THOUGHT PIECE

USING DYNAMIC FINANCIAL MODELING IN A VOLATILE COMMODITY PRICE ENVIRONMENT!

In a time of significant disruption to commodity markets, and a resulting spike in commodity prices, at least in the front part of the price curve, stock prices also increase reflecting changed fundamentals – both in the short and longer term. How can the dynamic financial modeling approach be used to keep a realistic, objective view on per share value, so as to balance the fear/greed investing dynamic in a better manner, to take full advantage of the potential stock price extremes likely to be experienced?

Relevant Natural Resources Industries – Oil & Gas, Mining & Metals

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Commodity price movements in early 2022, reflecting the lingering effects of the Covid-induced global shutdown, the increasingly damaging impacts of climate change and the expanding conflict in Eastern Europe, showed an interesting turnaround compared to prior years when commodities were somewhat ignored with respect to their importance to the efficient functioning of the global economic system. It seems their importance is now being better recognized by all investors, especially oil as it doubled to $130/Bbl over a 6 month period. Reflecting this rapid increase in the oil price, and in natural gas and NGL prices, respectively, the stock prices of oil and gas-based companies also saw a significant increase in their value as investors tried to understand what these impacts mean for the global energy value chain, and the competing impact of fossil-fuel driven demand in the short term versus the likely impact of climate change in the medium to longer term.

As investors review their respective 'crystal balls' to determine individual company value propositions and where energy stocks fall on the 'buy'/'hold'/'sell' spectrum, what tools can they use to help them develop an objective, probabilistic valuation model to make better investment decisions and not become beholden to the strip price given its variability over time? How can they convert a static financial model to one that will allow an investor to see where the stock price falls today on the likely range of future potential values thereby providing a probability-based estimate of the risk associated with increases or decreases in the stock price into the future as the underlying variables, particularly commodity prices, change?

For a more detailed discussion of the benefits of a dynamic/probabilistic approach to financial modeling versus the more traditional static/deterministic approach, please read my Thought Piece, dated 5 October, 2021, entitled *Natural Resources Financial Modeling and How to Make It Better!* per 4-dresourcesadvisory.com/natural-resources-financial-modeling-and-how-to-make-it-better/, and a more recent piece, dated January 17, 2022, entitled *Using Dynamic Financial Modeling to Enhance Insights From Financial Reports!* per 4-dresourcesadvisory.com/using-dynamic-financial-modeling-to-enhance-insights-from-financial-reports/ which applies this approach to a gold mining project.

For this example, I have undertaken a valuation of a U.S. based natural gas company with a significant natural gas and natural gas liquids (NGL) resource base requiring both a proved reserves blowdown and a non-PUD (proved undeveloped reserves) growth matrix resulting from its significant probable and possible reserve position. The resource is this company's primary asset, along with a minority position in a publicly traded midstream asset, which allows for a relatively easy valuation and comparison of the range of projected per share values to the company's current share price. I made balanced changes to the shares outstanding, for both the current price and the projected price range, to ensure this analysis cannot be attributed to a specific company as that is not the purpose of this Thought Piece.

The valuation analysis description is set out in Figure 1 below.

Figure 1:

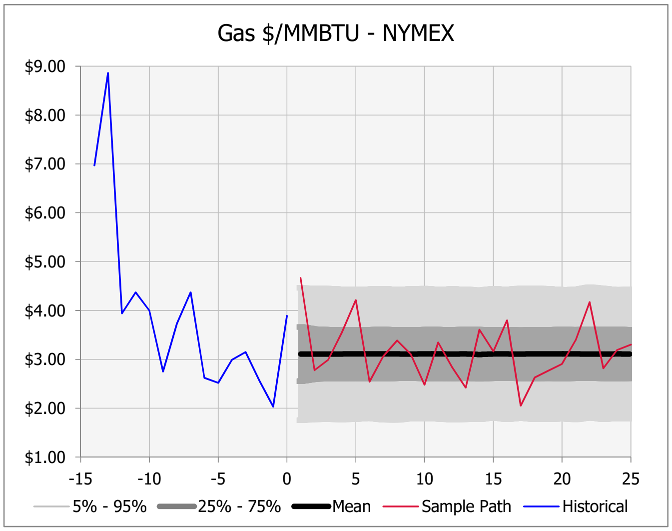
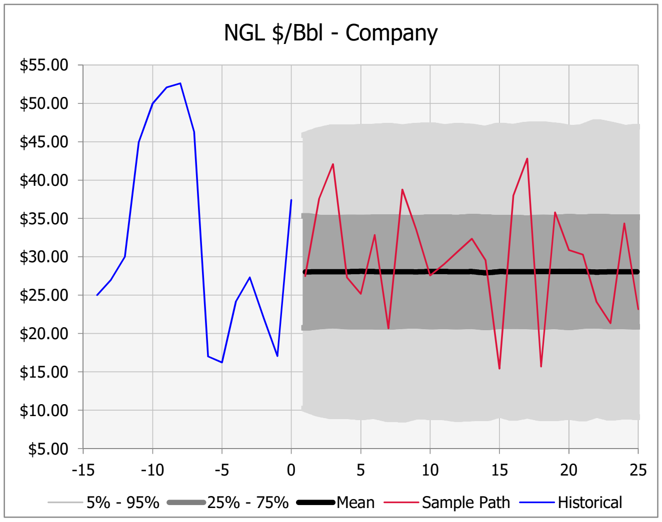
Valuation Analysis Description
• U.S. based natural gas and NGL focused company with a significant undeveloped resource potential in addition to its proved reserves; it also owns a minority stake in a publicly traded midstream company • Valuation based on blowdown of 2021 PV-10 data provided in the year-end 2021 10-K report, and balance sheet, combined with management guidance for wells drilled and completed, production, opex and capex over the next 5 years, along with the count of non-PUD wells • Based off a 25 year reserve life with the proved decline curve calculated using the PV-10 value and the company assumptions underlying this value including price; growth matrix production is based off projected wells completed, EUR/well and historical decline curve performance • Competent management with track record of delivering production growth • Minimal hedging is used so results are fully subject to commodity price volatility • Comprehensive data provided in the annual report and management presentations for data inputs and risk/variability assumptions

