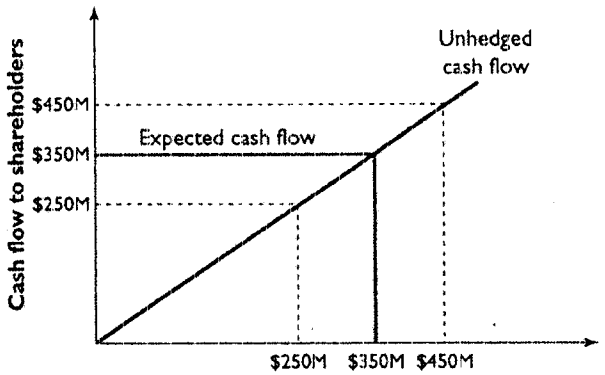
In the next chapter, we integrate these various sources of gain from risk management to build an integrated risk management strategy.

3.1. Bankruptcy costs and costs of financial distress

In our analysis of the value of risk management in Chapter 2, we take the distribution of Pure Gold's cash flow before hedging (the cash flow from operations) as a given. We assume that it sells one million ounces of gold at the end of the year and then liquidates. Pure Gold has no debt. The gold price is assumed to be normally distributed with a mean of $350 per ounce. There are no operating costs for simplicity. All the cash flow accrues to the firm's shareholders. This situation is represented by the straight line in Figure 3.1, where cash flow to

Figure 3.1 Cash flow to shareholders and operating cash flow

The firm sells one million ounces of gold at the end of the year and liquidates. There are no costs. The expected gold price is $350.



Pure Gold is on the horizontal axis and cash flow to the holders of financial claims against it is on the vertical axis. In this case, the only claimholders are the shareholders. In perfect financial markets, all cash flows to the firm accrue to the firm's claimholders, so there is no gain from risk management.

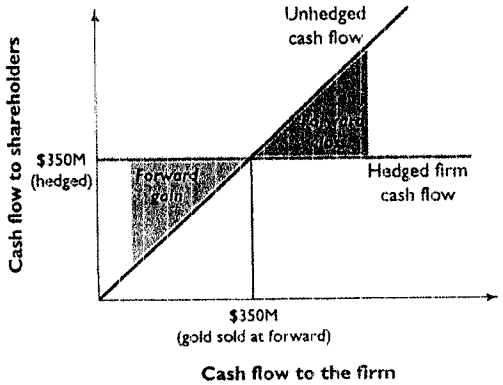
At the end of the year, Pure Gold distributes the cash flow to its owners, the shareholders, and liquidates. If the firm hedges by selling its production at the forward price, the shareholders get the proceeds from selling the firm's gold production at the forward price. Suppose the forward price is $350. If the gold price turns out to be $450, for example, the hedged firm receives $350 per ounce by delivering on the forward contract, while the unhedged firm would receive $450 per ounce.

The shareholders, however, can obtain for themselves the payoff of the unhedged firm when the firm is hedged and vice versa. This is shown in Figure 3.2. An investor who owns the hedged firm and takes a long forward position on personal account receives $350 per ounce of gold from the hedged firm plus ($450 – $350) per ounce from the forward contract, for a total payoff of $450 per ounce, which is the payoff per ounce for the unhedged firm. Hence, even though the firm is hedged, investors can create for themselves the payoff of the unhedged firm.

Now, suppose Pure Gold has some debt. We still assume that markets are perfect, that the distribution of the cash flow from operations is given, and that there are no taxes. At the end of the year, the cash flow to the firm is used first to pay off the debtholders, and then shareholders receive what is left over. The firm's claimholders still receive all of the firm's cash flow, and the firm's cash flow is not changed by leverage, but there are now two groups of claimholders, debtholders

Creating the unhedged firm out of the hedged firm *Figure 3.2*

The firm produces one million ounces of gold. It can hedge by selling one million ounces of gold forward. The expected gold price and the forward price are $350 per ounce. If the firm hedges and shareholders do not want the firm to hedge, they can recreate the unhedged firm by taking a long position forward in one million ounces of gold.



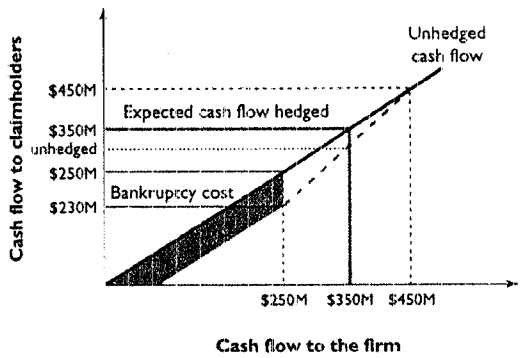
and shareholders. Leverage does not affect firm value. It simply specifies how the pie—the firm's operating cash flow—is divided among its claimants—the debtholders and the shareholders. Since the cash flow to claimholders is the firm's entire cash flow, risk management does not affect firm value.

