THOUGHT PIECE

Natural Resources Financial Modeling And How to Make It Better!

The corporate finance function is critical to the decision making success of any natural resources company. Unfortunately, the primary tool used to generate the data required to optimize the decision making process, the static financial model, is often wrong, biased or contains mistakes which negate its usefulness. Given this limiting reality, is there a better way to enhance financial model output usefulness and its critical role in supporting value creation and company momentum?

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The natural resources industry, especially the finance function, tends to use a static, or single data estimate, approach to its planning, valuation and M&A models. This often fails to capture the dynamic interrelationships between the strategic, operational and financial variables of the business, especially commodity price volatility, over time. A comprehensive financial model should correctly reflect the dynamic interplay of these fundamental variables over the company life and commodity price cycles. This requires enhancing the quality of key input variables and quantitatively defining how they interrelate and change depending on the strategy, operational focus and capital structure utilized by the company.

The use of complex static, or deterministic, financial models, which attempt to reflect the dynamic nature of the natural resources business, also creates more risk of a modeling mistake as does using rigid, sub-optimal input relationship assumptions. Furthermore, this approach does not properly account for risk – the variability of outcomes – instead relying on simplistic measures such as the Capital Asset Pricing Model (CAPM) and Weighted Average Cost of Capital (WACC) approaches, which are best used by stock investors. Such a model, which only provides single data estimates of the output variable, does not allow for a full understanding of the realistic range of potential outcomes and their associated probability. Additionally, it is virtually impossible to build a financial model of this type that reflects the input data variability and respective input interrelationships without making the model very unwieldy and prone to mistakes.

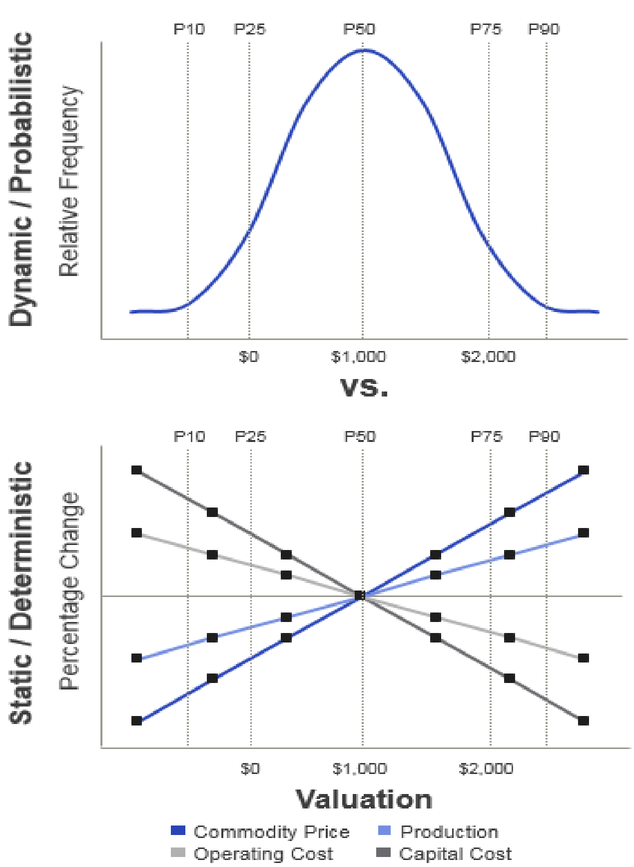
Given these critical limitations, a static modeling approach fundamentally reduces the decision making power of the results generated leading to unbalanced views as to the actual probabilities associated with expected outcomes. Equally, it creates an over-confident belief as to outcomes and eliminates the potential optionality of different courses of action as real options cannot be fully evaluated.

Fortunately, there is another financial modeling method – using Monte Carlo simulation – which generates more meaningful output data to enhance the company's decision making process. Dynamic, or probabilistic, modeling allows for far greater flexibility of input variables and their correlation, so they better reflect the operating reality, while generating an output which provides more insight than single data estimates of the output variable.

