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Oil & Gas

DISTRESSED PRODUCTION LENDING:

A STOCHASTIC RESPONSE

The steep decline in commodity prices during the last twelve months means that borrowing base calculations, for Oil and Gas Production Financings, are likely to lead to distressed situations. Oftentimes, deterministic or static cases are used to evaluate the collateral supporting these production loans. However, the use of stochastic analysis, such as Monte Carlo Simulation, is far superior for lenders and borrowers alike.

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Most rational people do not like randomness and volatility. Bankers (other than traders) and lawyers, in particular, don't like randomness and volatility. But commodity markets are notoriously volatile, and this makes it very challenging to make loans against assets that have unpredictable valuations. Perhaps even worse, the assets actually deplete over time.

Companies that produce oil and gas in the United States have increased their debt burden from $128 billion in 2010 to $235 billion as of the end of Q1 2015.[1] At the same time, crude oil prices are at five year lows, and natural gas is off 35% since July 2014.[2] Producers rely on capital to fuel their drilling and production operations, but lower realized prices means that the value of the collateral underlying their loans is now less valuable. When lending gets reduced, it becomes harder and harder for a producer to replace oil and gas assets as they deplete. It is a circular trap that can be one of the biggest challenges for an independent oil and gas company.

This white paper takes on this timely topic in four sections. First, it examines production lending in general and outlines its primary characteristics. Second, there is a discussion of the valuation techniques commonly used to assess the collateral and firms that support this kind of financing. Third, the paper goes on to contend that a market view is essential and that the only thing that matters at the end of the day are commodity prices and where they are headed. Finally, Monte Carlo Simulation ("MCS"), a stochastic analysis tool, is introduced as a far superior method for assessing the risk/return profile of production lending from the perspective of all constituents: Creditors, Lenders, Borrowers, and Shareholders.

1 "The Shale Industry Could be Swallowed by Its Own Debt," By Allyn Loder, Bloomberg Business, June 18, 2015.

2 Bloomberg LP., using WTI for crude oil and NYMEX Henry Hub for natural gas, August 6, 2015.

PRODUCTION LENDING STRUCTURES

Most production loans are revolving credit facilities, but they can also be structured as term loans or a combination of the two. Typically, the revolvers are 3 - 7 years and a carefully defined borrowing base serves as the collateralization. Borrowing bases are usually recalculated in Q1 and in Q3 of each year, and depend upon current reservoir engineering reports and utilize pricing that is also current.[3] Price curves are generally called "price decks," and are most often forward curves drawn from market quotes that can be observed on Bloomberg or Reuters. They are snapshots at a point in time. Most banks develop their own forward commodity price curves to use with the engineering reports or to "sanity" check them.

This is the first challenge in a declining price environment. If a Q1 2015 borrowing base was $100 million - and this is recalculated in Q3 2015 with a new forward commodity price curve - it might now be only $65 million. The producer has to pay down the revolver's outstanding balance, but is likely to be experiencing declining cash flows.

Volumetric Production Payments ("VPP") are a structure that allows banks to take their compensation in actual oil, liquids, and gas volumes. By entering into forward contracts for the expected volumes, banks can lock in their prices and reduce, or eliminate, this element of risk. There remains production risk, however.[4] If the volumes that are predicted, modeled, and /or forecasted do not happen, then the cash realized from the VPP will be lower.

VALUATION TECHNIQUES

A borrowing base for production loans estimates the present value of the oil, liquids, and natural gas that can be produced into the future. Actual production data and independent, third-party engineering valuations are used to support borrowing base calculations. Borrowing base formulas are spelled out in loan agreements, and should be unambiguously defined. The formula sets the maximum amount of revolving credit available at any one time, and the facility is usually secured by the actual reserves.[5] Banks that lend in this market establish limits on how many producing wells have to be in the credit to be acceptable to support the borrowing base. The value of the reserves determines the loan amount and dictates the availability of funds.

Bankers are naturally more comfortable setting borrowing bases on Proved-Developed-Producing ("PDP") assets. Risking is always done, such that the cash loans advanced by banks against PDP reserves can be anywhere from 70% up to 90 %[6] of the present worth of future net income ("PWFNI"). Proved-Developed-Not-Producing ("PDNP", often called "behind pipe") and Proved-Undeveloped ("PUD") reserves, get a steeper haircut. Probable and Possible reserves do not support the borrowing base in most cases.[7]

Reserve estimates, prepared by engineering firms and by in-house teams within producers and banks, are plagued by inconsistencies. This business is very technical, complex, and

3 "Oil and Gas Production Lending," Office of the Comptroller of the Currency, April 2015, pages 8-9.
4 "Oil and Gas Production Lending," Office of the Comptroller of the Currency, April 2014, page 9.
5 "Oil and Gas Production Lending," Office of the Comptroller of the Currency, April 2014, pages 17-18.
6 SPEE data and industry discussion.
7 Ibid. 19-20.

exposed to external factors that often cannot be managed well. At least three areas are hard to forecast and play a significant role in the calculation of present value: Pricing, Costs, and Cost of Capital.