In the real world, it is costly for firms to file for bankruptcy and renegotiate debt. Firms have to hire lawyers, incur court costs, and need to pay for all sorts of financial advice. Costs incurred as a result of a bankruptcy filing are called **bankruptcy costs**. The present value of future bankruptcy costs reduces the value of a firm that has debt relative to one that does not. While there are benefits to leverage, for the time being we ignore them. As shown in Figure 3.3, these bankruptcy costs create a "wedge" between cash flow to the firm and cash flow to the firm's claimholders. This wedge corresponds to the bankruptcy costs incurred by the owners.

The extent to which bankruptcy costs affect firm value depends on their extent and on the probability that the firm will have to file for bankruptcy. The probability that a firm will be bankrupt is the probability that it will not have enough cash flow to repay the debt. We know how to compute this probability for a normally distributed cash flow. Figure 3.4 shows how the distribution of cash flow from operations affects the probability of bankruptcy. If Pure Gold hedges its risk completely, it reduces its cash flow volatility to zero because the claimholders receive the present value of gold sold at the forward price. In this case, the probability of bankruptcy is zero and the present value of bankruptcy costs is also zero. As cash flow volatility increases, the present value of bankruptcy costs increases because bankruptcy becomes more likely. This means that the present value of cash flow to Pure Gold's claimholders falls as cash flow volatility increases.

Figure 3.3 Cash flow to claimholders and bankruptcy costs

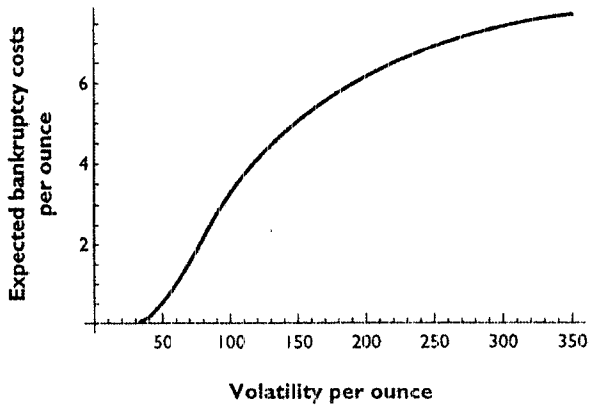
The firm sells one million ounces of gold at the end of the year and liquidates. There are no transactions costs. The expected gold price is $350. Bankruptcy costs are $20 million if cash flow to the firm is $250 million. Suppose that the firm can have a cash flow of $250 million with probability p or a cash flow of $450 million with probability 1 - p. Expected cash flow of the unhedged firm is given by the equation p x $230M + $(1 - p)$ x $450M and is plotted by the dotted line. The case where the forward price of gold is $350 and equal to expected gold price corresponds to p = 0.5. With this case, expected cash flow of the hedged firm is $350 million and expected cash flow of the unhedged firm is $340 million.



Therefore, by hedging, Pure Gold increases its value; that is, it does not have to pay bankruptcy costs, and hence its claimholders get all of the firm's cash flow. In this case, homemade risk management by the firm's claimholders is not a substitute for the firm's risk management. If the firm does not reduce its risk, its value

Figure 3.4 Expected bankruptcy costs as a function of volatility

The firm procuces one million ounces of gold and then liquidates. It is bankrupt if the price of gold is below $250 per ounce. The bankruptcy costs are $20 per ounce. The gold price is distributed normally with expected value of $350. The volatility is in dollars per ounce.



is lower by the present value of bankruptcy costs. Homemade risk management can do nothing about this deadweight cost of low gold prices.

3.1.1. Bankruptcy costs and firm value

We can use the present value equation to show that risk management increases firm value when the only financial market imperfection is the presence of bankruptcy costs that affect firm value. We therefore assume that markets are perfect for hedging instruments traded in capital markets, so that hedging involves no transaction costs. Remember that in the absence of bankruptcy costs, the firm's claimholders receive the cash flow at the end of the year when the firm is liquidated. Under our new assumptions, the claimholders receive the cash flow only if the firm is not bankrupt. Denote this cash flow by C. If the firm is bankrupt, the claimholders receive C minus the bankruptcy costs. Consequently, the value of the firm is now:

$$\textbf{Value of firm} = \textbf{PV(C} - \textbf{Bankruptcy costs)}$$

We know from Chapter 2 that the present value of a sum of cash flows is the sum of the present values of the cash flows. Consequently, the value of the firm is equal to:

$$\begin{aligned}\textbf{Value of firm} &= \textbf{PV(C)} - \textbf{PV(Bankruptcy costs)}\\ &= \textbf{Value of firm without bankruptcy costs}\\ &\quad - \textbf{Present value of bankruptcy costs}\end{aligned}$$