Many investors build a financial model based on a static approach – by calculating the expected value of input variables and including those in the model, with potential variability from the base case calculated using sensitivity analysis for key input variables. As a result, the financial model output only calculates one expected value despite there being a wide range of potential outcomes given the uncertainty associated with each variable and their respective correlations. When valuing energy companies, the forward prices used are typically based off the forward curve which, in itself, is not a good predictor of future commodity prices. **To enhance the efficacy of this static model approach, the same data can be used to instead build a dynamic financial model (using the @RISK software here) whose output will provide far greater insight into the variability of the per share value, thus giving investors a better base off which to determine their investment and trading decisions.**

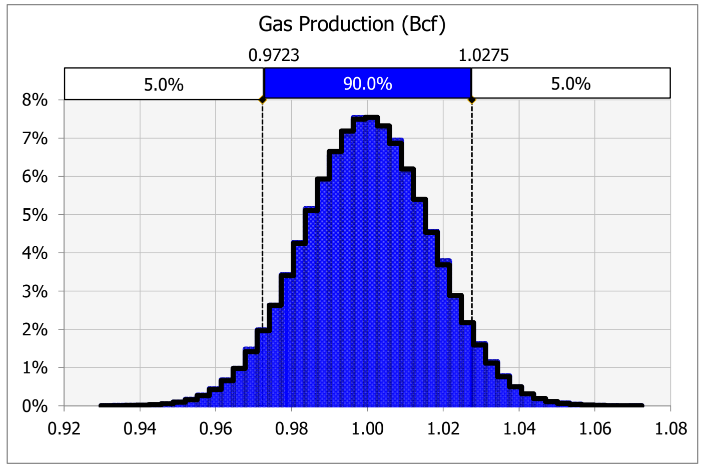
In order to develop a dynamic financial model, first the input variables need to be calculated based off the data in the annual report and company presentation, and appropriate distribution assumptions. The input variables and assumptions for the dynamic model are highlighted in Figure 2 below.

This is a simplified example to illustrate the logic behind using a dynamic approach to financing modeling, and how valuable the output data is to make better investment and trading decisions.

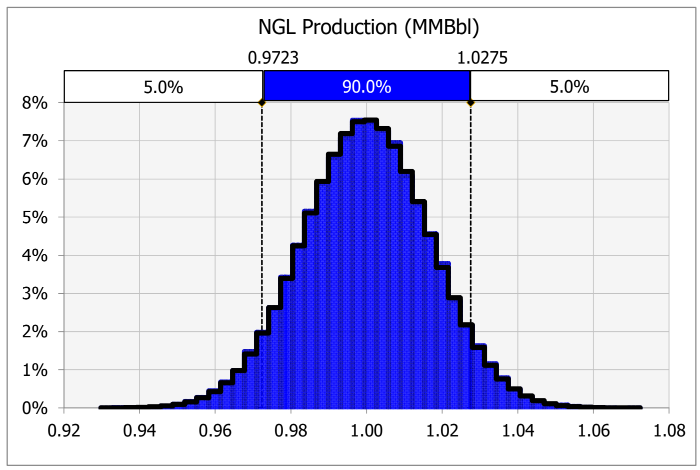
Figure 2:

Inputs & Assumptions	Input Distribution Used
Natural Gas Price ($/MMBtu) – Projected using a *time-series distribution* through the life of the project based on the 15-year historical natural gas price performance from 2007-2021. Each iteration of the model will generate a new annual price projection for the tenor of the valuation (25 years here), with each estimate related to but different from the previous.	
NGL Price ($/Bbl) – Projected using a *time-series distribution* through the life of the project based on the 15-year historical NGL price performance from 2007-2021, based on company data for specific barrel composition. Each iteration of the model will generate a new annual price projection for the tenor of the valuation (25 years here), with each estimate related to but different from the previous.	