Pricing

Forward prices for oil, liquids, and natural gas have to be supportable, but this is hard to do, as they run into the future. How much oil will China need next year?[8] How much oil will the Saudis pump out in the second half of this year? These are just a couple of the items that have an impact on the market price of oil. Plus, in the USA, weather often drives natural gas prices in the short term, on top of production economics. How many weathermen get it right most of the time?

Costs

Production costs, called Lease Operating Expenses ("LOE"), include operating and maintenance expenditures for materials, supplies, fuel, property and severance taxes, insurance, maintenance and repairs. Capital expenditures include such items as roads, utilities, drilling pads, site facilities, development wells, wellheads, well casing, pipe and well equipment. Contracts can lock in some of this price risk, but long term contracts are hard to get and re-pricing can squeeze margins.

Cost of Capital

No shortcuts can be taken here. Choosing the right cost of capital, or discount rate, is not just based on the risks of the cash flows that are being evaluated. It also must involve a detailed look at the capital structure and costs of the producer itself. This is also not fixed, as floating rate debt and public equity prices move each and every day.

The complexity and challenges of trying to prepare estimates of the present value of oil and gas reserves are very difficult and vary across the world. In the US in 2007, The World Petroleum Council ("WPC"), the American Association of Petroleum Geologists ("AAPG"), the Society of Petroleum Engineers ("SPE"), and the Society of Petroleum Evaluation Engineers ("SPEE") got together to issue a joint definition as follows:

"…those quantities of petroleum anticipated to be commercially recoverable by application of development projects to known accumulations from a given date forward under defined conditions. Reserves must further satisfy four criteria: they must be discovered, recoverable, commercial, and remaining (as of the evaluation date) based on the development projects applied. Reserves are further characterized in accordance with the level of certainty associated with the estimates and may be sub-classified based on project maturity and/or characterized by development and production status."[9]

It is important to note that the Securities and Exchange Commission ("SEC") definitions for financial reporting purposes are **not identical** to the definitions presented by the engineering societies. However, with the adoption of the SEC's so-called '"Final Rule," in 2008, the definitions

8 "Oil Puzzle: How Much China Needs," Mark Magnier, Brian Spegele, and Eric Yep, The Wall Street Journal, C1, February 26, 2015.

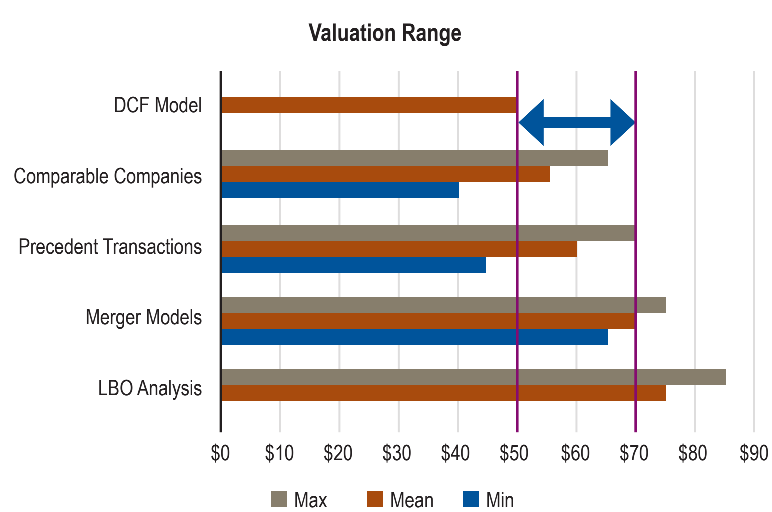
9 "Petroleum Accounting, Principles, Procedures, and Issues," Brady, Change Jennings, & Shappard, Professional Development Institute, University of North Texas, 7th edition, pages 285-287.

are pretty close.[10] "SEC PV10" is a term used to describe the quantification of oil and gas assets under the Final Rule.

Borrowing base calculations and engineering valuations are asset based valuations, in the sense that they do not include corporate expenses, taxes, and financing assumptions. They also often do not include Plugging & Abandonment ("P&A") estimates, and these can be substantial liabilities. Therefore, business, enterprise and/or corporate valuation techniques should be used to enhance and go beyond reservoir economic reports, especially in workout situations.

