SPE-179987-MS

Analyzing the Effect of Debt on the Equity Valuation of Oil and Gas Producers in the Current Commodity Price Cycle

Manoj Devashish

Citi Corporate and Investment Bank | Global Energy Group

Table of Contents

Valuation Management Strategy for an Exploration & Production (E&P) Company

Managing the Risk of Debt Induced Equity Value Loss

- In the current commodity cycle, the % loss of equity value for many companies has significantly exceeded the % drop in commodity prices.

- This magnification of value loss can be largely attributed to an increase in the debt load. The more leveraged companies within a geologic basin lost a larger percentage of their equity value.

- Price hedging was used effectively by certain Appalachian basin companies to preserve value and prevent the debt induced equity value loss.

Managing the Risk of Debt Induced Equity Value Loss

- A valuation management strategy, called the Devashish Method, can be used for immunizing an E&P company's equity value against the adverse effect of its debt load.

    Key Aspects of this Strategy
    1. Aligning a company's hedge book with its debt load; and
    2. Measuring the alignment using DEVA Plot which is a Cartesian plot drawn using debt and price hedging information.

- To achieve the equity value immunization goal, a company should manage its hedging program such that it maintains a position close to the unit slope line through the origin on the DEVA Plot.

Importance of Valuation to the E&P Community

Current Commodity Price Cycle

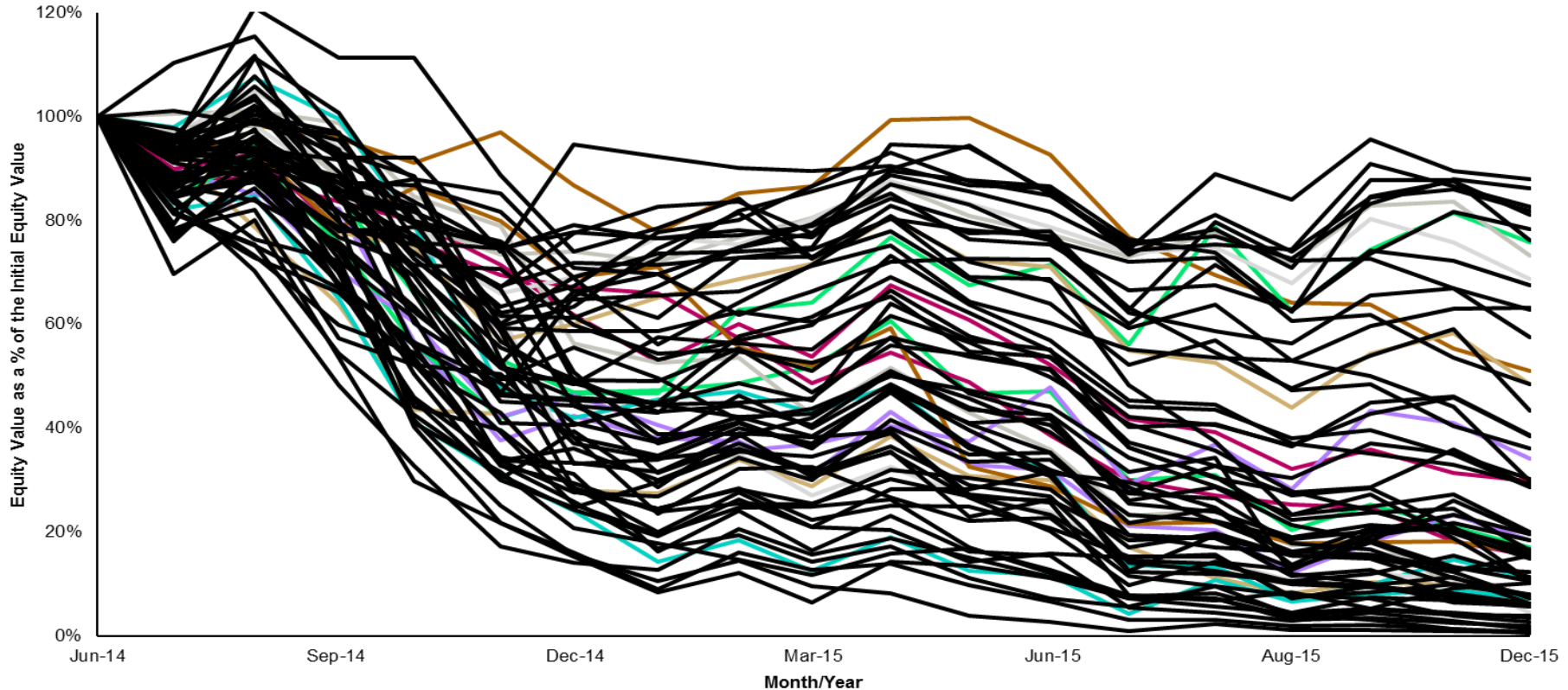
Oil and Gas Prices Dropped Precipitously after September 2014
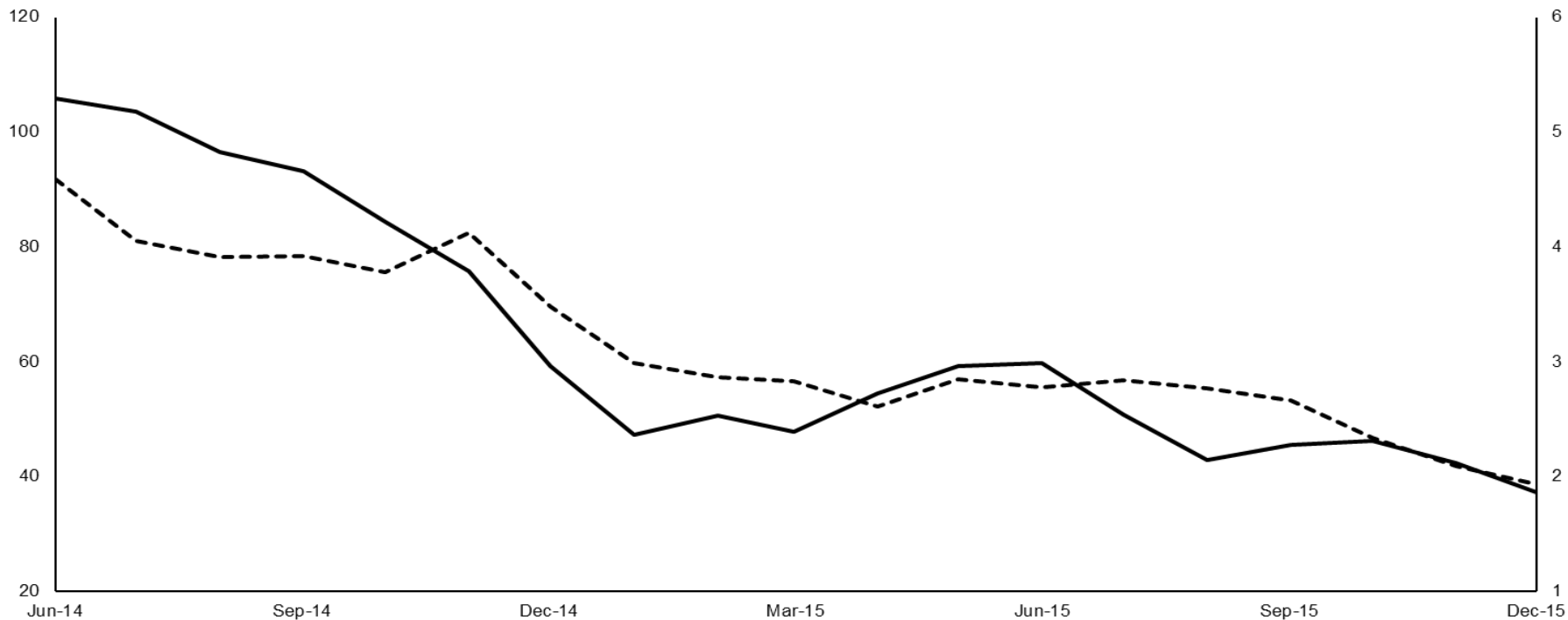
Spot Price ($/Barrel) of WTI Crude Oil on Left Axis — Spot Price ($/MMBtu) of Henry Hub Natural Gas on Right Axis