A dynamic financial model allows the user to leverage the power of technology to include more realistic input data ranges along with the critical relationships between important variables. With this approach, there is less risk of mistakes, given fewer internally built relationships to check, while allowing for greater flexibility for "cases" run (i.e. Downside, Base and Upside). This approach also enhances understanding the quantitative relationships between critical variables. Furthermore, it facilitates a better understanding of the main output determining variables and their quantitative contribution to the output range. Additionally, less time is required to build such a model – "let technology do the work so you can do the thinking" can be a key mantra when using the probabilistic software available such as @RISK or Crystal Ball.

A review of the model output differences, per Figure 1 below, for a dynamic and static model, highlights the benefits of a dynamic approach to fully understanding the range of likely outcomes for the variable being measured.

Figure 1:

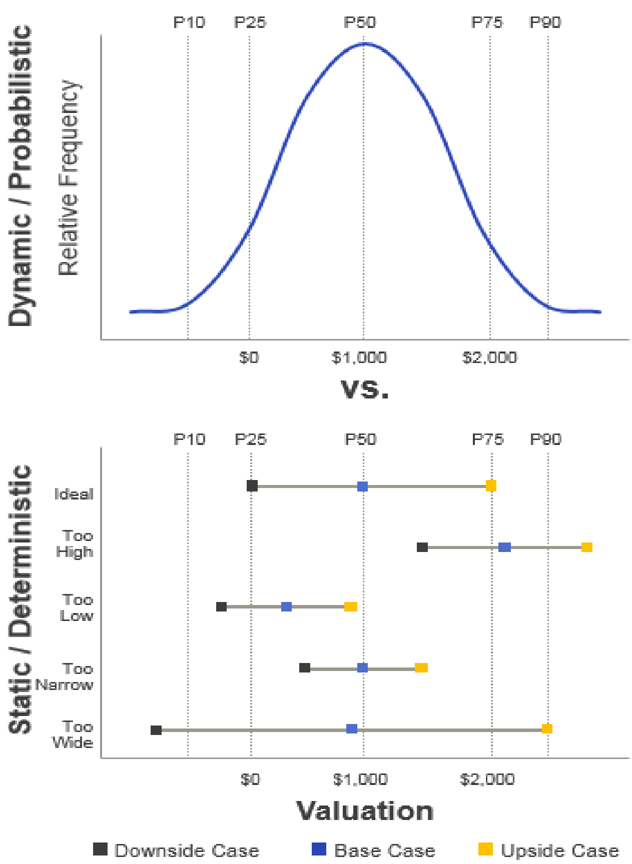


- Takes into account input variable distribution profiles and correlation between variables
- Shows probability of outcome desired and level of risk (i.e. P90/P10)
- Provides objective output range without intentional/unintentional biases
- Don't need to run multiple models or use random sensitivities to understand output value distribution and risk
- Output based on 10,000 data points vs. 28 data points below

- No sense of distribution of different input variables and how the input values chosen reflect reality
- No sense of interrelationship between different input variables as often modeled separately
- No sense of probability of different results or the risk associated with output
- Complex calculations required to mirror actual input relationships
- Output based on 28 data points vs. 10,000 data points above

Another way to consider the differences between the two types of models, and to understand the benefits of the dynamic modeling approach, are seen in the output graphs, per Figure 2 below. The dynamic approach gives the user an understanding of the likely output range (presented as a normal distribution here) and the probabilities associated with a particular output value. The static approach is relatively "random" as it is based on input assumptions that are often subject to biases and a poor understanding of their potential range vs. reality (i.e. +/- 10%, 20% vs. historical or projected data range).

Figure 2:



- Data probability functions for input ranges and correlation coefficients allows for better relationship modeling between input variables
- Can use historical data ranges and correlations as proxy for future if outcomes tend to repeat
- Holds management to a discipline of understanding the historical nature of the industry and historical operating performance
- Objective focus on output ranges enhances decision making as most likely outcomes objectively presented

- The use of "Downside", "Base" and "Upside" case models generates a mistaken belief as to the actual reality of the output range
- Does not give the user a sense for whether the output is biased to the upside or the downside, is too wide or too narrow, relative to likely outcome probabilities
- Allows biases to creep into the model, and hence the output, where other factors drive desired output
- Compensation, access to capital, buy-side vs. sell-side transaction and/or historical focus introduces biases to a static model

Dynamic financial modeling, based off the many different potential outcomes or "states", "payoffs" for those states, and the associated "probability" of those states, provides much more insightful detail than comparing the traditional "Downside", "Base" and "Upside" cases with no sense for what their respective probabilities are.

