Market Evidence of Reserve Adjustment Factors and Risk Adjusted Discount Rates in a North American Unconventional Play

Theme: Resource Assessment

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Abstract

There is a lack of information on how the U.S. oil and gas industry handles investment risk when valuing mineral rights. One of the more useful sources of information is the Annual Survey collected by the Society of Professional Evaluation Engineers' (SPEE) which asks industry experts to share their opinion concerning Reserve Adjustment Factors (RAF) and Risk Adjusted Discount Rates (RADR) for different reserve categories. But little has been done to observe direct market evidence of RAFs or RADRs. This research aims to address this shortfall.

This investigation gathered information on the sale of mineral rights in a region of Oklahoma and then conducted discounted cash flows to establish the un-risked fair market value (FMV) of the mineral rights at the date they were transacted. The un-risked FMV's are compared to the actual sale price. The difference between the two is indicative of the industries perspective on investment risk.

As would be expected, we observe progressive de-risking over the life cycle of mineral rights. Large risk adjustments are applied prior to initial drilling when reserves would be categorized as Possible or Probable. Then smaller risk adjustments are applied as exploratory wells are drilled and reserves become Proved-Undeveloped. Once a production unit is fully drilled-out there is almost no risk adjustment, and an industry standard 10% discount rate for Proved Developed Producing (PDP) reserves is applied.

Our findings serve to strengthen commonly accepted RAF and RADR with direct market evidence. It also serves as an example of how oil and gas evaluators can approach RAFs and RADRs in a way that is more consistent with the real-property appraisal. We encourage oil and gas evaluators to continue this type of research and seek market driven risk adjustments and discount rates when estimating FMVs.
Summary

Mineral rights values have a life-cycle – increase as they are drilled/proved/de-risked and decrease as they are depleted.

Investment risk can be accounted for with a Reserve Adjustment Factor (RAF) or Reserve Adjusted Discount Rate (RADR), these change depending on the reserve category.

The best data we have had available for what RAFs or RADRs industry participants apply is the annual SPEE survey.

This study shows market-based evidence of RAFs and RADRs and provides an example which is more in line with real-property appraisal methods for Fair Market Valuations.

Need more research! Additional efforts could focus on how RAF and RADR might change by play type, basin, operator, or interest type.
Market Evidence of Reserve Adjustment Factors and Risk Adjusted Discount Rates in a North American Unconventional Play

Nicholas Devereux Kernan, Geologist

Annual Conference - Rocky Mountain Section
American Association of Petroleum Geologists

Denver - July 27, 2022
Case Study

Continental (2010)

• Map (right) showing extent and maturity windows of the Woodford Formation

• Case study focused on the SCOOP play of the Anadarko Basin where the Woodford Formation is the primary target

• Region is optimal for this research due to the large number of mineral deeds transacted over a long period (10+ years) and at different stages of oil and gas development

Symcox (2021)
Case Study

- 7 sections with a relatively similar geology and development pattern
- Initial one-mile horizontal well drilled around August 2013
- Five additional two-mile horizontals wells drilled between November 2015 to March 2016
Mineral deed sales within the seven sections of the study area:
Mineral deed sales within the seven sections of the study area:

**Key Take Away:**
- There is a life-cycle to mineral rights values
- Go up in value as reserves are de-risked
- Go down in value as reserves are depleted

**Increasing Value = Decreasing Risk**

**Decreasing Value = Depletion**

First well drilled August 2013

5 additional wells drilled March 2016
How is Investment Risk Applied?

• An investment is typically analyzed with a discounted cash flow (economic model that considers the time value of money)

• Example: A five-year cash flow with an initial investment of $500,000 and a risk-free 10% discount rate:

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<th>PV 10</th>
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• To account for risk, we can apply a Reserve Adjustment Factor (RAF) or a Risk Adjusted Discount Rate (RADR) to our cash flow
How do we Apply Investment Risk?

- **Reserve Adjustment Factor (RAF) Method**
  - Applied to the NPV of discounted cashflows
  - Example: At a 10% risk-free discount rate a cash-flow has an NPV of $1,712,902
    - 80% RAF = $1,712,902 x 0.80 = $1,370,322
    - 50% RAF = $1,712,902 x 0.50 = $856,451
    - 20% RAF = $1,712,902 x 0.20 = $342,581

- **Risk Adjusted Discount Rate (RADR) Method**
  - The rate obtained by adding a risk premium to the risk-free rate
  - Example:

<table>
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<td>Total</td>
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<td>1,712,902</td>
<td>1,363,104</td>
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</tbody>
</table>
The Resources Classification System

• Investment risk is best thought within the framework of the SPE resource classification system.

• For continuous, unconventional reservoirs, there tends to be a relationship between distance from producing wells and the risk category.

• For mineral buyers, a clear pathway to development is one of the largest risks.

SPE, 2018
The Society of Professional Evaluation Engineers (SPEE) publishes annual surveys which ask professionals their opinion on handling risk.

At present, this is the primary indicator of how the market accounts for Risk.

Graph to the right is for RAFs. Number of responses varied by resource category from 39 for proved producing to 17 for prospective shut-in.

Higher risk categories have greater adjustments.
Existing Tools

- **Graph to the right is for RADRs.** Number of responses was 34

- Higher risk categories have greater discounting
Mineral deed sales within the seven sections of the study area:

- Proven Developed
- Producing
- Possible and Probable Undeveloped
- Undeveloped

First well drilled August 2013

5 additional wells drilled March 2016
What About Market Indicators?