More than a third of E&P companies lost >90% of their equity value

Equity Performance of 71 Public E&P Companies Operating in the United States

Valuation Affects Project Funding and Business Continuity

Almost $60-billion in Canadian projects in peril.

- Financial Post, January 2, 2015

Low oil price hits $200 billion in mega-projects.

- Reuters, June 16, 2015

Oil rout forces companies to delay decisions on $380 billion in projects. Companies delayed making decisions on 68 major projects world-wide last year.

- The Wall Street Journal, January 14, 2016

Deloitte estimates that a third of global oil and gas exploration and production companies - with a combined debt of over $150 billion - are at high risk of default or bankruptcy.
.

- Fortune, March 25, 2016

Analyzing the Impact of the Current Commodity Price Cycle on E&P Valuations

Selection of Comparable Companies for our Valuation Analysis

We limited our research solely to SEC reporting public companies because the desired data are not publicly available for non-reporting companies. Further, to be able to make comparisons, we limited our research to companies operating exclusively within the United States.

- E&P Company Universe

    These exclusions left us with a set of 71 publicly listed, SEC reporting companies for our research.

- Appalachian Subset

    In this E&P Company Universe, 13 companies have a majority of their reserves located in the Appalachian basin.

Value Loss % for a Majority of the Producers Exceeded the % Price Drop

Oil and Gas Prices Dropped Precipitously after September 2014
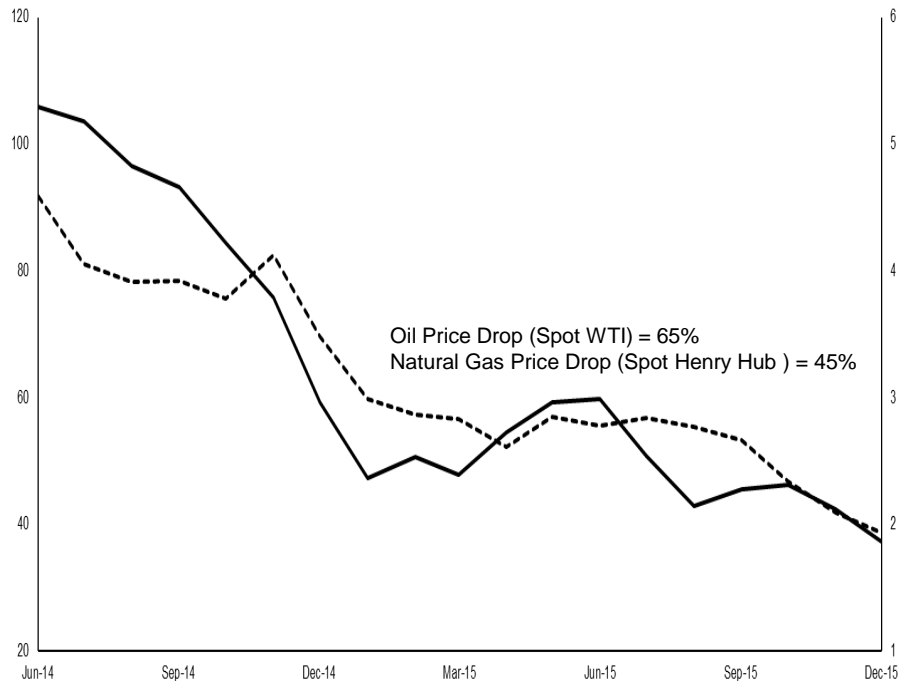
Oil Price Drop (Spot WTI) = 65%
Natural Gas Price Drop (Spot Henry Hub) = 45%

——— Spot Price ($/Barrel) of WTI Crude Oil on Left Axis   ------ Spot Price ($/MMBtu) of Henry Hub Natural Gas on Right Axis

