Risk, Risk Management and Derivatives
Gary Mullins
Professor of Finance
Division of Business and Economics, UW SP

Introduction

Risk has been much in the news lately. The problems of Orange County, Barrings PLC, Wisconsin's State Investment Board, and Piper-Jaffray's Institutional Government Income Portfolio fund are just a few examples of the difficulties associated with risk especially risky derivatives. The most common complaint is, "We had no idea that our portfolio was so risky!" Upon further examination of news articles, it becomes clear that the people who had problems with risk in their portfolio should have asked some questions. Most importantly, what is risk? How does risk affect my investment? Also, how can an investor recognize risk in the portfolio?

There are some additional questions which investors should ask, but often do not. Is risk always a bad thing? Can risk be managed? Are derivatives inherently risky? Finally, should investors avoid derivatives entirely? I will address all of these questions, beginning with, "What is risk?"

Definition of Risk

Risk is the variability of the expected payoff, or return, of a financial investment. Notice that variability has an upside as well as a downside. That is, a risky investment may have a very high return on the upside, or it may have a highly negative return on the downside. In other words, if you invest in a risky asset, you may "make a killing," or "lose your shirt." When average investors think about risk, they usually think about the risk of losing their money, but they do not really understand the impact of risk on their investments.

Impact of Risk

Higher-risk investments have a higher average return than lower-risk investments. There are two reasons for this. The economic reasoning is that higher-risk investments must pay higher average returns to induce investors to purchase them. 1 A less understood reason is that the arithmetic associated with risky investments causes them to pay a higher return. The discussion for the second reason is rather technical, and is not covered here.

Because higher-risk investments have higher average returns, they are very attractive -provided things are going well. Obviously, when things are going well, few investors complain about risk. This means that looking at an investment's returns means nothing without first knowing the level of risk associated with the investment. Every year, the Wall Street Journal examines the performance of portfolios chosen by investment advisors versus a portfolio chosen by a random selection of stocks. In the article comparing portfolio performance, an important, but usually ignored consideration is the
risk of the different portfolios. Higher risk investments will, on the average, pay higher returns than lower risk investments. Understanding this makes risk easy to recognize.

**Recognizing Risk**

Risky assets typically have very high returns in some years, and very low returns in other years. On the upside, risk does not seem so terrible because of the high returns. However, investors complain bitterly about downside risk. Financial professionals call this higher average return a risk premium.

Generally, more extreme returns, either positive or negative, indicate higher levels of risk. Articles concerning recent disasters in the derivatives market describe derivatives with such adjectives as arcane, complex, esoteric, and difficult-to-understand. However, buried toward the back of the article will be an indication that investors often received very high returns in previous years. No one complains about the risk during these good years.

Because of these wide swings in returns, risk is usually very easy to recognize, even in good years. An investment that is paying a very high return compared to an obviously safe investment usually has a high degree of risk. For example, suppose Treasury Bills (usually considered to be risk-free) are paying 4%, and an investor receives 25% on a portfolio. The investor should recognize two things. First, the portfolio has a significant level of risk. Second, the portfolio could lose just as much, if not more, next year.

**Risk: An Example**

Suppose investor A owns a lawnmower manufacturing company, and investor B owns a snow blower manufacturing firm. Further suppose that both companies pay out 100% of their earnings in dividends. Investor A's payout peaks in the summer, while investor B's payout peaks during the winter. See figure 1 for the payout for both companies.

Assume both companies are identical in net worth and profits, and that A and B swap 50% ownership in each company. Then each investor's portfolio has a constant payout throughout the year. When lawnmowers are up, snow blowers are down and vice versa (see figure 2). The line through the center of the graph is the payout for each investor.

For Piper's Institutional Government Income Portfolio, 1983 returns were nearly 16%, at a time Treasury Bills were paying an annual return of between 3%-4%.

By swapping ownership, the owners have diversified their risk. Diversification occurs when an investor combines risky assets so that the risk for the entire portfolio is less than the risk of either asset alone. Diversification is the primary method of risk management. Although diversification is the great tool for risk management, investors cannot use diversification to eliminate all risk.
Diversifiable vs. Non-Diversifiable Risk
The equity swaps eliminated risk associated with the specific firms in our example (that is, *idiosyncratic* risk). This type of risk is diversifiable. Unfortunately financial theory states that investors do not receive compensation for holding risk that is diversifiable. This is one reason we do not typically see stocks fluctuating seasonally.

However, consider what happens to the investment if there is a recession (see figure 3). Profits from both snow blowers and lawnmowers would decline as homeowners make do with their old equipment. On the other hand, suppose the economy experiences a boom. Then profits from both companies would increase (see figure 4). Please note the portfolio payoff line does not run through the intersection points for the payoff for lawnmowers and snow blowers. This is correct because of the mathematical properties of two series.

The investors have still eliminated the risk associated with the individual firm. That is, the investors have diversified out the risk associated with their individual firms (idiosyncratic risk), but they have not eliminated the risk associated with the economy as a whole. Fluctuations in the economy (or system) cause this type of risk, called systematic risk. Investors cannot eliminate this type of risk by diversification.

