"EXCERPT FROM "PROBABILISTIC APPROACHES: SCENARIO ANALYSIS, DECISION TREES, AND SIMULATIONS""

INTRODUCTION

2. SIMULATIONS

- Simulations provide a way of examining the consequences to continuous risk.
- Simulation generates hundreds of possible outcomes to provide a fuller picture of the risk in an asset or investment.

2.1 Steps in Simulation

- As compared to scenario analysis, simulations allows for more flexibility in how we deal with uncertainty.
- Steps associated with simulation includes:
  - i. ⇒ Determine probabilistic variables ⇒ no constraint on number of variables allowed in a simulation & we can define probability distribution in each & every input in a valuation.
  - ii. ⇒ Define probability distribution for these variables⇒ most difficult step in the analysis & comprise of following three steps:
    - i. Historical data ⇒ for variables with long history, historical data is used to develop distributions.
    - ii. Cross sectional data ⇒ substitute data on differences in specific variable across existing investments that are similar to investment being analyzed
    - iii. Statistical distribution⇒ where historical & cross sectional data will be insufficient / unreliable, a statistical distribution that best capture the variability in input estimate the parameters for that distribution.
  - iii. Check for correlations across variables⇒ after the distribution have been specified it is important to check correlations across variables (can be estimated by looking at past).
  - iv. Run the simulation⇒ draw one outcome from each distribution & compute the value based upon those outcomes (process can be repeated as many times as desired). The number of simulation can be determined from the following:
    - a) Number of probabilistic inputs ⇒ ↑ the number of inputs,↑ the number of simulations.
    - b) Characteristics of probability distribution ⇒ the greater the diversity of distribution, the ↑ the required number of simulations.
    - c) Range of outcome ⇒ the ↑ the potential range of outcomes, the ↑ the number of simulations required.
- Two impediments to good simulations:
  - i. Estimating distributions of values for each input into a valuation is difficult to do (informational).
  - ii. Too time & resource intensive for the typical analysis (computational). Both these constraints have eased in recent years.

2.2 An Example of a Simulation

2.3 Use in Decision Making

- In ideal simulations, analysts will examine both the historical & cross sectional data on each input variable before making a judgment on distribution & parameters.
- Ideal simulation yields a distribution for expected values rather than a point estimate.

2.4 Simulations with Constraints

2.4.1 Book Value Constraints

- BV of equity is an accounting construct & by itself, means little.
- Two types of restrictions on BV of equity that may call for risk hedging:
  - Regulatory capital restriction
  - Negative BV for equity

2.4.2 Earnings and Cash Flow Constraints

- These constraints may be internally or externally imposed.
- Simulation can be used to assess the likelihood that these constraints will be violated.

2.4.3 Market Value Constraints

- Simulation can be used to qualify the likelihood of distress & can also be used to build in the cost of indirect bankruptcy into valuation.

2.5 Issues

- Garbage in, garbage out ⇒ simulation output is input dependent so input should be based upon analysis & data rather than guess work.
- Real data may not fit distributions.
- Non-stationary distributions (means & variance estimated from historical data for an input that is normally distributed may change over time).
- If correlations b/w input variables change over time, it becomes far more difficult to model them.

2.6 Risk-Adjusted Value and Simulations

- In simulations, the cash flows that we obtain are expected cash flows & are not risk adjusted (discount at risk adjusted rate).
- Variance of the simulated values around the expected value indicates that the estimation is in an uncertain environment.

3. AN OVERALL ASSESSMENT OF PROBABILISTIC RISK ASSESSMENT APPROACHES

3.1 Comparing the Approaches

- Decision of choice b/w scenario analysis, decision trees & simulations depends on the followings:
  - i. Selective v/s full risk analysis ⇒ scenario analysis is best for selective risk analysis (usually 3 scenarios) while decision trees & simulations are used for full risk analysis.
  - ii. Type of risk ⇒scenario analysis & decision trees ⇒ discrete outcomes in risky events. Simulations ⇒ for continuous risk.
  - iii. Correlation across risks ⇒ if various investment risks are correlated ⇒ simulation is best.

Table 6.4. Risk Type and Probabilistic Approaches

Discrete/Continuous	Correlated/Independent	Sequential/ Concurrent	Risk Approach
Discrete	Independent	Sequential	Decision tree
Discrete	Correlated	Concurrent	Scenario analysis
Continuous	Either	Either	Simulations

Reference: Level 2 Reading 10

3.2 Complement or Replacement for Risk-Adjusted Value

- Decision tree & simulations ⇒ used as either complements to or substitutes for risk adjusted values.
- Scenario analysis ⇒ always used a complement to risk adjusted value.
- All three approaches use expected rather than risk adjusted cash flows & the discount rate that is used should be a risk adjusted discount rate.

3.3 In Practice

- With the surge in data availability & computing power, the use of probabilistic approaches has become more common.
- The ease with which simulations can be implemented has allowed its use in variety of new markets including;
  i. Deregulated electricity market.
  ii. Commodity companies.
  iii. Technology companies.