Equity Performance of 71 Public E&P Companies Operating in the United States
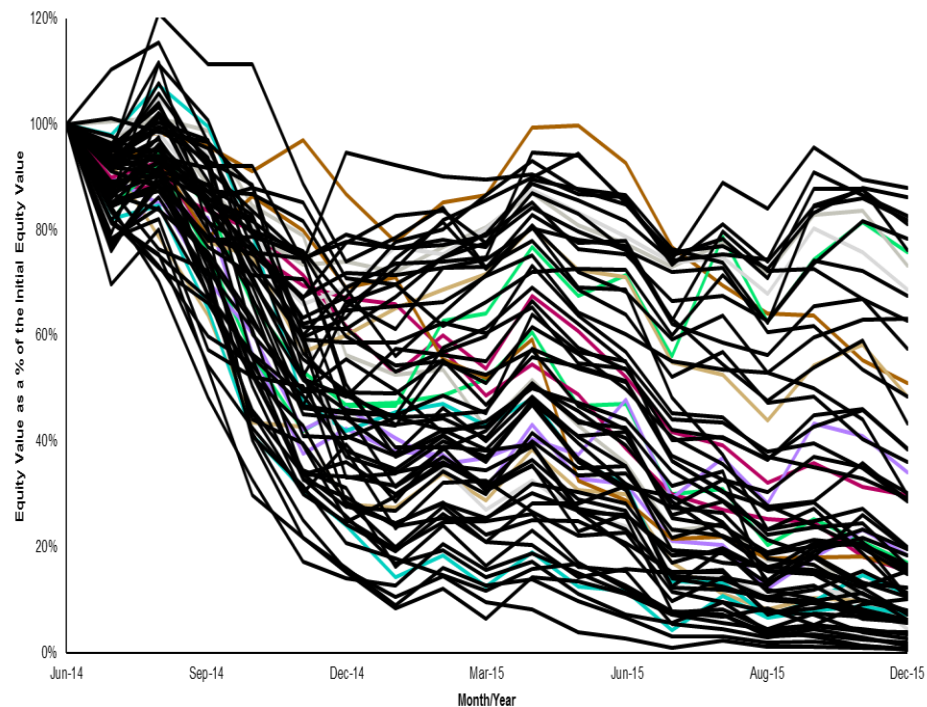
Would the varying debt load explain the significant variability in equity performance observed above?

Data Processing to Analyze the Effect of Debt Load on Valuation

To analyze the relationship between debt load and equity value loss, we employed statistical regression for identifying and measuring patterns. Certain normalized measures defined below were computed for making comparisons. The stock prices used were adjusted for dividends and splits.

- Normalized Measure for Debt:

$$Leverage = \frac{Net\ Debt}{LTM\ EBITDA}$$

- Normalized Measure for Equity Value Loss:

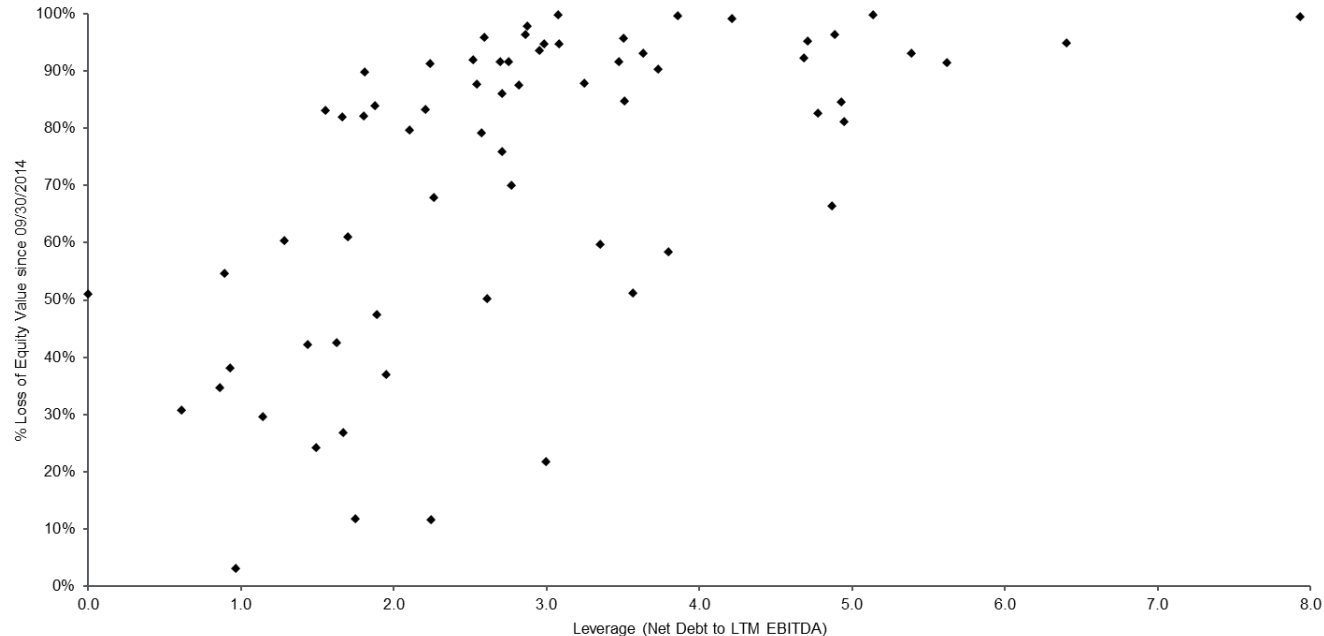$$Equity\ Value\ Loss\ \% = \frac{Drop\ in\ stock\ price\ between\ 30\ Sept\ 2014\ and\ 1\ Feb\ 2016}{Stock\ price\ on\ 30\ Sept\ 2014}$$

LTM means relating to the Last Twelve Months period
EBITDA means Earnings Before Interest, Taxes, Depreciation, & Amortization expenses

Regression using Sept-2014 Leverage and Subsequent Value Loss

**% Loss of Equity Value versus Corporate Leverage**

(1) Debt load has a value diminishing effect on equity valuation,
(2) Companies with more than 5 times Leverage lost almost all of their equity value, and
(3) Scatter indicates the presence of other factors, in addition to the debt load, causing variability in equity performance for companies with similar Leverage.

