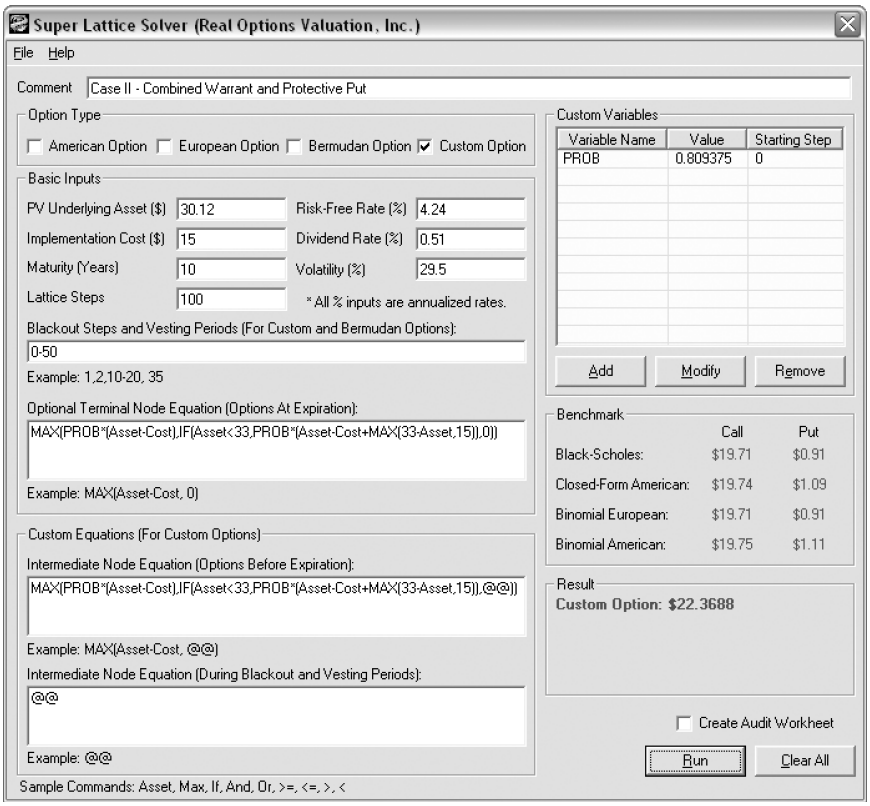

FIGURE 11.9 Combined Warrant with Protective Put at Grant Date

tion (with vesting requirements). To summarize, the analysis cannot be completed without the use of the Single Asset SLS software, and even when solving such complicated instruments, the pricing is relatively straightforward when using the software.

CASE 3: PHARMACEUTICAL DEVELOPMENT—VALUE OF PERFECT INFORMATION AND OPTIMAL TRIGGER VALUES

Suppose BioGen, a large multibillion dollar pharmaceutical firm is thinking of developing a new type of insulin that can be inhaled and the drug will directly be absorbed into the blood stream. This is indeed a novel and honorable idea. Imagine what this means to diabetics who no longer need painful and frequent

injections. The problem is that this new type of insulin requires a brand new development effort but if the uncertainties of the market, competition, drug development, and FDA approval are high, perhaps a base insulin drug that can be ingested should first be developed. The ingestible version is a required precursor to the inhaled version. BioGen can decide to either take the risk and fast-track development into the inhaled version or buy an option to defer, to first wait and see if the ingestible version works. If this precursor works, then the firm has the option to expand into the inhaled version. How much should the firm be willing to spend on performing additional tests on the precursor and under what circumstances should the inhaled version be implemented directly?

Suppose that BioGen needs to spend $100M on developing the inhaled version and if successful, the expected NPV is $24M (i.e., $124M PV Asset less the $100M PV development cost). The probability of technical success, market prices, revenues, and operating expenses are all simulated in the discounted cash flow model and the resulting cash flow stream has a volatility of 22 percent. In contrast, if BioGen first develops the ingestible version, it will cost $10M and take an entire year to develop, forcing the later phase development of the inhaled version to start one year later. Because this inhaled version uses similar precursors, the development cost is only $95M and not $100M. However, by being one year late to market, the PV Asset of doing an ingestible version before attempting the inhaled version will reduce to $120M. This means that the ingestible–inhaled strategy will yield an NPV of $15M. Figure 11.10 shows these two competing strategies.

