

Managing the Risk of Fixed Assets

Mark Garman, founder and president of [Financial Engineering Associates](#), reveals derivatives masquerading as fixed assets.



Start looking at your fixed assets as derivatives, and you may realize that you could be sitting on a gold mine—literally.

Enterprise-wide risk management means precisely that: evaluating and managing risk for the entire enterprise. People are used to analyzing the market risk of their trading book, but they are not used to looking at other parts of the enterprise in the same fashion. If you're typical, you probably assign those fixed assets to a rock-bottom priority slot.

So how do you bring fixed assets into the risk management realm? Treat them as if they were derivatives. Let's take that gold mine as a first example. Naturally there will be difficulties with any noneconomic perspective, such as viewing the mine as a hole in the ground with workers milling around. But we soon discover that there are also severe problems with the traditional economic analyses, regarding both risk analysis and return analysis.

Let's examine the return analysis first. Suppose you own a gold mine where the production cost is high, say about \$300 an ounce. Now suppose also that gold is currently trading at \$300 an ounce, and all the forward prices from here to forever are also \$300 an ounce. You do a net-present-value (NPV) analysis of this mine and find that you can extract this gold for \$300 an ounce,

and then sell it for \$300 an ounce, so you get nothing, forever. Your NPV—well, that's exactly zero.

That's the traditional return analysis without derivatives. But if you add derivatives to it, you get an entirely different view of the gold mine. Instead, you view the gold mine as the option to extract gold from the ground, by paying the strike price of the production cost. In fact, it's not just one option, but instead a time sequence of these, or strip of options. So every month you can decide whether to extract gold or not, in which case you pay the strike price of \$300 to produce each ounce of gold, and then you sell your gold at the market price. But the market price might change, and that's essentially what gives an option its value. The price might go down, but it might go up as well. So because of the volatility of the gold price, that option to take gold out of the ground could be quite valuable. The same gold mine that registered an NPV of zero might actually be worth millions of dollars because of its option value.

Now that we've tackled the return side of the gold mine, let's look at the risk side. The risk side is that you have implicit market exposures to the price of gold, by virtue of owning the mine. Viewing the mine as a strip of gold options, however, you can now do a precise option delta calculation to determine exactly what those exposures are. The op-

tion deltas report the size of your exposures to the price of gold for all months in the future, and therefore can be used for precision value-at-risk calculations.

You can easily tell that the option analysis has improved the analysis—if you owned that gold mine, would you sell it to me for its NPV—that is, zero? Probably not. So the fact that the option valuation depends on the volatility of gold is an important feature of this viewpoint. From the risk management perspective, the calculation of the deltas arising from the strip of options is another important step in managing the price risk of the gold in the mine, and this delta gold risk can then be easily incorporated into the enterprise risk management process.

Swing options

Another step up in sophistication for our derivatives viewpoint arises from considering the following issue: Suppose you exercised every option in your strip of options representing the gold mine, and as a result, you extracted more gold than was actually in the mine in the first place? To avoid this, we need to recognize that all of the options in the strip are interconnected, by virtue of the limited gold reserves in the mine. So there's a sense in which those options might be interlocking: If you exercise some of them, you might not be able to exercise others. Further, there might also be physical limits that dictate the maximum and minimum gold production rate each month.

Fortunately, there's an option type that deals with both issues—it's called a swing option. Essentially it is a strip of options as before, but with additional constraints on both overall amounts and periodic amounts. The swing option is common within the natural gas industry. In natural gas, I might agree to buy a certain amount of natural gas from you each day, but when the weather turns, I can demand more gas, a feature known as swinging up. Or I can

swing down to a lower amount when the weather is favorable. Overall, the contract requires me to buy a certain total amount of natural gas. Thus, a more sophisticated analysis is to treat the gold mine as a swing option. We can swing up to the monthly maximum production rate, we can swing down to a minimum rate (maybe zero), and the overall constraint is that we can't produce more than the total reserves of the mine.

Cogeneration assets

Now that we understand the simple gold mine example, let's take a look at power. The American power industry is undergoing substantial changes with deregulation, and there is a lot of turnover in power generation assets, or "cogenerators." A number of utilities have purchased power from cogeneration plants, which are typically owned by third parties. Ignoring the fact that many utilities have agreed to long-term purchases of cogeneration power at high historical prices (which the derivatives viewpoint would label an underwater forward contract), let's apply the derivatives notion to the cogeneration facility itself.

For example, suppose that generation facility produces power, but it runs on either natural gas or coal. The operator gets to choose which fuel is used, based on the relative prices of coal or natural gas. From a derivatives perspective, the operator has the option to transform the cheaper of the two commodities--coal or gas--into power. In derivatives parlance, the cogeneration facility is then nothing more than a strip of rainbow options, since such choices can be repeatedly made during the facility's useful life. From a risk management point of view, the operator has exposures to all three commodities. He will be short coal and natural gas (because he needs those to fire his generators), and he will be long power (because he owns the generator). But his exposure to power, as shown by the power option delta, wouldn't be 100

percent of the output of the plant necessarily, since he can decide not to run the plant. In a similar vein, the exposures (option deltas) of the coal and gas exposures will vary according to the relative prices of those commodities.

Doing valuation and VAR Calculations

The goal of treating fixed assets as derivatives is to produce certain decision-relevant information, such as a valuation num-

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ber or a value-at-risk number. But the acid test of proper derivatives thinking is the nature of the input data you use. Valuation, as done via derivative theory, will typically depend on the volatilities. In the cogeneration case, it will also depend on the correlations between the gas, coal and power prices. The same is true for a VAR analysis. If you're not using volatility and correlation information on the market factors affecting your fixed assets, you simply can't produce correct VAR results.

The downside of ignoring the derivatives approach has been demonstrated nowhere more dramatically than in the U.S. power market, where many utilities have attempted to purchase cogeneration plants, only to find that savvy competitors outbid them. In such cases, those competitors had a better grasp of the derivatives viewpoint, and the losing utilities had instead relied on traditional NPV analysis. In fact, because of the volatility and correlation information, a cogenerator purchase

typically departs from the traditional analyses by providing both an increase in valuation and a decrease of VAR.

Your company as a Derivative

You can also view the entire enterprise as a derivative. The idea here is that if all of the pieces, such as the fixed assets, of the company are essentially derivatives, then perhaps the enterprise as a whole can be thought of as a derivative. But what's a derivative? A derivative is something whose value responds to changes in market factors, and indeed companies do that. In fact, one perspective on the role of corporate risk managers is that they should create the situation where their companies have a derivative response, or delta, of zero with respect to all market factors. In this light, the option hedger and the risk manager are performing essentially the same activities.

For example, consider the case of an international oil company, which, of course, is exposed to international oil prices. But it's likely that they are exposed also to all of the foreign exchange prices in the countries where they do business. Such prices represent the fundamental economic market factors that drive the P/L of the company, and it's reasonable to view the company value as a derivative of the same. The company's oil wells can be viewed as options to extract oil, with the strike price being the variable cost of well production. Their risk managers can produce the cash flow maps used in modern VAR analysis (which are nothing more than the amounts and timings of oil and foreign exchange deliveries), perhaps with some extended effort. But to complete the derivatives analysis that yields valuation and VAR, they need the crucial volatility and correlation data.

Does your company have a derivatives perspective on its fixed assets? Is volatility and correlation information entering your analyses of valuation and risk? If not, you could be missing out on results that are important to your decisions. ■