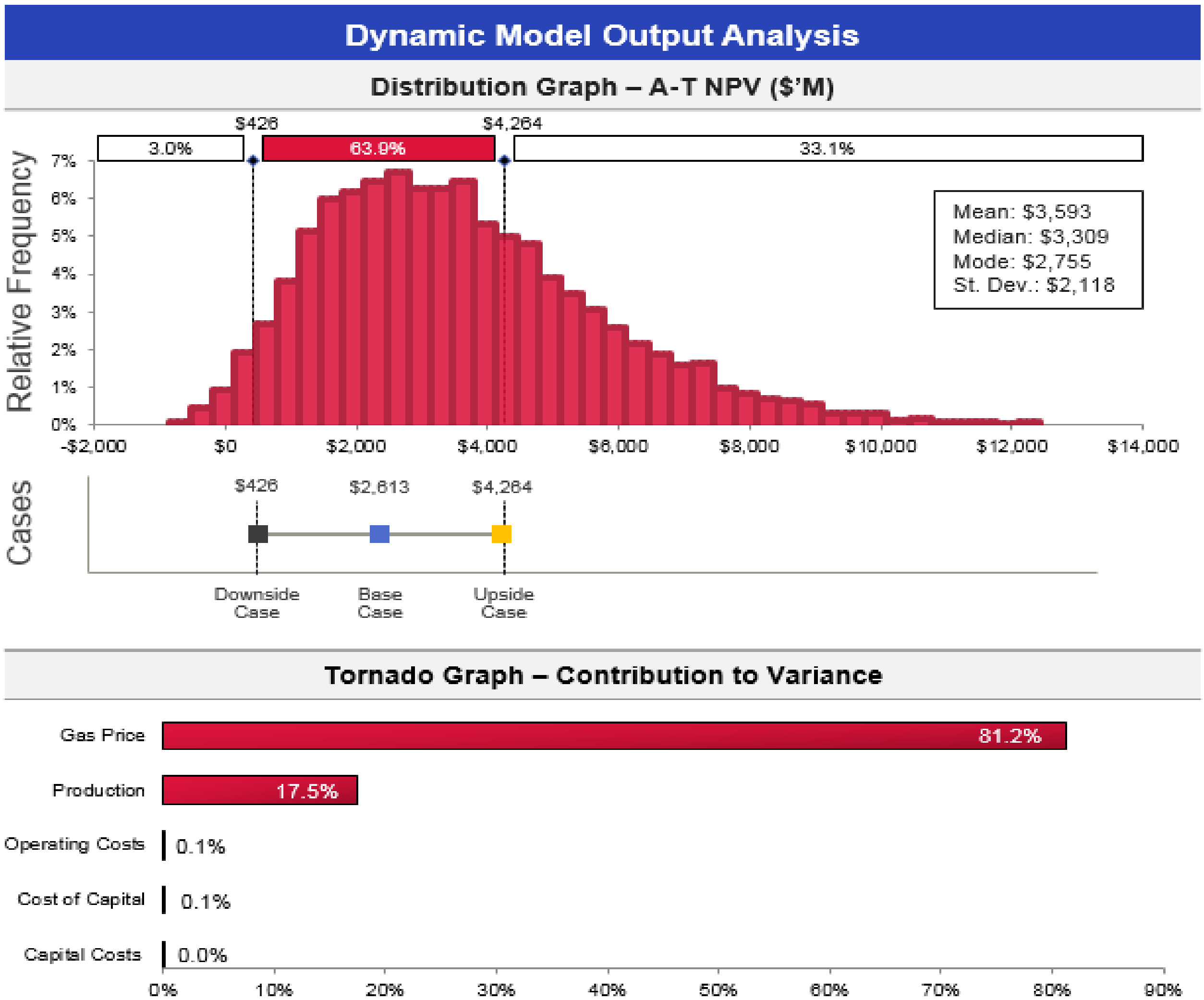
In the case of a dynamic model, there is less scope for the biases (compensation, optionality, historic perspective, desire for optimal transaction outcome) that often impact the static, single data estimates modeling process. Additionally, it imposes a fiscal discipline on management as there is less scope to manipulate input data for desired outcomes (i.e. strategic misrepresentation), especially where strong correlations to historical data exist. It encourages management to consider the likely range of outcomes, and probabilities and options, rather than being bound to/driven by achieving a specific outcome with no known probability. Equally, it introduces an "option" mindset to recognize and value real options as a key way to maintain/enhance company momentum over time.