Clearly, under an NPV analysis, the best approach is to pursue the inhaled version directly. However, when a real options analysis is performed by applying a two-phased sequential compound option, the total strategic value is

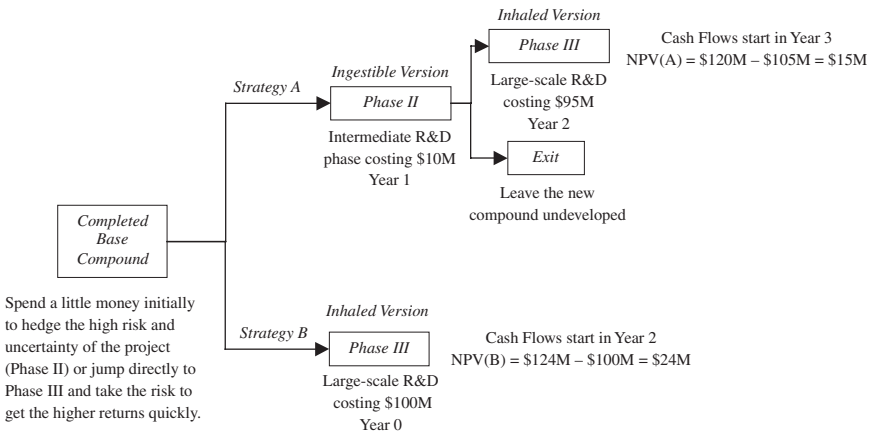

FIGURE 11.10 Strategy Tree for Pharmaceutical Development

found to be $27.24M as seen in Figure 11.11. The strategic option value of being able to defer investments and to wait and see until more information becomes available and uncertainties become resolved is worth $12.24M because the NPV is worth $15M ($120M – $10M – $95M). In other words, the *expected value of perfect information* is worth $12.24M, which indicates that the intermediate phase of developing an ingestible precursor can be used to obtain credible information to decide if further development is possible. The maximum the firm should be willing to spend in the ingestible intermediate phase is on average no more than $22.24M (i.e., $12.24M + $10M). If the cost to obtain the credible information exceeds this value, then it is optimal to take the risk and execute the entire project immediately at $100M or Strategy B. To follow along, open the MSLS file: *Solution to Chapter 11—Case III Strategy A* from the accompanying CD.

In contrast, if the volatility decreases (uncertainty and risk are lower), the strategic option value decreases. In addition, when the cost of waiting (as described by the *Dividend Rate* as a percentage of the *Asset Value*) increases, it is better not to defer and wait that long. Therefore, the higher the dividend rate, the lower the strategic option value. For instance, at a 17.20 percent dividend rate and 22 percent volatility, the resulting value reverts to the NPV of $15M (Figure 11.12), which means that the option value is zero, and that it is better to execute immediately as the cost of waiting far outstrips the value of being able to wait given the level of volatility (uncertainty and risk). Finally,

