Valuation Strategies

MARCH/APRIL 2007

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Valuation Strategies

MARCH/APRIL 2007
VOLUME 10, NUMBER 4

WARREN, GORHAM & LAMONT
OF RIA

counterpoint

MONTE CARLO SIMULATION AND BUSINESS VALUATION

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I read Salty Schumann's article "Improving Certainty in Valuation Using the Discounted Cash Flow Method"[1] with interest, as I have been trying to find a use for Monte Carlo simulation (MCS) in business valuation (BV) for years. The reason I have not been successful is that MCS answers three questions (What is the worst that can happen? What is the chance of hitting the target? What is the most important variable?) that are not especially germane to BV, as they have more to do with the vetting of competing investment projects for a particular company. Mr. Schumann did demonstrate the one thing that MCS might be used for in a BV situation, and that is the charting of the concept, "value is a range."

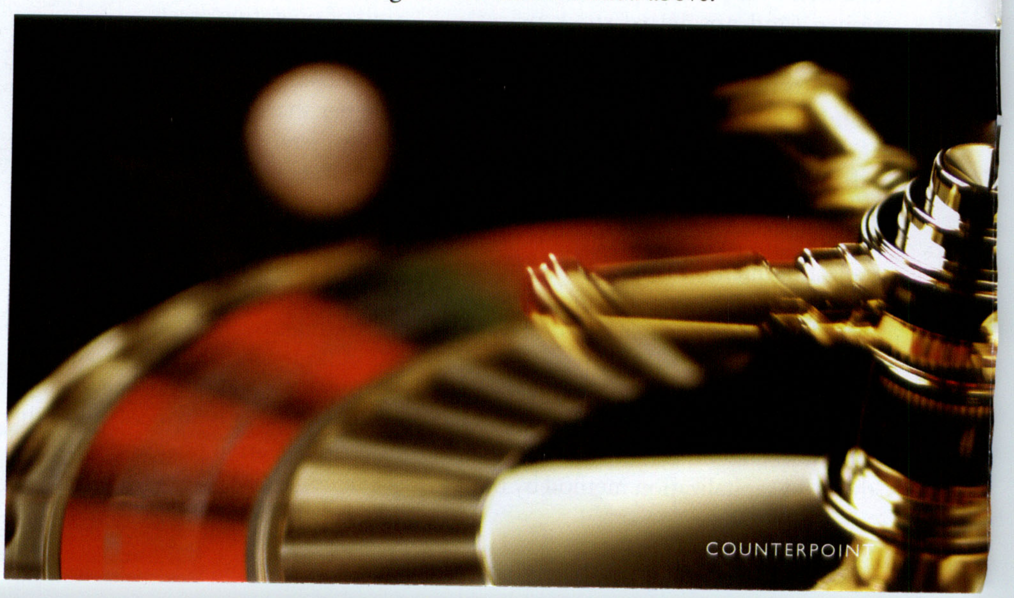
While I found the overall article on point, I do have a few quibbles and one major complaint. However, before I get to those items, the following topics must be discussed: the difference between uncertainty and risk; the use of MCS in a business setting; and the proper discount rate to be used when MCS is employed.

BV professionals tend to use the terms risk and uncertainty interchangeably, when perhaps they should not. For example, the financial markets define risk as volatility of returns from the market, where volatility is equated with the standard deviation of those same returns. This volatility of returns creates uncertainty about the future prospects of a stock, which increases its risk in the eye of the investor. This is probably a good working definition, but a more theoretical approach would differentiate between uncertainty and risk by positing the following definitions:

- Risk is where the probabilities of different outcomes are known, but not the outcome itself. An example would be the spin of a roulette wheel, or the throw of one or more dice.
- Uncertainty is where the probabilities themselves are unknown. An example would be trying to predict the weather. There are too many inputs and too many possible outcomes to be able to make long-term predictions with any degree of accuracy.