"Running comps" can refer to "Guideline Public Companies," "Trading Comps," "Comparable Companies," "Deal Comps," and "Precedent Transactions Comps." This is a market approach to valuation, and commonly used by investment bankers in oil and gas deals. However, the technical nature of this business means that the selection of comps has to be done very carefully. Oil and gas mixtures, positioning on the production life cycle, geological location, onshore vs. offshore, and operator vs. non-operator, are just some of the elements that have to be very similar for a company to qualify as a comp to another company. The same goes for asset and corporate transactions. The physical specifics of the assets and the company have to be very similar, or the comp metrics are not useful. In addition, the metrics themselves are different than those used in standard valuation work. EBITDAX, rather than EBITDA, is used, and multiples of SEC PV10 and "barrels of oil equivalent" ("BoE") per day production are most common.

Adding merger models and leveraged buyout ("LBO") analysis makes the assessment complete. Merger models, also a tool of investment bankers, factor in intangible asset valuation and synergies analysis to determine what a set of assets or an entire firm will be worth to a market participant acquirer. LBO models can sensitize a transaction to find the optimized maximum capital structure that can be supported by the deal's cash flows. The figure below gives a sense of how these techniques create a range of valuations that allow decision makers to make the best risk assessments.



10 Ibid. 287-291.

HAVE A MARKET VIEW

Just as it is not possible to answer the question "where will oil be trading in two years" with certainty, the answer "I don't know" is not acceptable either. It is important to have a view and a reason for the view. Price decks typically take a forward curve from Bloomberg or Reuters, at a point in time, and use this set deterministic position for valuation. But there are far more robust quantitative forecasting tools that can be used to take a more proprietary market view. For example, ARIMA and GARCH models can be used to produce forward price curves for commodities. These are time-series econometric models that can be adjusted to work for commodity price data. ARIMA means *autoregressive integrated moving average model*, and GARCH refers to *general autoregressive conditional heteroskedasticity* models. They can be used with historic commodity price data and other inputs to model forward with uncertainty elements modeled, as well. What makes them powerful tools to forecast commodity prices is that they are designed to forecast and model volatility, which is the real challenge.

A great deal of time should be invested on volatility, because of its importance, and because of the difficulty involved in getting it right. There is substantial evidence that financial prices - such as equities, interest rates, foreign exchange rates, and commodities - do not follow the lognormal random walk that is an underpinning of modern finance. Two key elements play a role in this. First, assets can jump up or down suddenly in value. Second, volatility is not a constant. It is always changing. These factors cause price paths to be discontinuous. Models that address this issue are called jump-diffusion models, and they rely on Poisson processes. A Poisson process is defined like this:

$$dq = \begin{cases} 0 \text{ with a probability of } 1 - \lambda dt \\ 1 \text{ with a probability of } \lambda dt \end{cases}$$

There is a probability of λdt of a jump in q in the time step dt. For example, q could be the price of oil and dt could be the time between borrowing base recalculations. The parameter λ is the intensity of the Poisson process. The scaling of the probability of a jump with the size of the time step is important in making the model realistic. There should be a finite chance of a jump happening in a finite time period. This Poisson process can be built into an MCS model fairly easily, if the analyst and advisory firm have a proper grounding in quantitative finance:

$$dS = \mu S dt + \sigma S dX1 + (J-1) S dq$$

This assumes that the Brownian random walk is not correlated to the Poisson process, and:

dS = change in the asset's value,

μ = drift,

dt = a finite time increment,

σ = volatility,

dX1 = Geometric Brownian Motion,

J = a jump, and

dq = defined above.

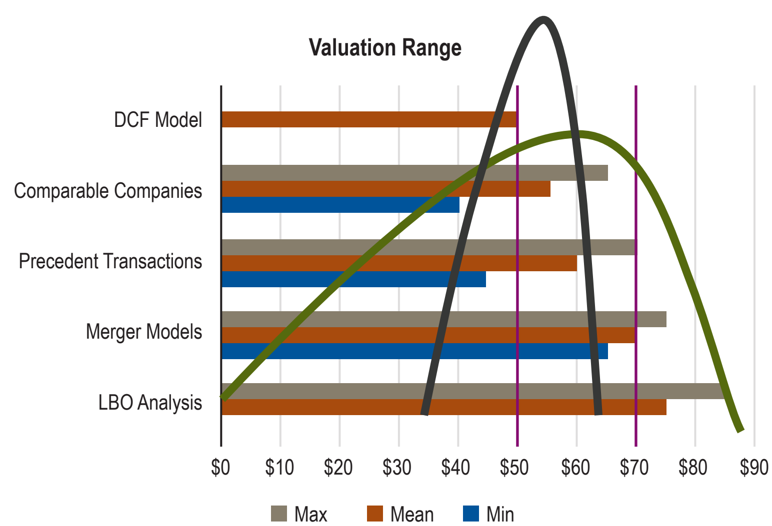
If there is a jump, then *dq* is = to 1. Then S becomes JS. If we test that oil will fall by 10% in *dt*, then J = 0.9. J can be random, adding more realism to the model. But there is still an issue. Volatility, σ, is also moving. It is not constant. Moving, or stochastic, volatility, can be modeled this way.

$$d\sigma = p(S,\sigma,T)dt + q(S,\sigma,T)\, dX_2$$

The two increments dX_1 (from the prior equation) and dX_2 have a correlation of *p*. The choice of the functions *p(S,σ,T) and q(S,σ,T)* is critical and based on skill and experience.

