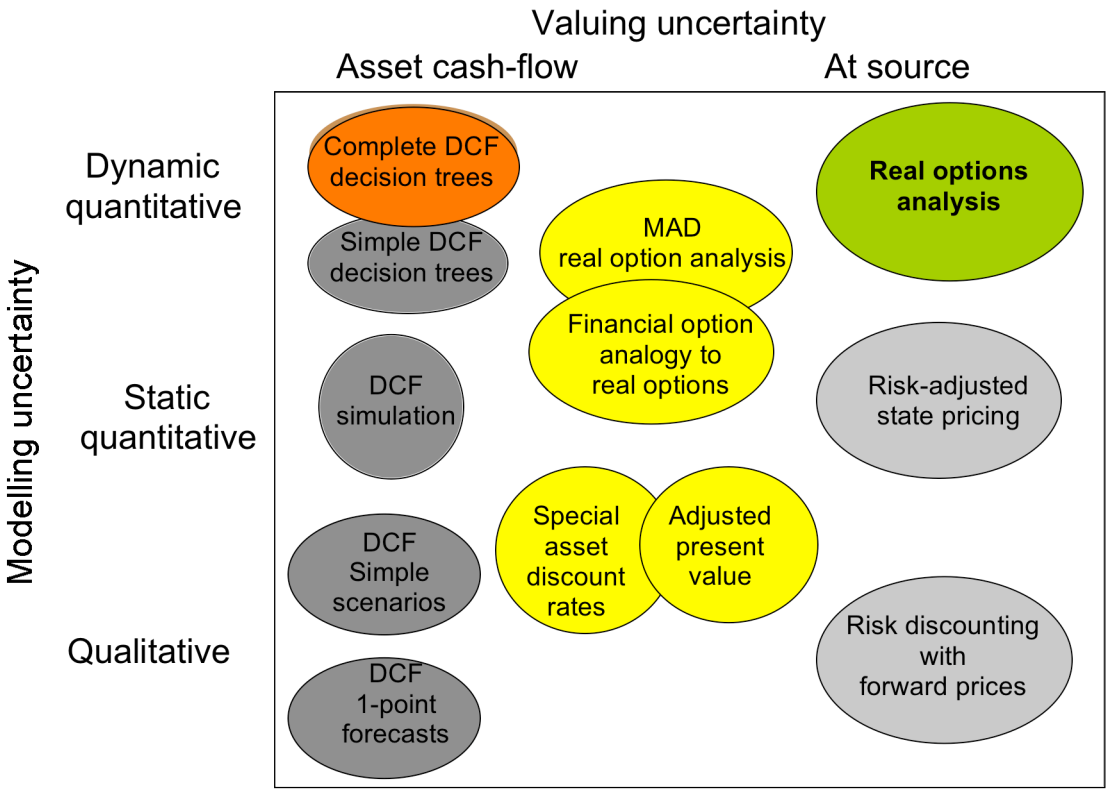
Mining and Upstream Petroleum Asset Design and Management: What Financial Market Value Estimation Methods Can Tell Us about Increasing Real Asset Value

The detailed outline of a 3-day course presented by David Laughton

The Banff Taxonomy of Real Asset Valuation Methods



First Morning (0830-1200)

1 Introduction and Executive Executive Overview

1.1) Introductions, review of expectations, and discussion of the agenda.

1.2) The role of asset value estimation in the corporate process for making decisions about real asset design and management

1.3) A brief description of a few of the decisions to be considered in the course

1.4) The Banff Taxonomy of methods for estimating asset value:
A matrix based on different approaches to:
    1) modelling uncertainty
    2) determining the effect of uncertainty on value

1.4.1) A brief look, using the taxonomy, at developments since 1965 in asset valuation in:
    1) the mining and upstream petroleum industries
    2) financial markets (including what Black, Scholes and Merton actually did)

1.4.2) A review of the reasons why industry might benefit from moving:
    1) up the vertical axis to more complete decision tree analysis
    2) to the right on the horizontal axis to value the effects of uncertainty at source using MBV methods