- For Fair Market Valuations (FMVs) interviews and surveys are great... but should be supported by market evidence (mineral deeds)

- Example to right is of a Mineral Deed that indicates a sale value of $6,000/NMA

Ex: Property description and of net-mineral-acres (NMA). Ex: 10 NMA in Section 24 2N 4W, Stephens County, OK

Document stamping fee used to calculate sale price ($0.75/$500)

Ex: $90 fee = $60,000 sale

Date

Ex: May 2013
Mineral deed sales within the seven sections of the study area:

First well drilled August 2013

5 additional wells drilled March 2016

What RAF is implied with a May 2013 $6,000/NMA sale?
Assumptions for **May 2013** Discounted Cash Flow:

- Royalty: 3/16 (18.75%)
- Unit Size: 640 acres (1-section)
- Oil Price: $90/BBL (actual price averaged $115.42)
- Gas Price: $4/MCF (actual price averaged $4.02)
- State Severance Tax: 7%
- Development: Initial well drilled August 2013 and 5 additional wells drilled five years later
- Risk-Free Discount Rate: 10%

**July 2013 Woodford Type Curve:**

In May 2013 there were several nearby sections producing from 1-mile horizontal Woodford wells. Development expectations were that each section would initially have one well to hold leases, then an additional five wells could be drilled in the future.

- Results in an un-risked NPV of $22,000/NMA
- A sale of $6,000/NMA implies a 27% RAF or a 41% RADR
What RAF is implied with a May 2013 $6,000/NMA sale?

A 27% RAF
(or a 41% RADR)
Mineral deed sales within the seven sections of the study area:

First well drilled August 2013

5 additional wells drilled March 2016

What RAFs are implied with June 2015 sales ranging from $14,000/NMA to 19,000/NMA?
Assumptions for June 2015 Discounted Cash Flow:

- Royalty: 3/16 (18.75%)
- Unit Size: 1,280 acres (2-sections) for subsequent wells
- Oil Price: $60/BBL (actual price averaged $59.47)
- Gas Price: $4/MCF (actual price averaged $3.43)
- State Severance Tax: 7%
- Development: PDP value from an existing 2013 well and PUD value from an additional five wells. Additional wells assumed to be two-mile horizontals and completed in one year
- Risk-Free Discount Rate: 10%
- June 2015 Woodford Type Curve:

By June 2015 development had pivoted towards two-mile, horizontal wells and denser spacing. Commodity prices had significantly dropped.

- Results in an un-risked NPV of $22,000/NMA
- $5,000/NMA associated with PDP value of an existing well
- Sales of $14,000/NMA to $19,000/NMA implies a 53% – 82% RAF or 15% to 30% RADR for the PUD value
What RAF is implied with a June 2015 $15,000/NMA sale?

- A 100% RAF for the PDP value
- A 58% RAF for the PUD value
  (Or a 10% discount rate for PDP value and a 26% RADR for the PUD value)

Risk-Free value of $22,000/NMA

First well drilled August 2013

Possible and Probable Undeveloped

Proved Undeveloped

Proved Developed Producing
Mineral deed sales within the seven sections of the study area:

First well drilled August 2013

5 additional wells drilled March 2016

What RAF is implied with January 2019 $18,000/NMA sale?
Assumptions for **January 2019** Discounted Cash Flow:

- Royalty: 3/16 (18.75%)
- Unit Size: 640 acres for initial well and 1,280 acres (for five subsequent wells)
- Oil Price: $60/BBL (actual price averaged $62.45)
- Gas Price: $4/MCF (actual price averaged $3.27)
- State Severance Tax: 7%
- Risk-Free Discount Rate: 10%
- Forecasted production from existing wells:
  
  By January 2019, units had been fully drilled out with six horizontal wells per section. Commodity prices had not changed very much.

  - Results in an un-risked NPV of $18,000/NMA
  - A sale of $18,000/NMA implies a 100% RAF or a 10% discount rate
Mineral deed sales within the seven sections of the study area:

First well drilled August 2013

5 additional wells drilled March 2016

Possible and Probable Undeveloped

Proved Undeveloped

Proved Developed Producing

What RAF is implied with January 2019 $18,000/NMA sale?

A 100% RAF

(Or a 10% discount rate)
Conclusions: RAF

Key Take Away:
- RAFs increase over time
- Sharp changes after wells are drilled
- 0.00 – 40% RAF for Possible and Probable Undeveloped
- 50% – 80% RAF for Proved Undeveloped
- 100% RAF for Proved Developed Producing
Conclusions: RADR

Key Take Away:
• RADR decrease over time
• Sharp changes after wells are drilled
• 30% – 60% RADR for Possible and Probable Undeveloped
• 15% – 30% RADR for Proved Undeveloped
• 10% RADR for Proved Developed Producing
Mineral rights values have a life-cycle – increase as they are drilled/proved/de-risked and decrease as they are depleted

Investment risk can be accounted for with a Reserve Adjustment Factor (RAF) or Reserve Adjusted Discount Rate (RADR), these change depending on the reserve category

The best data we have had available for what RAFs or RADRs industry participants apply is the annual SPEE survey

This study shows market-based evidence of RAFs and RADRs and provides an example which is more in line with real-property appraisal methods for Fair Market Valuations

Need more research! Additional efforts could focus on how RAF and RADR might change by play type, basin, operator, or interest type
Thank you!

• Tatiana Sazonova, Geologist - Program Lead for Indian Mineral Valuations

• Brett Brown, MAI - Regional Supervisory Appraiser for Oklahoma

• The Division of Minerals Evaluation Team