A simple example, per Figure 3 below, is shown to help the reader understand the practical application of the dynamic modeling approach and its multiple benefits over a static model.

- A Marcellus dry gas well valuation is modeled below to highlight the benefits of the output range and understanding the most significant input variable contribution to the output variability:
  - Data from Hughson's Imperial College London dissertation dated September 2010 – *A Discounted Cash Flow Valuation of U.S. Shale Gas Plays and Corporate Strategy Implications;*
  - Unique commodity price, production, capital cost, operating cost and discount rate distributions utilized, with a correlation table for all input variables to reflect relationships;
  - After-Tax NPV (A-T NPV) in $'M calculated using @RISK software.

- The dynamic model output, below, highlights the potential range of values based on a 10,000 simulation run:
  - Mean well value of $3,593, reflecting the distribution of potential gas prices, compares to a base case value of $2,613 using the natural gas forward curve;
  - Highlights a 33% probability of achieving a value greater than the Upside Case value from the static model;
  - Real Option value – using the Black-Scholes formula – is $3,996 based on an A-T pre-capex PV of $7,087 (S), a capital cost of $3,500 (X), a 7-year risk-free rate of 1.0% (R_f), a 5 year lease term (T) and a pre-capex cash flow St. Dev. of $2,229 or 31.5% ($\sigma$) calculated from the simulation model;
  - The gas price and production volumes account for 99% of output variability – important to know for hedging and production risk management decisions.

Figure 3:



CONCLUSION

In the simple example above, the financial model was more real-world through using input variables and correlation assumptions that reflect historical and projected reality rather than single data estimates that tend towards the most expected value.

Additionally, the output data provide greater insight into the variability of outcomes than the static model Downside, Base and Upside cases' single data estimates did. The dynamic data also facilitated the real option value of the asset in a manner a static model cannot.

And the model took less time to build, with less internal relationships to create to make the output trustworthy, given input variables and correlation were set using the @RISK software options. This dynamic modeling approach can be used for all types of financial models.

With @RISK modeling software used by 97% of Fortune 100 companies, and countless Fortune 500 companies, it further highlights how especially useful it can be for smaller and mid-sized companies who have to make the most of the decision making capacity of their smaller finance departments.

Lachlan Hughson, the Founder of 4-D Resources Advisory LLC, has a 30+ year career in the oil/gas and mining/metals industries as an investment banker and a corporate executive. He has undertaken $30+ billion of M&A and $15+ billion of capital raising assignments during his career. His commercial experience is further enhanced through a Master of Business degree from the University of Technology Sydney, Australia, a Master of Business Administration degree from the Kellogg School of Management, Northwestern University, U.S.A., and a Master of Science degree, with Distinction, from the Royal School of Mines at Imperial College London.

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4-D Resources Advisory LLC is a boutique financial advisory firm that utilizes probabilistic-based financial models to enable executives and investors in the oil/gas and mining/metals industries to enhance their decision making process. Its genesis was the realization by its founder, Lachlan Hughson, that the natural resources industries are not well served by complex, static financial models but instead require a dynamic approach given the complexity and interrelationships of the primary variables driving the value creation process. If the geoscience and engineering departments rely on probabilistic software and models, and the enhanced insights gained from their output, shouldn't the finance function utilize the same approach to their work?