Analysis for Companies with a Leverage of < 5 times

% Loss of Equity Value versus Corporate Leverage with Regression Line
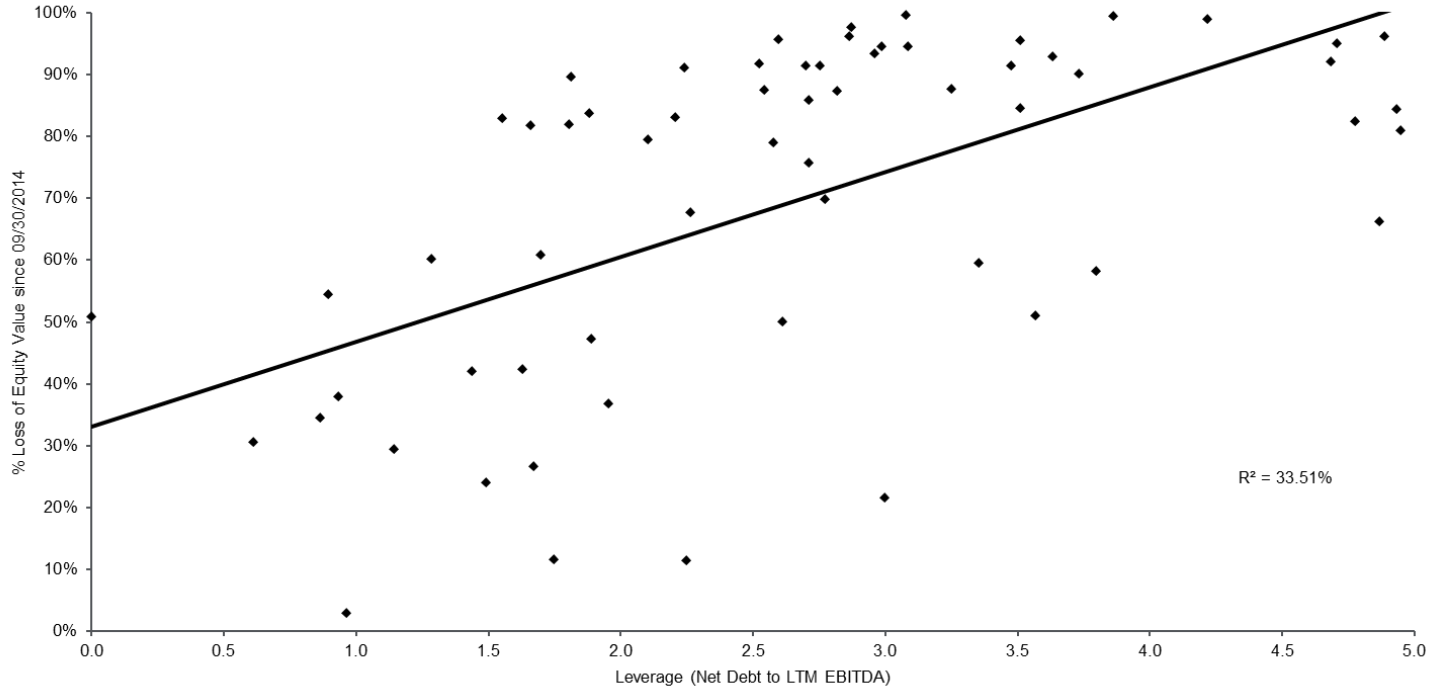
There is a modest correlation between the debt load and the loss of equity value.
- *However, the debt load alone does not explain all of the value loss.*
  - *What other factors have an influence on equity performance?*

Does the Geologic Basin affect Equity Valuation?

PERMIAN BASIN: % Loss of Equity Value versus Corporate Leverage
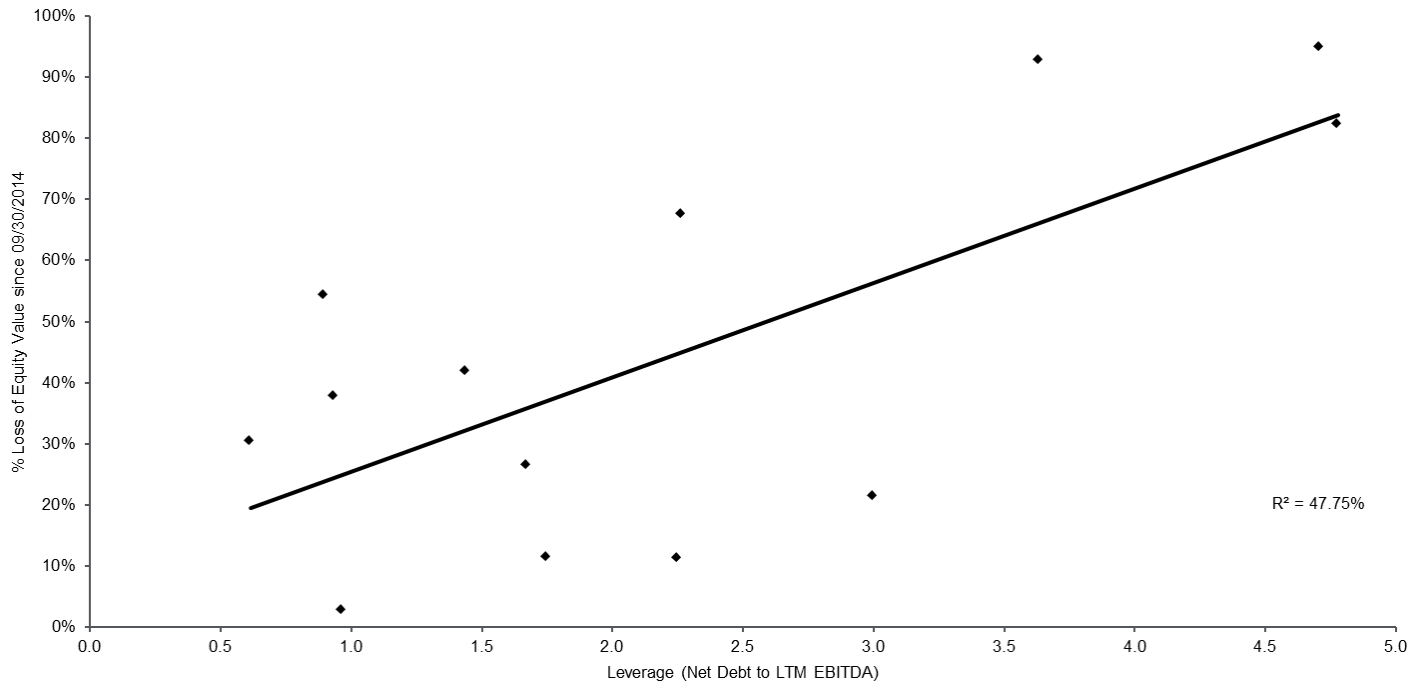
Higher R^2 above (48% vs. 34% before) indicates that the ability of debt load to explain the equity performance variability improves if we control for the effect of geologic basin.