One way to tell the difference between the two is to ask if the event can support an insurance market. If the answer is yes, then one is dealing with risk. If the answer is no, then it is uncertainty one faces. By these terms, then, all discounted cash flow (DCF) valuation calculations deal with "uncertainty" rather than "risk." As Mr. Schumann has pointed out, MCS can help quantify, account for, describe, and thereby reduce, uncertainty. However, this still leaves risk unchanged. Betting on the outcome of the spin of a roulette wheel is not a riskless event, even though there is no uncertainty as to the long-term outcomes.

MCS first came into use in everyday corporate finance when it was applied to a firm's DCF models that were attempting to determine which competing project produced the largest net present value, and therefore, could logically claim first dibs on the firm's investment dollars. Prior to the use of MCS, cash flows for each project were projected using deterministic models, and then a discount rate was chosen for each project, reflecting that project's degree of uncertainty concerning the amount and timing of its cash flows. What then followed was an extensive investigation of "what ifs" that looked at the effect of certain assumptions, the creation of alternative scenarios, the sensitivity of alternative discount rates, or other changing factors. The result was a confusing output of scenarios that made it almost impossible to select the one scenario that best answered the three important questions mentioned above.



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MCS, in a somewhat similar but more powerful way, provides a distribution of the net present value of many possible future outcomes for each project. By analyzing such distributions, one can reach judgments as to the net present value of the overall opportunity of each project, even though one does not, and generally cannot, know which outcome will occur. Again, the uncertainty encountered does not get solved by the use of MCS. Rather, MCS provides a more powerful means of characterizing such future possible outcomes and interpreting the net present values of all such possible outcomes for each project.

This leads to the next question: What should the discount rate be if one is using a MCS model? If a discount rate is chosen for each project based on that project's uncertainty as to the amount and timing of its cash flows, and then some standard such as a 50% probability for a value is used, uncertainty will be double-counted. If a project-unique discount rate over-discounts value, a generally reasonable selection would be the firm's weighted average cost of capital (WACC), because this represents the bare cost of capital required. Such a discount rate then imbeds all the cost of capital, but only the cost of capital, in the discount rate, and all the risk, and only the risk, in the MCS determined probability.

The powerful MCS method can easily create any number of "what if" analyses by adjusting distribution functions and values for the key input parameters, including an appropriate cost of capital, and then interpreting the result based on a willingness to undertake a level of outcome risk. Uncertainty is a state of nature—risk is in the eye of the investor. These MCS features—separating the cost of capital from the risk, the ability to consider the impact of almost any type of uncertainty, and portraying results in a way that enables a judgment to be reached as to the appropriate level of risk for the prospective reward—make it an extremely powerful and useful tool in the area of corporate finance decision making.

The same cannot be said of MCS in the BV arena, where its usefulness in comparing competing projects typically has no place when valuing an ongoing business. Business valuations are stand-alone computational models, and, except for start-up companies or those companies about to introduce a new product or service, the point estimate of value produced by MCS will be no different from that of a deterministic model, as Mr. Schumann's two examples demonstrate. The best that can be said of the use of MCS in the valuation of a company with a normal operating history is that the valuator can answer "yes" to the question: "Did you consider the variability inherent in your input factors?"

In his book, *Quantitative Business Valuation, A Mathematical Approach for Today's Professionals*,[2] Jay Abrams substituted the First Chicago method for MCS because at the time he did not realize that inexpensive software and cheap but powerful computers were available to run MCS. The same can be said of the expected cash flows method, which is also a hand-cranked substitute for MCS. More precisely, these are not three approaches to dealing with uncertainty, but one overall approach using probability distributions to model uncertainty, further broken down into two primitive, manual methods and one method that is sophisticated and computerized. As to decision trees, or the "probabilities cash flows method," their usefulness in BV is very limited, as Mr. Schumann's own demonstration of the concept is a start-up situation. Besides, they are extremely cumbersome to use, even with good software.

Mr. Schumann's presentation and terminology for the assumptions of a normal probability distribution are incorrect. He has presented triangular distribution language, rather than normal distribution language, which for revenue would have to state a mean and a standard deviation, and in addition, for subsequent years, the same parameters for either an input variable for growth or market share. In addition, linear distributions are more commonly known as uniform distributions, e.g., the probability distribution of the roll of one die, where each possible outcome has an equal chance of coming up.