STOCHASTIC VALUATION

The Greek word *stochastikos,* or more properly στοχαστικός, means to guess or to aim at. The actual root, *stokhos,* was the target archers shot at in ancient Greece.[11] This term found its way into analytical finance in the last century, and advances in computer technology have made its application easier and easier to do. The guessing element certainly makes most people uncomfortable, but reflects the reality we see in the world today: randomness plays a role in all aspects of life. The oil and gas world is no exception. Stochastic calculus refers to the math that includes a random term in the equation, and a stochastic model includes random variables occurring in time, or over time.[12] Reserves engineering models use price assumptions with cost assumptions to create hypothetical wells. Simply put, if oil is $45 per barrel, given specific cost assumptions, some wells will not be drilled in the model. This means that the entire analysis is a circular process that regresses and correlates into itself, in such a way that set assumptions in a vacuum will lead to bad answers. The entire value chain has to be modeled stochastically to get the best data for a decision. "Garbage in / garbage out" means that the parameters in the model need to be carefully selected and vetted with commercial and market reality. Thousands of simulations should be run to reach an answer, and the range is as important as is the mean and median. The shape of the valuation results determines just how tight it is possible to be against the lending levels, and how much capital is at risk at any given point in time. See below.



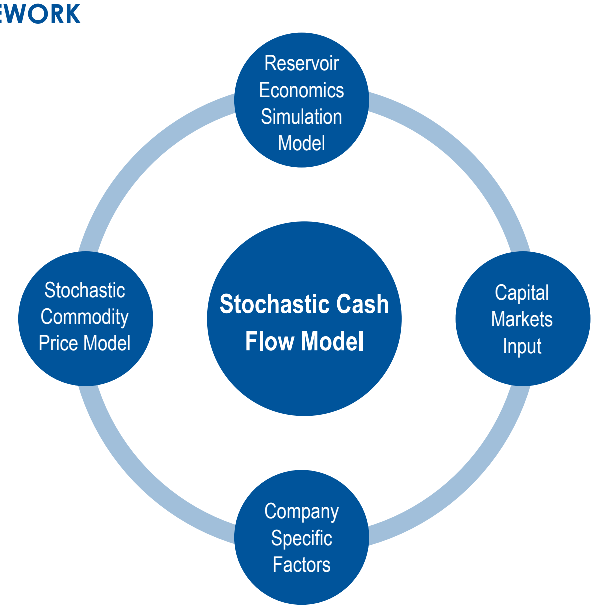
11 www.vocabulary.com
12 Asset Price Dynamics, Volatility, and Prediction, Stephen J. Taylor, Princeton University Press, 2005, pages 30-33.

FINAL THOUGHTS......

MATH + MODELS + MARKETS = VALUATION

If a lot of money is at stake, then why use artificial and deterministic shortcuts to test all of the assumptions and possibilities when modeling an oil and gas situation? It is far better to use the most sophisticated tools available. Commodity market volatility means, by definition, that lending into this market must be seen as **lending into future volatility. Tactical decisions do not result in the best outcomes.** The use of MCS for the development of curves and to test a wide range of potential outcomes leads to the best assessment of risk, and the best pricing of risk for lenders, borrowers and creditors. Above all, the most robust analysis combines commodity market model experience, technical reservoir engineering skills, and capital markets expertise into a single, unified stochastic analysis. Navigant is an advocate of work product that combines all three critical skill sets in order to get to the best result for borrowers, lenders, and other stakeholders. It is time for banks to move away from deterministic borrowing base thinking and embrace a stochastic approach to lending in the oil and gas patch. Banks made loans when oil was $100 a barrel, and now will make loans with oil at $45 per barrel. The one element that has the largest impact on cash flows that can support production lending, namely commodity prices, is the one element that gets the **least analytical scrutiny**. It is time for a paradigm shift. Borrowers and lenders need to come together to structure financings set against cash flow models that use best practices quantitative finance, market skills, and more robust price curves. If banks and their clients agree on a model framework that they both use together, simultaneously, then the chances for distress will be dramatically reduced in the months and years to come. The Navigant Framework builds a stochastic cash flow model that is designed specifically for borrowers and lenders to see the complete picture of potential outcomes. Four elements feed into the Framework, as shown below. All four elements enjoy equal importance in how they influence the core model.

NAVIGANT FRAMEWORK



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