Basin-specific Analysis for Williston Basin Companies

WILLISTON BASIN: % Loss of Equity Value versus Corporate Leverage
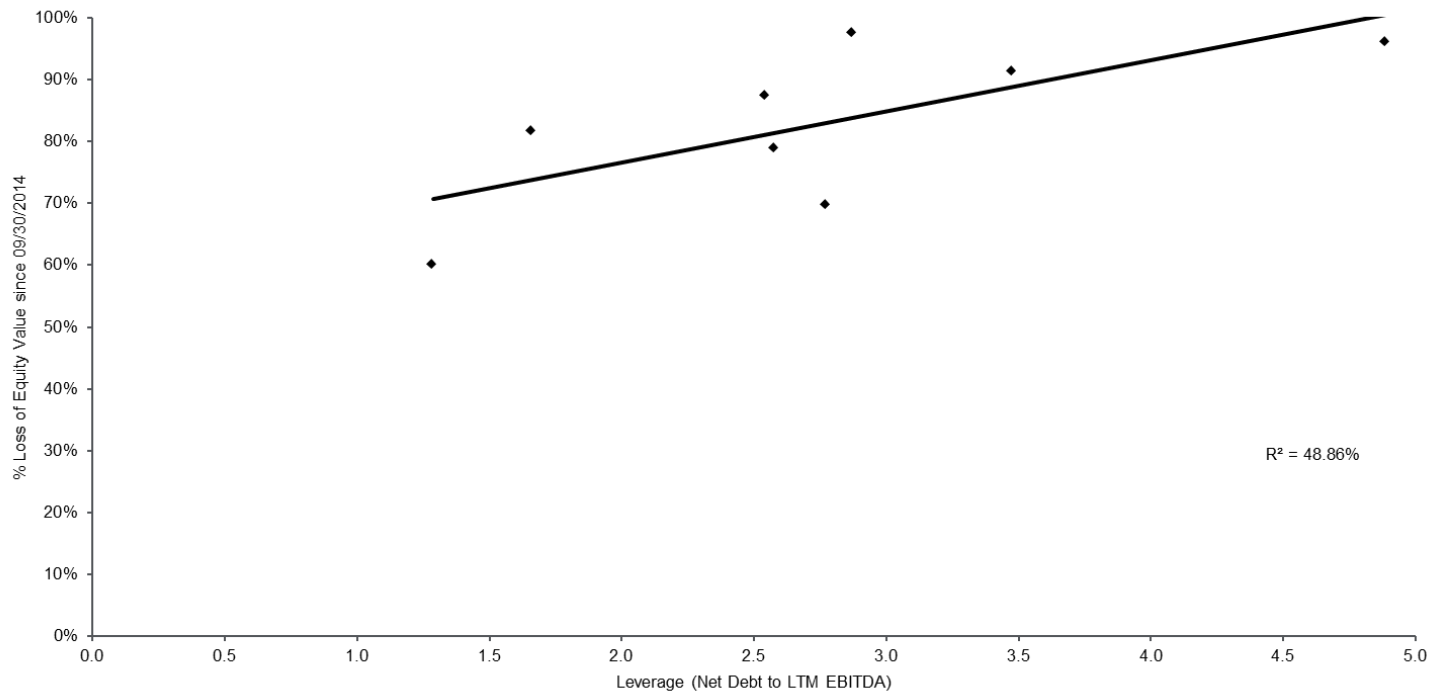
R^2 improvement is also observed for Williston basin companies (R^2 = 49%). These analyses confirm that the relationship between Leverage and equity valuation is basin specific.

Appalachian Basin Analysis Indicates Other Influences

APPALACHIAN BASIN: % Loss of Equity Value versus Corporate Leverage
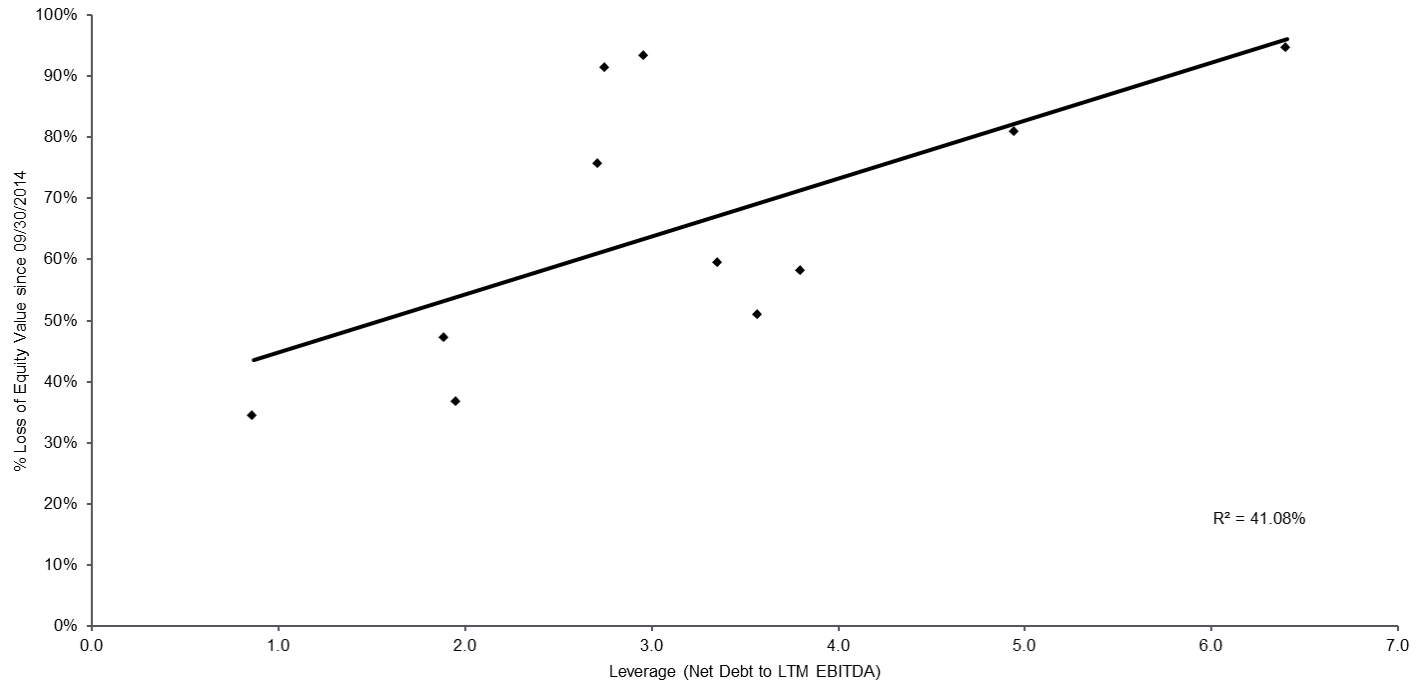
Certain companies with higher debt load outperformed other lesser leveraged companies which indicates the presence of additional influences (note a reduction in R^2 down to 41%).