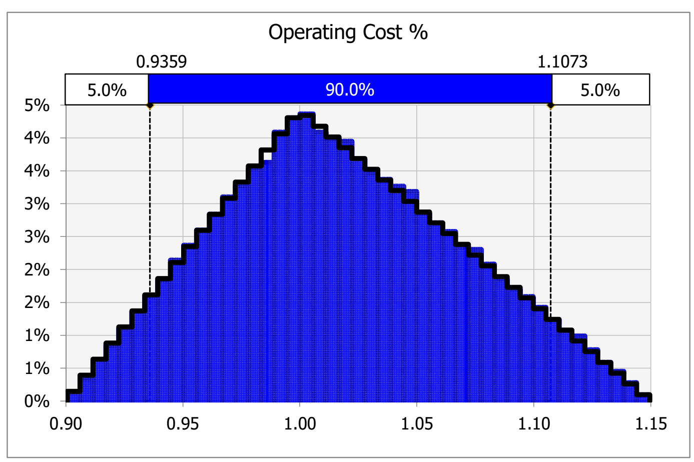
Gas Production – Projected using a *normal distribution* of +/- 5% applied to production data (i.e., Mean of 1.0 and St. Dev. of 0.0167 so 3 standard deviations = 5%). There will be variability in the production profile so a +/- 5% factor is applied. The 1 factor (i.e., 100%) reflects the static data directly from the reserves report and management guidance.



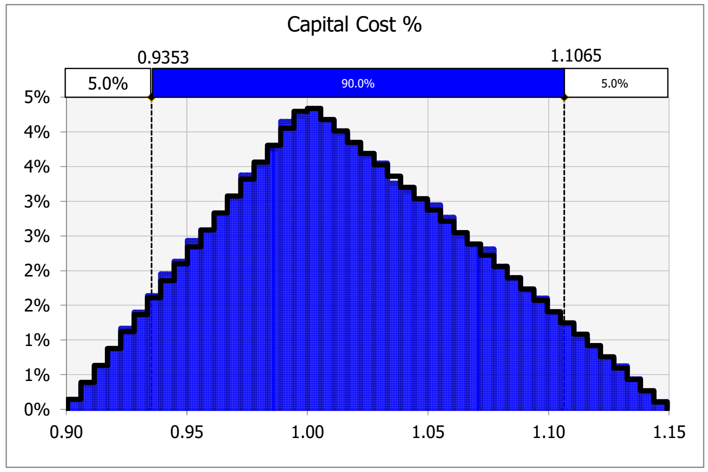
NGL Production – Projected using a *normal distribution* of +/- 5% applied to production data (i.e., Mean of 1.0 and St. Dev. of 0.0167 so 3 standard deviations = 5%). There will be variability in the production profile so a +/- 5% factor is applied. The 1 factor (i.e., 100%) reflects the static data directly from the reserves report and management guidance.



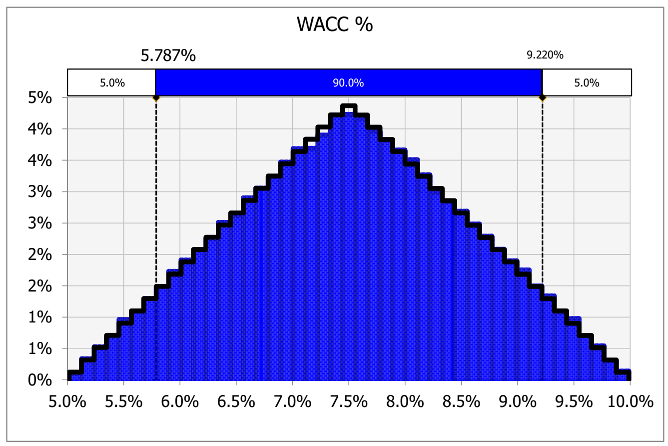
Operating Cost – Projected using a *triangular distribution* of -10%/+15%, given limits of management guidance in a dynamic commodity price and service cost environment, applied to operating cost data. This cost adjustment factor reflects the underlying variability of cost estimates in the reserves report and management guidance. The 1 factor (i.e., 100%) reflects the static data directly from the reserves report and management guidance.