Let's now consider the impact of risk management on firm value. If the hedge eliminates all risk, then the firm does not incur the bankruptcy costs. Hence, the cash flow to the firm's owner is what the cash flow would be in the absence of bankruptcy costs, which is C. This means that with such a hedge the claimholders get the present value of C rather than the present value of C minus the present value of bankruptcy costs. Assuming that no market imperfections affect the cost of hedging instruments, the gain from risk management is:

$$\begin{aligned}\textbf{Gain from risk management} &= \textbf{Value of firm hedged}\\ &\quad - \textbf{Value of firm unhedged}\\ &= \textbf{PV(Bankruptcy costs)}\end{aligned}$$

A simple example of the benefit of hedging is as follows. We assume that the interest rate is 5 percent and that gold price risk is unsystematic risk. The forward price is \$350. Because gold price risk is unsystematic risk, the forward price is equal to the expected gold price (from the analysis in Chapter 2). As before, Pure Gold produces one million ounces of gold. Consequently, $PV(C)$ is equal to \$350M/1.05, or \$333.33 million. The present value of the hedged firm is the same (this is because expected cash flow, $E(C)$, is equal to one million times the expected gold price, which is the forward price).

To get the present value of the bankruptcy costs, we must specify the debt payment and the distribution of the cash flow. Let's say that the bankruptcy costs are \$20 million, the face value of debt is \$250 million, the gold price is normally distributed, and its volatility is 20 percent. The firm is bankrupt if the gold price

falls below $250. The probability that the gold price will fall below $250 is 0.077 using the approach developed in Chapter 2. Consequently, the expected bankruptcy costs are 0.077 x $20M, or $1.54 million. By the use of risk management, Pure Gold ensures that it is never bankrupt, thus increasing its value by the present value of $1.54M. Since gold price risk is assumed to be unsystematic risk, we discount the expected bankruptcy costs at the risk-free rate of 5 percent to get a present value of bankruptcy costs of $1.47 million ($1.54M/1.05).

In the presence of bankruptcy costs, the risk management irrelevance theorem no longer holds. The cost to Pure Gold of bearing gold price risk is $1.47 million. Because we assume that gold price risk is diversifiable, the cost of having the capital markets bear this risk is zero. The capital markets therefore have a comparative advantage over the firm in bearing gold price risk.

Note that if gold price risk is systematic risk, capital markets will charge a risk premium for bearing the gold price risk—the same risk premium that shareholders charge in the absence of bankruptcy costs. Hence, the capital markets still have a comparative advantage for bearing risk; it is measured by the bankruptcy costs saved by having the capital markets bear the risk. There is nothing that shareholders can do on their own to avoid the impact of bankruptcy costs on Pure Gold's value, so homemade risk management cannot eliminate these costs.

3.1.2. Bankruptcy costs, financial distress costs, and the costs of risk management programs

A study of bankruptcy for 31 firms over the period from 1980 to 1986 by Weiss (1990) finds an average ratio of direct bankruptcy costs to total assets of 2.8 percent, with a high of 7 percent. Other researchers find similar estimates. Bankruptcy also entails large indirect costs. Managers spend much of their time dealing with the firm's bankruptcy proceedings instead of managing operations. Managers of a firm in bankruptcy lose control of some decisions. They might not be allowed to undertake costly new projects, for example.

Many of these indirect costs start accruing as soon as a firm's financial situation becomes unhealthy. The costs firms incur because of a poor financial situation are called **costs of financial distress**. Costs of financial distress can occur even if the firm never files for bankruptcy or never defaults. Managers have to think about finding ways to conserve cash to pay off debtholders. They might cut investment, which means the loss of future profits. Potential customers may become reluctant to deal with the firm, leading to losses in sales.

Our analysis of the benefits of risk management in reducing bankruptcy costs holds for all costs of financial distress also. Any time costs of financial distress divert cash flow away from the firm's claimholders, they reduce firm value. Reducing firm risk by minimizing the present value of costs of financial distress naturally increases firm value.

Reducing the costs of financial distress is one of the most important benefits of risk management. Consequently, we study in more detail how risk management can be used to reduce specific costs of financial distress in later sections in this chapter.

In the example, Pure Gold eliminates all of its bankruptcy costs through risk management. If managers identify other costs of financial distress that occur