Diversification can be one of the great advantages of investing in mutual funds rather than investing in individual stocks. However, to diversify their portfolios, investors should choose diversified mutual funds. For example, you may not diversify your portfolio by investing in a mutual fund that specializes in a given industry or geographical area.

Derivatives and Diversification

Derivatives are financial assets whose price depends on the price of other financial assets. In spite of all the sensationalism recently associated with derivatives, they have been around a long time. Options to buy (calls), options to sell (puts), selling stocks short, and commodities futures are all derivative investments. Properly used and understood, derivatives are a powerful tool for managing risk. Using derivatives to manage risk is like using a chain saw to cut down trees. The chain saw is more effective than a hand saw, but it is also more dangerous. To see this, let's return to our snow blower-lawnmower example.

Suppose that instead of swapping equity, the investor A decided to use derivatives. To do this, he could short another (or her own) lawnmower company. Shorting or selling short means that the investor promises to sell the stock for a given price at a future date. As a practical matter, it means that as the price of the stock increases, the value of the short sale decreases, and vice versa. Consequently, the value of investor A's short position decreases if the value of the lawnmower stock increases. Thus, investor A has diversified away her risk using derivatives instead of swapping equity (see figure 2).

On the other hand, suppose that investor A shorts investor B's stock. This approach explodes the risk - the positive as well as the negative returns. When lawnmowers are
up, so is the short position for snow blowers (see figure 5). When lawnmowers are
down, so is the short position for snow blowers. Why would an investor do such a thing?
Look at the payoff on the upside. This type of payoff is extremely attractive. Also, as we
saw before, few investors complain about risk on the upside.

Except for leverage or margin considerations, derivatives are no more or less risky than
the securities on which the derivatives’ prices are based. However, investors can use
them to reduce portfolio risk, or to increase returns by increasing risk. Investors who
seek higher returns by speculating in derivatives may incur sizable losses. This has
been a theoretical example. Next, let’s examine something that really happened.

What Happened to Orange County?

Robert L. Citron, Orange County’s treasurer, expected interest rates to decline in 1994,
and "bet" accordingly. As is typical in these stories, his investment strategies in previous
years had reaped a return of 9%, double that of California’s state fund. He achieved
these returns with highly levered investments in derivatives. In 1992 and 1993, betting
on interest rate declines proved extremely profitable. In fact, in 1993, Orange County’s
tax revenues were less than the revenues from Mr. Citron’s investment decisions.

In 1994, however, Mr. Citron was wrong.

He used derivatives, such as inverse floaters, levered with collateralized loans, which
would have paid a handsome return had interest rates declined. In 1994, the Fed
increased interest rates substantially, and Orange County paid the price. Mr. Citron’s
investments in derivatives were complex. The value of the portfolio would increase
substantially if interest rates declined, and fall if interest rates increased. I will use
long-term bonds to illustrate Mr. Citron’s problems. They have similar valuation
characteristics, and are easier to understand.

Assume investor A wished to purchase $100,000 of 10% long-term bonds with a 10year
maturity. To do this, suppose she used $25,000 of her own money and $75,000 from a
6-month, 12% per annum bank loan. Investor A can pay the interest with the bond
interest payment, and can roll over the loan. If, in the next 6 months, interest rates
decline to 9%, the bonds are now worth $106,297 plus $500 interest differential
between the bond’s Interest and the loan’s interest. Investor A rolls over the loan (again
the bonds will pay the interest), and now borrows $74,500 at 11 °.6 per annum. If, in the
next 6 months, interest rates decline to 8%, the bonds are worth $112,659 plus
$902 interest. This is a gain of $14,082 on investor A’s original investment of $25,000.
This represents an annualized return on investment in excess of 58%. Two good things
have happened: the value of A’s bond holdings has increased, and the bank’s interest
rate has declined. If Interest rates rise, the story is different.

Suppose investor A’s initial position is the same, but interest rates increase to 11 %.
The bonds are now worth $94,198, plus $500 interest differential. Now, investor A
borrows $74,500 at 13%. If interest rates rise to 12%, then the bonds are worth $88,842
plus interest of $158. This yields a dollar loss of $9,756 - a loss of more than 19% on the original $25,000.

An investor might reasonably make this Investment because the downside risk is so much less than the upside risk. However, there are two problems. First, the upside risk is almost always greater than the downside risk. Risky investments are more valuable than non-risky investments precisely for this reason. Also, if interest rates increase one more point, the investor can no longer meet the interest payments. Consequently, investor A must liquidate the portfolio, and realize a loss of more than 40%. If A had used derivatives to eliminate her risk, things would have been different.

If A had sold treasury futures, each dollar change in her bond holdings would be exactly equal to the dollar change in the futures position. Thus, the portfolio value would still be $100,000, and the investment would pay a steady 10% from the bond's interest.

**Conclusion**

In this article, I have reviewed some basic concepts about risk, risk management, and derivatives. Derivatives themselves may be arcane, esoteric, or hard-to-understand, and brokers may use names that hide the nature of the investment, or may mislead investors concerning the composition of a mutual fund. In spite of these difficulties, investors should be able to use the concepts discussed above to identify risk in their portfolios, and make more intelligent investment decisions.