Capital Cost – Projected using a *triangular distribution* of -10%/+15%, given limits of management guidance in a dynamic commodity price and service cost environment, applied to operating cost data. This cost adjustment factor reflects the underlying variability of cost estimates in the reserves report and management guidance. The 1 factor (i.e., 100%) reflects the static data directly from the reserves report and management guidance.



WACC – Discount rate projected using a *triangular distribution* of 5% - 10% (based on a 7.5% midpoint) assuming Requity of ≈10% and Rdebt of ≈7.5% (tax rate @ 30%) and 50/50 split for equity and debt. Lower bound set by WACC approaching Rfree for all inputs at low end of range (i.e., low risk outcomes) and higher bound set at 100% equity cost (i.e., high risk outcomes).



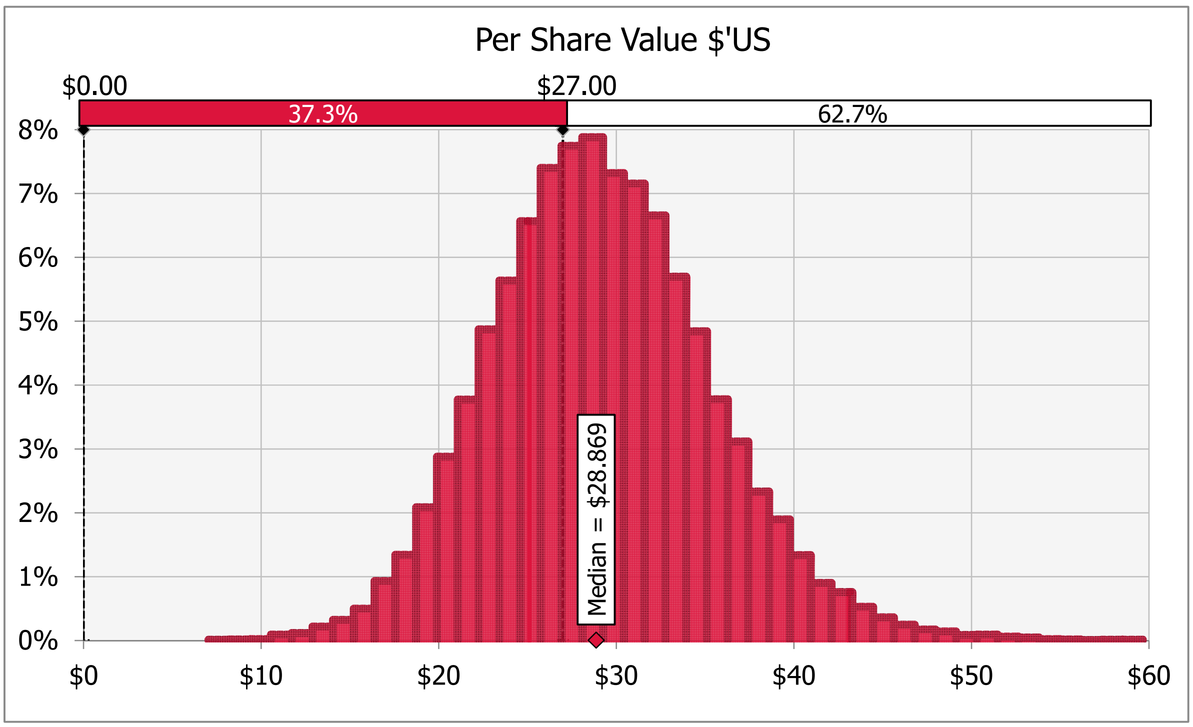
Correlation Coefficients – Positive for gas and NGL price vs. production, opex and capex as these generally move in the same direction, albeit with a time lag. Negative for gas and NGL production vs. opex and capex as these generally move in the opposite direction, albeit with a time lag. Positive for the WACC vs. prices and production as increasing values increase the discount rate given greater risk vs. low prices and production.

@RISK Copula: Copula2	Gas Price	Oil Price	NGL Price	Gas Prod'n	Oil Prod'n	NGL Prod'n	Opex	Capex	WACC
Type	Gaussian								
Gas Price	1.000	0.337	0.295	0.400	0.295	0.379	0.211	0.126	0.316
Oil Price	0.337	1.000	0.337	0.295	0.400	0.358	0.211	0.126	0.316
NGL Price	0.295	0.337	1.000	0.316	0.253	0.400	0.211	0.126	0.316
Gas Prod'n	0.400	0.295	0.316	1.000	0.253	0.295	-0.211	-0.126	0.316
Oil Prod'n	0.295	0.400	0.253	0.253	1.000	0.337	-0.211	-0.126	0.316
NGL Prod'n	0.379	0.358	0.400	0.295	0.337	1.000	-0.211	-0.126	0.316
Opex	0.211	0.211	0.211	-0.211	-0.211	-0.211	1.000	-0.126	0.316
Capex	0.126	0.126	0.126	-0.126	-0.126	-0.126	-0.126	1.000	0.316
WACC	0.316	0.316	0.316	0.316	0.316	0.316	0.316	0.316	1.000