Six Appalachian Basin Companies (the Leaders) Outperformed Others

Company	Symbol	% Change in Equity Value	Equity Performance Rank	Net Debt to LTM EBITDA (as of 09/30/2014)	Net Debt to LTM EBITDA (as of 09/30/2015)
Company 27	C27	(34%)	1	1.1	0.9
Company 8	C08	(37%)	2	0.9	2.0
Company 32	C32	(47%)	3	1.5	1.9
Company 3	C03	(51%)	4	4.0	3.6
Company 52	C52	(58%)	5	2.5	3.8
Company 55	C55	(59%)	6	3.7	3.4
Company 60[1]	C60	(76%)	7	0.8	2.7
Company 30	C30	(81%)	8	2.7	4.9
Company 61	C61	(91%)	9	1.7	2.8
Company 21[2]	C21	(93%)	10	3.1	3.0
Company 54	C54	(95%)	11	3.4	6.4
Company 69[3]	C69	(97%)	12	4.4	N/M
Company 38[3]	C38	(99%)	13	7.2	N/M

1. Company 60's debt increased to 3.0 times EBITDA as of 2014 year-end following its acquisition of certain assets.

2. Company 21 reduced its Leverage with a $440 million equity raise in January 2015.

3. Leverage could not be calculated with negative EBITDA values. N/M stands for non-measurable.

The Devashish Method

Hedging Hypothesis based on an Analysis of Leaders' Financial Data

The value loss for the top six Appalachian basin companies (the Leaders) was largely in line with the price drop of oil and gas. Debt didn't magnify the severity of value loss. Why?

Hedging Hypothesis

- We hypothesized that, by hedging production adequately, an E&P company would protect its equity from the value diminishing effect of debt during a downturn.

Thought Process behind the Hedging Hypothesis

- Let us consider an E&P company with a Leverage of 3.0 immediately prior to the price collapse. Since LTM EBITDA represents a year's worth of cash flows, a Leverage of 3 means that the debt amount is 3 times the annual cash flows.

- **Q:** Would the value diminishing effect of debt be neutralized if the company had, prior to price collapse, protected 3 years of cash flows by hedging 3 years of production volume?

- **A:** Yes – Because, by hedging 3 years of production, the hedge protected cash flows would equal 3 times the annual cash flows and be sufficient to fully repay the debt.

Use DEVA Plot to Determine Hedge Adequacy

- We used a graphical tool, called DEVA Plot, to analyze if a company's debt load would adversely affect its equity value following a dramatic price decline.

- DEVA Plot is an acronym for the **D**ebt [effect on] **E**quity **V**aluation **A**nalyzer.

- The DEVA Plot of one or more comparable companies is a Cartesian plot of certain debt and hedge metrics of the companies. Debt metric for the DEVA Plot is Leverage which was defined earlier. Hedge metric for the DEVA Plot is H/P Ratio as defined below.

$$\frac{H}{P} \, Ratio = \frac{Total \, Volume \, Hedged}{LTM \, Production}$$

Leaders' DEVA Plot as of Sept-2014 Validates the Hedging Hypothesis

DEVA Plot: Leaders' Positions with Regression Line (R² = 58%)
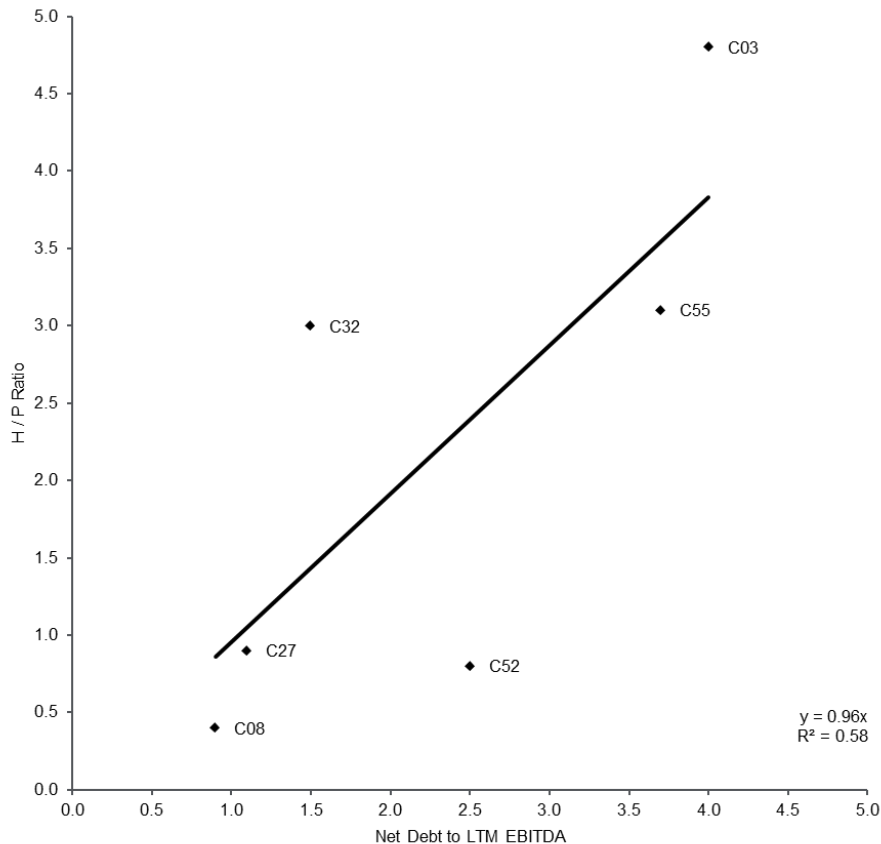
Leaders were positioned close to the unit slope line through origin on the DEVA Plot (R^2 = 58%).