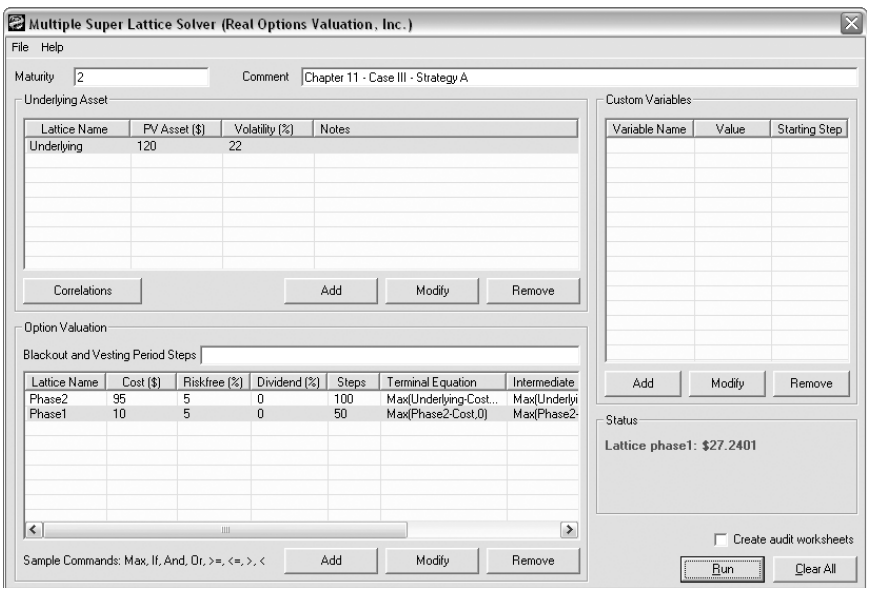

FIGURE 11.11 Value of Strategy A

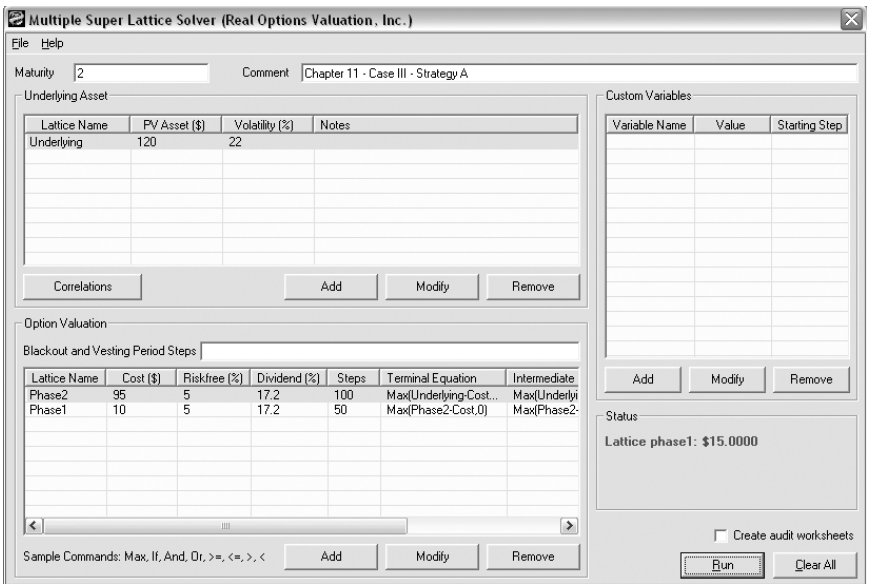

FIGURE 11.12 Sequential Compound Option's Break-Even Point

if risks and uncertainty increase significantly even with a high cost of waiting (e.g., 17.20 percent dividend rate at 30 percent volatility), it is still valuable to wait.

This model provides the decision maker with a view into the optimal balancing between *waiting for more information* (expected value of perfect information) and the *cost of waiting*. You can analyze this balance by creating strategic *options to defer* investments through development stages where at every stage the project is reevaluated as to whether it is beneficial to proceed to the next phase. You can vary the volatility and dividend inputs to determine their interactions—specifically, where the break-even points are for different combinations of volatilities and dividends. Thus, using this information, firms can make better go or no-go decisions (for instance, break-even volatility points can be traced back into the DCF model to estimate the probability of crossing over and this ability to wait becomes valuable).

CASE 4: OIL AND GAS—FARM OUTS, OPTIONS TO DEFER, AND VALUE OF INFORMATION

An oil and gas company, NewOil, is in the process of exploring a new field development. It intends to start drilling and exploring a region in Alaska for oil. Preliminary geologic and aerial surveys indicate that there is an optimal