Using the distribution profiles for the primary input variables, based off the single data estimates of the same variables provided by management per the reserves report and guidance, the dynamic financial model is set up to allow the user to gain a much better understanding of what the full range of potential outcomes will be for the answers sought – in this case, the Per Share Value and the sensitivity of this value to changes in the respective input variables. The model output distribution for the Per Share Value is shown in Figure 3 below, for 42,600 iterations; the number required for a convergence confidence interval of 99% for the mean and standard deviation of the values calculated.

Figure 3:

Per Share Value Distribution Profile – Dynamic Model

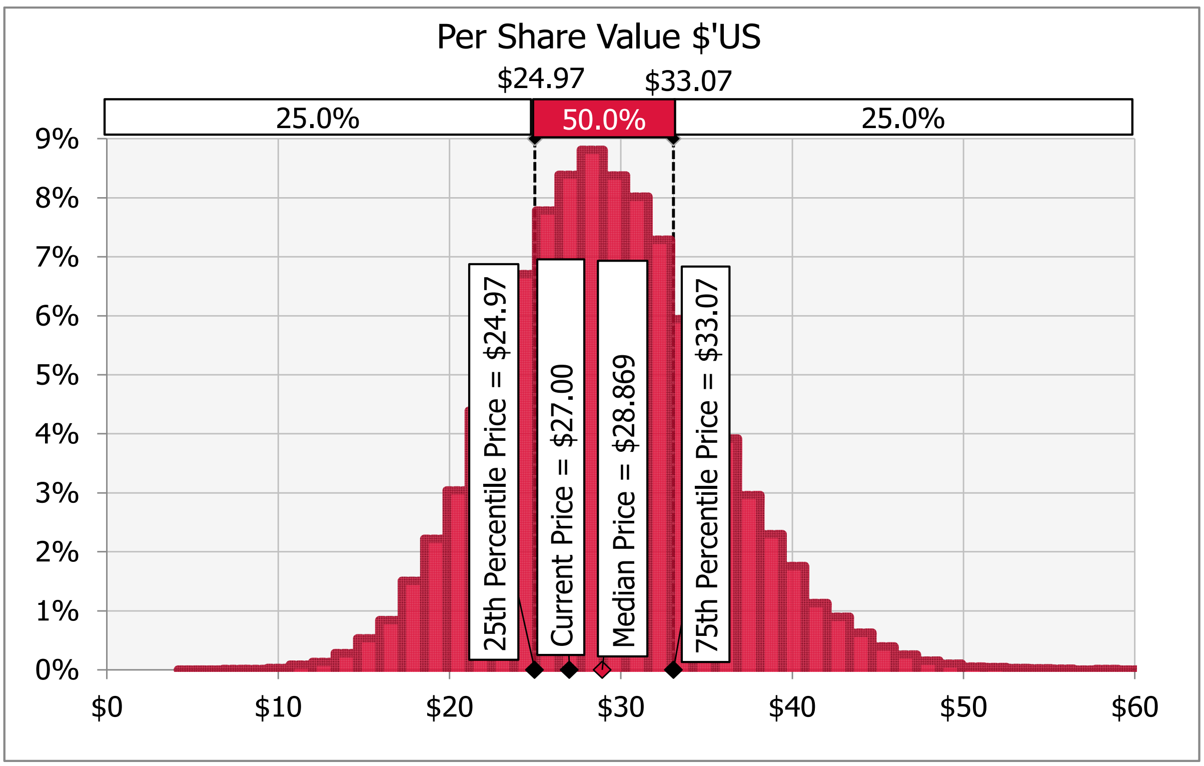


What can we learn from this? Firstly, a dynamic model generates a probabilistic distribution of per share vales which we can compare to the share price today. With the current share price at $27.00, the output shows there is a 62.7% probability the per share value of the company is higher than the share price today. While other investment considerations must be undertaken, such as corporate liquidity, guidance quality along with macro considerations, this analysis suggests the company share price has a higher probability of increasing than declining. For example, where the risk profile of an investor is to 'hold' until the 75th percentile price is reached, at which point a 'sell' decision is made, which represents a price of $33.07, an investor has a quantitative calculation of what price that actually represents; a value it is almost impossible to calculate when a static model is used instead. See Figure 4 below for the graph of this resulting price calculation.

Such a model can also be used to determine a 'buy' decision. For example, where the 'buy' decision is set for the 25th percentile or lower, that value would be $24.97 per share. And where the risk/return profile of an investor was based on a 'buy'/'sell' decision for the 25th/75th percentiles, this would represent a profit of $8.10 per share or a return of 32% based on the 'buy' price. From this model, the prices at which the investment decisions are made (i.e., 'buy'/'hold'/'sell') are able to be calculated with a distinct probability that is unavailable using single result, static financial models.

Figure 4:

Per Share Value Distribution Profile – 25th/75th Percentile – Dynamic Model

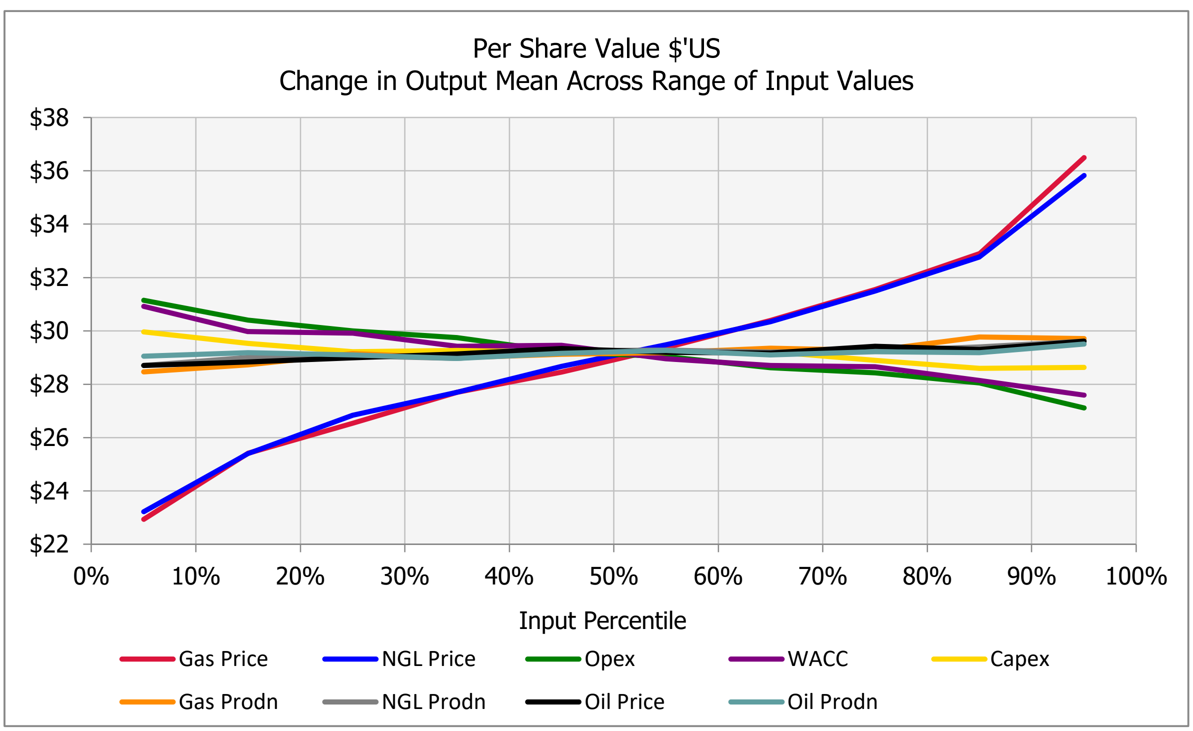


A dynamic financial model can also generate a sensitivity analysis – using a Spider Chart – which reflects both the probability distributions for the input variables and the correlations between the input variables. This allows for a more realistic sensitivity analysis, as the interrelationships between the input variables are taken into account, rather than just assuming -50% to +50% change in each variable (at 10% increments) without a quantitative reason why. It also provides a quantitative insight into those input variables that have the greatest impact on the per share value, and hence the primary risks associated with the company equity and how management responds to those risks.

Per Figure 5 below, this sensitivity analysis highlights the variability of the per share value is primarily driven by natural gas and NGL prices – views on these inputs are critical to the investment decision. It also highlights how mitigating operating and capital cost increases will also play an important role in enhancing per share value upside. This result is not directionally surprising as this reality is the typical dynamic for a resources company, whether hydrocarbon or mining based. However, it does highlight the nature of this relationship in a dynamic, quantitative manner that a static financial model cannot.

Figure 5:

Per Share Value Sensitivity Profile – Spider Chart – Dynamic Model

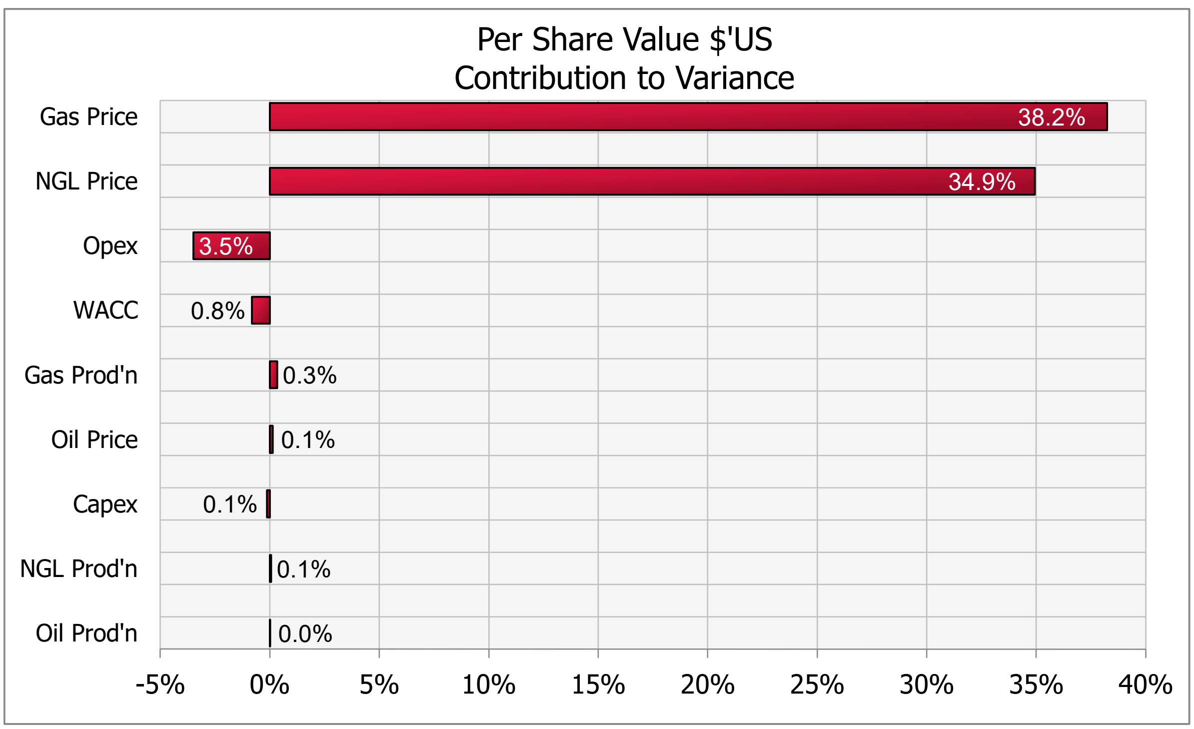


Understanding the contribution of the different input variables to the variance of the output variable, to quantitatively understand what drives the range of the output variable, can also be seen through the contribution to variance graph – another graphical output available from a probabilistic software such as @RISK. This form of analysis shows how much the underlying output variable, the per share value in this case, changes in percentage terms as the distribution profile for an individual input changes. It should also reflect the relative sensitivity responses seen in the spider chart above.

In this example, per Figure 6 below, the variability in the natural gas price drives 38.2% of the change in the per share value, while NGL prices drive 34.9%. In this case, a minimal hedging strategy is used – where more volume was hedged the variability would likely be lower. This analysis also highlights how minimizing operating costs is an important part of maximizing per share value as also highlighted above. The results do not sum to 100% due to the additional model randomness from using 2 or more variables.

Figure 6:

Per Share Value Sensitivity Profile – Contribution to Variance – Dynamic Model

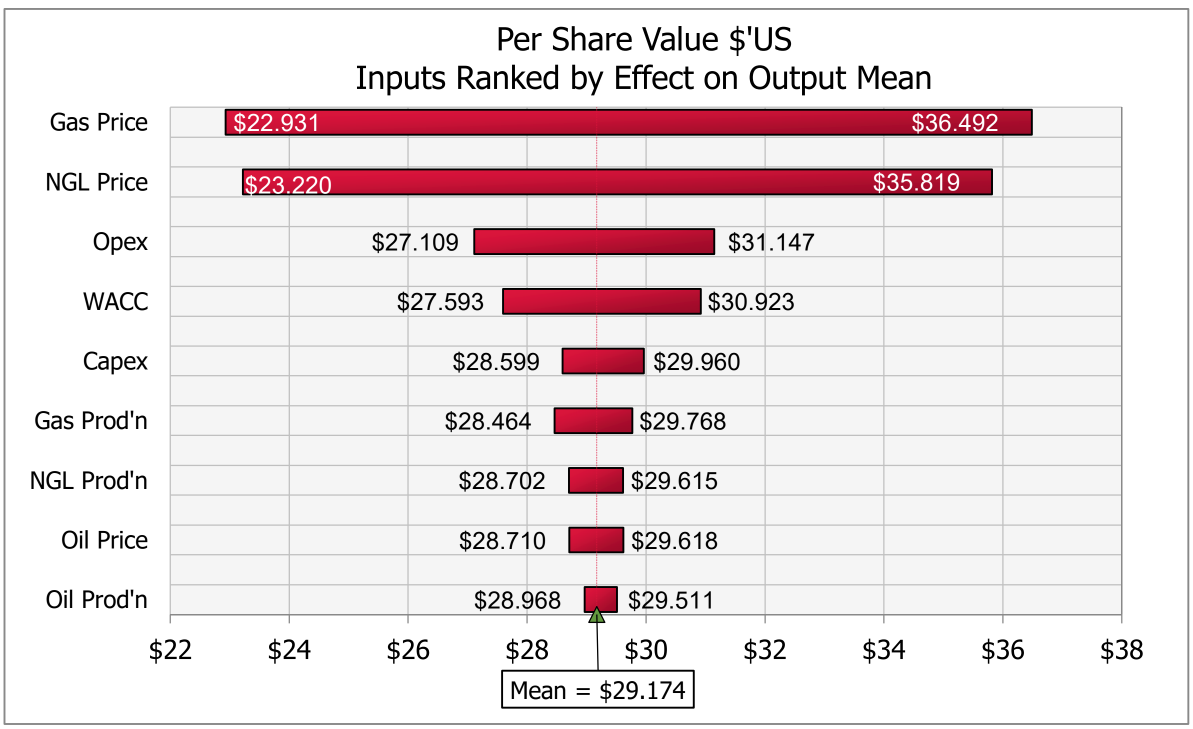


Understanding how much the output variable is impacted by the input variables, from a unit perspective (in this case $), can be seen through the inputs analysis graph – another graphical output available from a probabilistic software such as @RISK. This form of analysis shows how much the underlying output variable, the per share value mean value in this case, changes in dollar terms given the range from the smallest input value to the largest input value for each of the inputs used. It should also reflect the relative sensitivity responses seen in the spider chart and variability contribution charts seen above, just in a different manner.

In this example, per Figure 7 below, the variability in the natural gas price drives the greatest variance in the per share value with a low of $22.93 and a high of $36.49; a range of $13.56. Changes in the NGL price shows it is the next most sensitive variable with a range of $12.60 from the low and high input prices. This analysis allows the investor to understand quantitatively the value deltas that come from the low and high values of the respective input distribution variables and their relative contribution to the variability of the output variable – the value being sought.

Figure 7:

Per Share Value Sensitivity Profile – Input Analysis – Dynamic Model



Another useful benefit of a dynamic approach to financial modeling reflects the relative risk evaluation insights provided in the output data. For we can use either the standard deviation (σ) of the output distribution as a measure of risk, especially when comparing different investments, or we can use the PV-90/PV-10 calculation to understand the variability inherent in the range of potential outcomes. For an oil/gas company, this approach is used when assessing the relative risk of a well in a reserves report so we can do much the same for the equity of the company. In this case, the PV-90/PV-10 values = $37.10/$21.59 = 1.72x while the σ-= 21.3%. We can use these quantitative calculations of per share value risk/variability to determine the relative risk of this investment against other similar companies as part of the investment decision – data that cannot be gained from a static financial model.

CONCLUSION

In the relatively simple example above, using the data available for most public oil and gas companies, a dynamic financial modeling approach provides a more real world calculation of the per share value, using input variables and correlation assumptions that reflect projected reality, rather than static, single data estimates that tend towards the most expected value, assuming no strategic misrepresentation.

Additionally, the output data provides greater insight into the variability of the per share value than the static model single data estimates could. Company investors can use the more detailed information, and sensitivity graphs generated, to better define their 'buy'/'hold'/'sell' decisions, based on their respective risk profiles, and to understand the variables that play the most important role in driving per share value over time, which further helps them with their due diligence focus.

Additionally, the output variability data, such as the standard deviation or the PV-90/PV-10 calculation, provide a meaningful, quantitative insight for the per share value risk/variability for this company versus other potential investment opportunities analyzed using the same dynamic modeling approach.

Furthermore, the model took less time to build, with less internal relationships to create to make the output trustworthy, given the input variables and correlation coefficients were set using the @RISK software options. This dynamic modeling approach can be used for all types of investor financial models to generate valuation profiles that support a probabilistic-based value and risk methodology for trading and holding publicly traded securities. And it also facilitates small investors being able to develop the same trading tools available to larger, professional investors at a lower financial and time invested cost than would likely be expected.

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?