Due to such positioning on the DEVA Plot prior to the price decline (Sept. 2014), we believe the Leaders were able to better protect their equity value.

Note that a position on the unit slope line through the origin implies that the value of the hedged cash flows is sufficient to fully repay the debt.

Additional Validation from DEVA Plot of the entire Appalachian Subset

DEVA Plot: Appalachian Public Company Universe as of September 2014
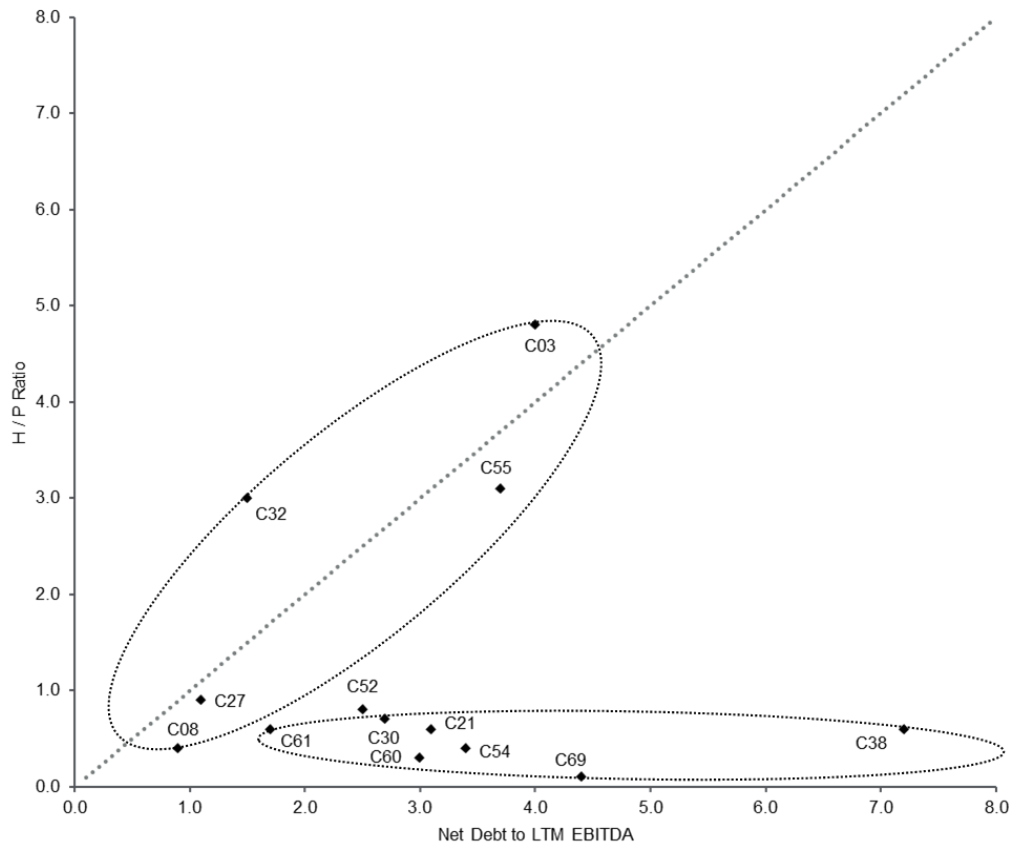
Upon adding the remaining Appalachian Subset companies, we observe the underperformers' positions fall materially below the unit slope line through origin on the DEVA Plot.

Underperformers' positions on the DEVA Plot, we believe, reflects their under-hedged position vis-à-vis the debt load carried by these companies.

The Devashish Method of Equity Value Immunization

- The Devashish Method is a management strategy for immunizing an E&P company's equity value against the value diminishing effect of debt during a downturn.

- It utilizes the DEVA Plot tool to determine the adequacy of an E&P company's hedge book.

- The Devashish Method states:

  To achieve the equity value immunization goal, a company's hedging program should be managed such that the data points comprising its H/P Ratio and Leverage fall close to the unit slope line through the origin on the DEVA Plot.

Leaders Managed Hedges to Maintain their Positions on DEVA Plot

DEVA Plot: Positioning of the Leaders over Time
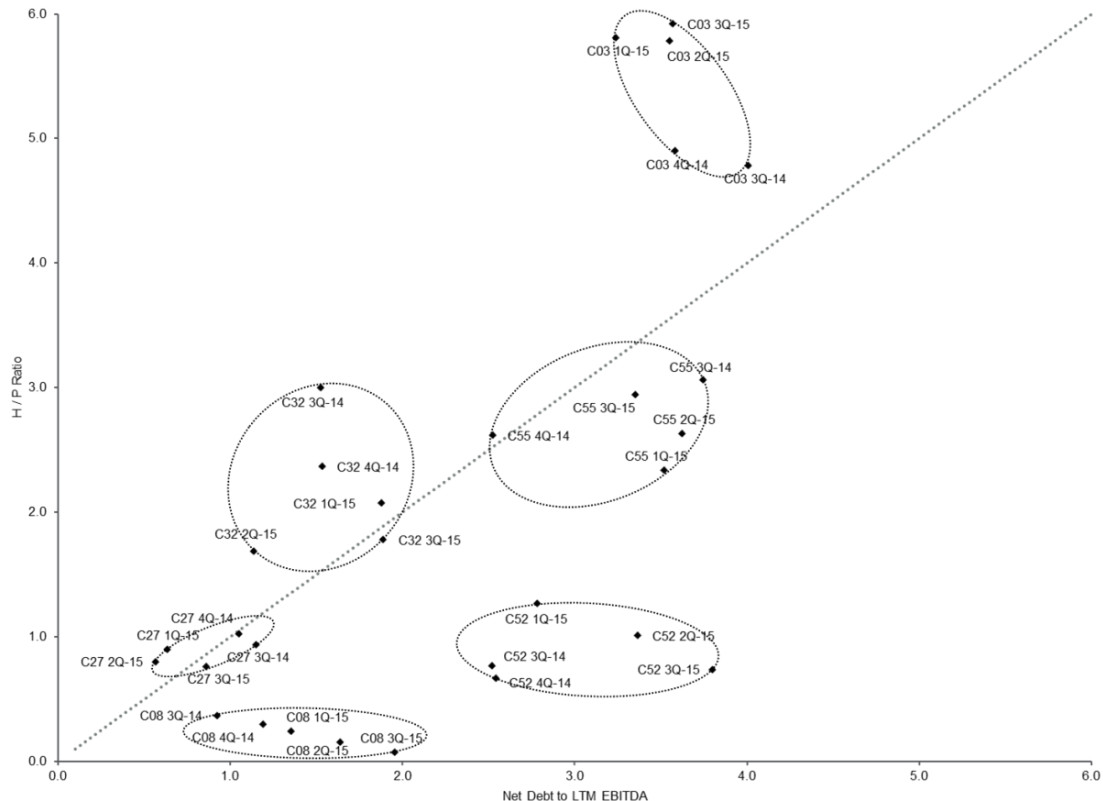
This DEVA Plot for the Leaders uses quarterly data from 3Q-2014 to 3Q-2015.