1.5) The interaction of real asset valuation and strategic planning, and the implications for choice of valuation methods

1.6) Organisational issues in changing the process for real asset valuation

1.7) Why some approaches to "real options" are a dead end

1.8) Some concluding remarks

Break

2 Modelling and Valuation Mechanics

2.1) Modelling uncertainty

2.1.1) The mechanics of qualitative vs. quantitative, static vs. dynamic models of uncertainty

2.1.2) The use of dynamic quantitative probabilistic simulation:
    1) to analyse flexibility
    2) to model dynamic economic forces like long-term demand-supply equilibrium
    3) to support MBV methods

2.2) Valuing uncertainty

2.2.1) Single forecast DCF valuation vs. MBV using forward prices
    1) The conditions for using forward prices to value risk
    2) The difference in the mechanics
    3) How MBV ideas result in the use of forward prices:
    The Law of One Price and its uses
        1) Value additivity
        2) Using forward prices to value risk
    4) Some implications:
        1) Issues of control
        2) Some systematic biases in DCF

2.2.2) DCF using simulation vs. MBV using state prices
1) The difference in the mechanics
2) Including both systemic and local uncertainty
3) Implications for the treatment of risk aversion
4) How the analysis of future flexibility fits in

First Afternoon (1230-1700).

3 Some case examples

3.1) A forward pricing case (from list at end)
3.1.1) Demonstrates single forecast DCF vs. MBV using forward prices
3.1.2) Highlights issues raised by:
1) operating and fiscal leverage
2) long-term output market equilibrium and production profile

3.2) A state pricing case (from list at end)
3.2.1) Demonstrates static simulation DCF vs. MBV using state prices
3.2.2) Highlights interaction between cash-flow non-linearities and uncertainty

3.3) A decision tree case (from list at end)
3.3.1) Demonstrates DCF decision tree analysis vs. real options analysis
3.3.2) Highlights issues raised by:
1) systemic exogenous (e.g., price) vs. local engodenous (e.g., geological) uncertainty
2) value of information vs value of time

Break

4 Market-Based Valuation (MBV) in a special setting: Using forward prices

4.1) Using the Law of One Price to set up a forward price valuation
4.1.1) Using value additivity to divide claims to cash-flow into parts
4.1.2) Using forward prices to value risk

4.2) Prices of risk and the effects of different types of uncertainty on value
4.2.1) Types of uncertainty and risk aversion
4.2.2) An example of an uncertainty and its price of risk in one time period with two scenarios
4.2.3) Prices of risk and the Capital Asset Pricing Model (CAPM)
4.2.4) An example of determining forward prices in multiple time periods

4.3) ***Participants reexamine forward pricing example***

Second Morning (0830-1200)

5 MBV in a general setting without the analysis of future flexibility: Using state prices

5.1) The simplest example:
Asset valuation in one time period with two scenarios
- 5.1.1) The example: A commodity production asset with known costs and production capacity that can be opened and closed at will without cost
- 5.1.2) Scenario and process representations of uncertainty
- 5.1.3) DCF valuation of the example asset
- 5.1.4) Using value additity to set up the state price valuation
- 5.1.5) Determination of state prices from forward prices and risk-free bond prices using BSM replication and The Law of One Price
- 5.1.6) State prices and risk-adjusted probabilities
- 5.1.7) Risk-adjusted expectations and forward prices
- 5.1.8) Risk adjustment and prices of risk
- 5.1.9) MBV risk adjustment vs. DCF risk discounting

5.2) Generalising to many time periods
- 5.2.1) Generalising the example to mulitple periods
- 5.2.2) Scenario and process representations of uncertainty in multiple periods
- 5.2.3) DCF analysis of the example asset

Break

- 5.2.4) Using value additity to set up the state price valuation
- 5.2.5) Determination of multiple period state prices from single-period state prices using rollover replication and The Law of One Price
- 5.2.6) MBV risk adjustment vs. DCF risk discounting
- 5.2.7) The separate effects on value of risk adjustment and cash-flow uncertainty

6 Analysis of future flexibility: Using decision tree analysis

6.1) A simple example of one- and two-period development leases
- 6.1.1) DCF decision tree analysis vs. real options analysis
- 6.1.2) Different techniques for searching for the best policy:
  1) Directed complete search
  2) Dynamic programming
  3) Others

Second Afternoon (1230-1700).

7 Different patterns of uncertainty

7.1) Local uncertainty
- 7.1.1) Special features of local uncertainty
  - 1) No risk adjustment
  - 2) Usually "private"
  - 3) Usually endogenous
- 7.1.2) State prices with local uncertainty
- 7.1.3) DCF vs. MBV with local uncertainty

7.2) Commodity markets with short-term shocks and long-term equilibrium
- 7.2.1) Scenario, price process and price forecast representations of uncertainty
- 7.2.2) The closer you are, the faster you learn, the greater the period uncertainty
- 7.2.3) The Samuelson effect in forward prices
- 7.2.4) Implications for valuation of short-term vs. long-term cash-flows: A reexamination of this in the cases

8 Small cases to illustrate the use of state pricing

8.1) Old Scona 1

Break

8.2) ***Participants analyse and report on one of :***
- ***1) Old Scona 2***
- ***2) Peace River Fine Papers***

9 Generalising state pricing to continuous states

9.1) Continuous models of uncertainty: The example of commodity price diffusion models
- 9.1.1) Price forecast models
- 9.1.2) Price models
- 9.1.3) Long-term equilibrium

Third Morning (0830-1200)

9.2) Risk adjustment in continuous state models
- 9.2.1) Continuous time replication
- 9.2.2) MBV risk adjustment vs. DCF risk discounting

9.3) Specification and parameterisation of uncertainty
and risk adjustment models
9.3.1) Use of expert opinion probes
9.3.2) Some brief comments on econometrics

9.4) Some computational issues
9.4.1) The discrete time approximation for cash-flow and decision timing
9.4.2) State price valuation as numerical integration on scenario trees
9.4.3) Analysis of future flexibility as directed search over a policy space
9.4.4) Random sampling(e.g., monte carlo) methods for numerical integration
9.4.5) Other forms of numerical integration
9.4.6) Dynamic programming as directed search over a policy space
9.4.7) Other forms of directed search

Break

10 Cases to illustrate state pricing with continuous states over many time periods and to introduce relevant software

10.1) A reexamination of the cases used to illustrate state pricing
or real options analysis

Third Afternoon (1230-1700).

10.2a) ***Participants choose two cases from a selection to analyse using:***
1) random sampling methods for numerical integration
2) dynamic programming

Break

10.2b) ***Participants continue and report on analyses***

11 Review and next steps

11.1) Review

11.2) Next steps
1) Organisational issues
2) More research on costs and benefits, improving the message
3) Better initial training
4) Methods development
5) Software development
6) Consulting support
7) Next steps in training, if any

Cases

Forward pricing

1) Natural gas: Outsource processing and/or gathering or not?
2) Natural gas or copper: The production capacity choice
3) Mature oil field extension and abandonment: The deterministic timing choice
4) SAGD heavy oil production: Sell heavy or upgrade and sell light?
5) Power plant design: Build CO2 capture ready or not, given a deterministic timing choice?

State Pricing

1) Offshore oil development with oil-in-place uncertainty: Processing and transport choices
2) A comparison of the effects of different fiscal systems on the value of "now or never" resource development projects
3) Mature oil field extension and abandonment with production uncertainty: Testing simple timing choices
4) CO2 geological sequestration: The deterministic timing choice

Decision Trees

1) Mature oil field extension and abandonment with production uncertainty: The dynamic timing choice
2) When is enough enough: Timing the decision to sanction development
3) Multiblock mine plans
4) Management of exploration and appraisal
5) Power plant design: Build CO2 capture ready or not, given a dynamic timing choice?

More information about the course and Dr. Laughton, comments on his work, and some applications of MBV methods, are available at www.davidlaughtonconsulting.ca.