Mr. Schumann states that comparing both the normal distribution method and the triangular distribution method is "an excellent way to demonstrate any statistical significance between them." Statistical significance is determined by statistical tests, not by some unknown means of comparison. Mr. Schumann also does not say what statistical test should be used to determine the statistical significance, if any, between these two methods. As it stands, the sentence is a non sequitur.

Mr. Schumann presents readers with stochastic and deterministic models that result in the same point estimates of value, regardless of whether the normal or triangular distribution was used. This is so only because both of the distributions he selected are symmetrical—the normal by definition and the triangular by choice. If he had selected asymmetrical distributions, e.g., those whose upside potential was greater than their downside potential, or vice-versa, the stochastic output would differ from the deterministic output. Of course, this is difficult to do with a company that has a normal operating history. Hence, once more, this demonstrates the limited use of MCS in such a situation.

The last point concerns Mr. Schumann's remark regarding the standard deviations of both the normal and triangular distribution outputs. He says, "[T]he standard deviation in the triangular distribution is less than half of the standard deviation in the normal distribution." He does not ask, nor does he explain, why this is so. However, knowledge of the two distributions shows that the triangular distribution is closed at both ends, i.e., revenues can never be less or more than 10% of the most likely amount. On the other hand, a normal distribution is never closed at either end, and in fact, the tails never reach zero, but are open-ended to infinity, causing a much greater spread of possible outcomes, hence more variability and a greater standard deviation. This, of course, can be cured using a truncated normal distribution function in MCS, which would return a standard deviation closer in size to that produced by the triangular distribution.

One metric that Mr. Schumann does not discuss is the coefficient of variation (COV), which is the standard deviation divided by the mean. For the triangular distribution model it is 20%, and for the normal distribution model it is 50%. Both numbers are shown in the Crystal Ball output schedule to the right of each respective histogram chart (Exhibits 6 and 8 in Mr. Schumann's article). The reason for the difference in the two COVs has been explained above. It should be noted that the 20% is high even without assigning probability distributions to the input variables for the EBITDA multiple, the discount rate, a sales growth factor, the cash flow conversion factors, etc. Including these factors would have driven the COV to something greater than 30% for the triangular distribution model. Just using a COV of 20% means that approximately 95% of the possible value outcomes for this company are within the range of \$5,675,849 ±40%, or \$5,675,849 ±\$2,270,260, or \$3,405,400 to \$7,945,900. This is quite a spread. Imagine what it would be if the COV were 30% or more. If value is nothing more than capitalized returns, should anything different be expected when the COVs for the 80-year average returns on publicly traded stocks per Ibbotson's 10 deciles range from 169% to 210% as shown in table 7-4 in the 2006 SBBI Valuation Edition Yearbook?

Thus, what is the implication for valuation professionals and the concept of "value is a range"? It is often assumed that the range of value ought to be the concluded value, plus or minus 10%-15%, as if the distribution were uniform. However, there is no reason for either of these assumptions, and, as we have seen, they are unrealistic. In the DCF examples presented by Mr. Schumann, the spread of possible values far exceeds 10%-15%; in fact, approximately 68% of the values calculated in the limited triangular distribution model lie between the mean and ±20%. It has been suggested that the application of the direct market data method to the Bizcomps, IBA, and Pratt's Stats transaction databases results in such large COVs that the results are meaningless, and that therefore the valuation analyst should default to an income approach where the range of possible values is much narrower.[3] Mr. Schumann and I have shown this to be merely wishful thinking. Even the valuations done for publicly traded stocks, using either an income or market approach, will exhibit the same degree of variation about the mean value. A topic for further study is why this does not seem to bother anyone. ●

1 10 Val. Strat. 4 (September/October 2006).
2 (McGraw Hill, 2001).
3 See Wolpin, "Should Appraisers Rely on the Small Business Transaction Databases to Determine Fair Market Value?" 5 Val. Strat. 4 (July/August 2002).