Leaders' positioning over time on the DEVA Plot indicates that most of the Leaders were actively managing their hedge books.

Such active management caused them to stay close to the unit slope line through the origin on the DEVA Plot.

Devashish Method Requires Computation of Comparable Hedged Volumes

- Oil & gas producers use a variety of derivative instruments to hedge prices.

- Swaps, puts, and collars generally protect well against a catastrophic price decline by providing unlimited downside protection.

- Put spreads, protective spreads, and/or three-way collars offer limited downside protection in the event of a catastrophic price movement.

- Basis swaps offer protection from volatility of regional basis differentials.

- To normalize for the varying level of price protection offered by the derivative instruments, the Devashish Method requires us to make certain adjustments to the hedged volumes for the computation of H/P Ratio (see SPE-179987-MS).

Conclusions

Managing the Risk of Debt Induced Equity Value Loss

- The Devashish Method is a valuation management strategy for immunizing an E&P company's equity value against the adverse effect of its debt load.

- The Devashish Method prescribes the use of a set of rules to common-size the commodity volumes hedged using a wide variety of derivative instruments.

- The Devashish Method utilizes DEVA Plot, drawn using leverage and hedged volume data, as a tool for assessing the adequacy of an E&P company's hedge book.

- To achieve the equity value immunization goal, a company's hedging program should be managed such that the data points comprising its H/P Ratio and Leverage fall close to the unit slope line through the origin on the DEVA Plot.

Appendix

I.   Valuation Methods used in the E&P Sector

II. Theoretical Framework for Evaluating the Debt Effect on Equity Value

Valuation Methods used in the E&P Sector

Valuation of Oil & Gas Interests

- Society of Petroleum Evaluation Engineers (SPEE) Monograph 2 defines the fair market value as the price agreed to by a willing buyer and seller

    - ✓ with neither being under compulsion to [transact],

    - ✓ both being knowledgeable of the pertinent facts involved, and

    - ✓ the package having been adequately exposed to the market for a reasonable period.

- Please refer to SPEE Monograph 2 (Long et al 2002) for an in-depth discussion of the many different aspects of valuing oil and gas interests.

Fundamental Valuation

- Discounted Cash Flow (DCF) Analysis

An evaluator estimates future cash flows generated by the subject assets which are then discounted back at an appropriate risk-adjusted rate to compute the asset value.

E&P Cash Flow Equation:

Cash Flows = (Net Production) * (Realized Prices) – Taxes – Operating Expenses – Investments

Relative Valuation

- Three commonly used relative valuation methods are:

  ❑ Price paid on a per unit of proved reserves basis ($ per boe)

  ❑ Price paid on a per unit of daily production basis ($ per boe/day)

  ❑ EV/EBITDA : Enterprise Value (EV) to Earnings before Interest, Taxes, Depreciation, Amortization, and Exploration expenses (EBITDA) Multiple

- EBITDA functions as a proxy for operating cash flows which can be used for benchmarking a company against its peers, normalizing for the effect of the company's asset base, capital structure, and tax structure.

- See SPE-169858-MS (Devashish 2014) for a discussion of valuation methods.

Theoretical Framework for Evaluating the Debt Effect on Equity Value

Enterprise Value and Equity Value

- Enterprise Value (EV) is the total value of a company. EV equals the market value of the company's total capital net of cash.

- Debt and equity are two forms of capital commonly employed by E&P companies. Other forms of capital, such as preferred stock, were ignored for the purposes of this research.

    EV = Equity Value + Total Debt – Cash

- By re-arranging the equation above, we could compute the value of equity.

    Equity Value = Enterprise Value – Net Debt

Example Illustrating the Debt Effect on Valuation

(Continued on the Next Page)

Let us assume that two E&P companies, Company A and Company B, are comparable for the purposes of our analysis. Prior to a steep fall in prices, each company had an expected EBITDA of $100 million and an enterprise value of $800 million (i.e., EV/EBITDA multiple of 8 times).

- Each company had a debt capacity of 3.0 times EBITDA or $300 million.

- Company A borrowed $300 million utilizing all of its debt capacity.

- Company B borrowed $100 million thereby retaining $200 million of unused debt capacity.

- Both companies fully invested their capital (i.e., no cash on balance sheet).

Example Illustrating the Debt Effect on Valuation

Following a steep decline in commodity prices, the market sentiment soured on the E&P sector. Now, each of Company A and Company B has an expected EBITDA of $75 million and is valued at 6 times EV/EBITDA multiple. Debt and cash situation remains unchanged.

	Prior to the Price Decline	Post-Price Decline	% Change
Company A			
Enterprise Value	$800	$450	(44%)
Net Debt	$300	$300	0%
Equity Value	$500	$150	**(70%)**
Company B			
Enterprise Value	$800	$450	(44%)
Net Debt	$100	$100	0%
Equity Value	$700	$350	**(50%)**

As illustrated above, a company's equity performance is impacted by its debt load.

Acknowledgements / Thank You / Questions

For their invaluable assistance with this paper, the author would like to sincerely thank the following individuals: