IT’S BACK TO WORK

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25 September 2017
• Summer is over, kids are back in school, companies are starting to examine and summarize their year.
• It’s back to work!

• This is true of the state of the industry.
• Many, many companies have faced a day of reckoning, have been forced to make changes and are now expecting a much more challenging future.
• Let’s look at how these changes are flowing through to hard results.

• Most economic comparisons rely on public disclosure and “forward looking” statements, but what does a bottom-up approach give?

• Starting from the well level and aggregating upward, what trends in capital efficiency and cost control can we find?
CAPITAL EFFICIENCY

• Getting a high rate well is good
• Getting a low cost well is good
• Getting a well with lots of BOEs per dollar spent is great
• Delivering those BOEs will little incremental cost is fantastic

• For five plays (Montney, Spirit River, Bakken, Cardium, Viking)
  – We estimated the EUR for every single well (primary + major secondary sales products)
  – We estimated the drill cost for every single well
  – We estimated the completion costs for every single well
  – We estimated the gas variable costs for every single well
  – We estimated the HC liquids variable costs for every single well
SAMPLE EUR FIT
There are reasons to question the absolute accuracy of public completion cost data, not least it’s completeness. However, it does represent a unique means of back-checking statements to investors on cost efficiencies. Overall, costs do appear to be decreasing.
To fill in the missing values, a non-linear regression model was fit to public cost data. It’s accuracy appeared reasonable enough to apply to wells with no publicly available in commercial databases.
The trend in capital cost reduction remains, even after missing values are imputed.

The same process (though different cost model) was applied to drilling costs.

This was done for each of the five plays in this presentation.
Public data sources are reporting continued cost reductions in both the Montney and Spirit River unconventional gas plays. Please note that these estimates are uncertain and costs are often first gathered for low cost operators.
Public data sources are also reporting cost reductions in Viking, Bakken and Cardium oil plays. However, recent cost reductions do not appear as dramatic as those observed in the Montney.
These cost reductions have been forced by significant reductions in the price of the underlying commodity.
These cost reductions have been forced by significant reductions in the price of the underlying commodity.
• The majority of operating costs are variable
• We data-mined the op costs in our database, gathering everything from the last 10 years for the 5 plays in this presentation. Costs were pulled in at the well level.
• Not all wells were stored in our evaluations. A method was needed to impute missing values.
• A random forest algorithm was used to determine the factors most predictive of costs. Using just the main drivers, a model was constructed, again using a random forest algorithm, to estimate missing values.
VARIABLE OP COST MODELS

<table>
<thead>
<tr>
<th>IncNode Purity</th>
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<tbody>
<tr>
<td>Year 865.6</td>
</tr>
<tr>
<td>SURFACE_LATITUDE 758.4</td>
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<tr>
<td>SURFACE_LONGITUDE 808.8</td>
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<tr>
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<td>PSUM_FIRST3_WATER 130.2</td>
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<td>PSUM_CURRENT_STATUS 263.8</td>
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Unsurprisingly, the year and well location were the strongest drivers of variable op costs.

Other factors, such as well status (flowing gas, pumping gas, etc) also had an impact on variable op cost.
The op cost model was tested by splitting the data into training and test sets. The model was fit using the training set then used to predict costs on the test set. Predictions were compared to actual costs. Reasonable matches were observed.
Montney gas variable costs appear to have settled in their 10 year band. There is some evidence that liquid variable costs are dropping. But this analysis isn’t weighted by production.
Total variable costs, weighted for production, might be decreasing gradually.

2017 is the exception, but the reserves process is just getting started, so results might change.
Total variable costs, weighted for production, are relatively constant.
There is generally a reasonable spread between commodity prices and the total “growth” costs for gas resource plays.

But there have been many months during which gas prices have not even covered these costs, let alone fixed costs, G&A, royalties and the cost of capital.
Just like all other times are different!
These prices aren’t unusual by long-term historical standards

“It is more clear than ever that short-term prices are unpredictable, but this paper will attempt to demonstrate once more that mean reversion should be included in any long-term model.”
This is the mean reverting price

This is a 68% confidence interval

This is the inflation adjusted price
This is the mean reverting price

This is a 68% confidence interval

This is the inflation adjusted price
THE GOOD NEWS IS THAT...

1) If you can make money now you can probably make money for a long time.
2) Companies really do appear to be getting better at controlling capital costs… though more work may be needed on variable costs
• There are many good reasons to believe that both oil and gas prices will remain at current levels for many years.
• These prices are not unusual for the oil and gas industry, nor or prolonged periods of near constant price unusual.
• Rates of return may not reach previous highs, but the exploration risk in many plays is now incredibly low.
• Thus, risk adjusted rates of returns may be still be reasonable.
• Many in the industry touted a “manufacturing model”. It looks like this has fully arrived, including manufacturing IRRs.
• With a manufacturing model, we’re moving towards manufacturing levels of return:
  – “[as of 2014] the average return on assets for nondurable manufacturing industries was 7.61% compared with 4.99% for durable goods.”: Manufacturers Alliance for Productivity and Innovation
  – For “Oil & Gas Integrated Operations” ROA has varied from 15% (Q3 2006) to -146% (Q2 2017): CSIMarket.com

• We’ve gone from lobster thermidor to cheese burger
• Guess what, there’s a giant market of people who crave cheese burgers… they have for decades and will do so for decades to come.

• The just don’t want to pay lobster thermidor prices for their cheese burgers
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