Econ 366

Fall 2012

Economics of Exploration

Fossil Fuels

- Exploration is usually the first step in obtaining (the rights to extract from) a deposit of oil, natural gas, coal
- Uncertain (trial and error) process, sometimes facilitated for individual firms by geological surveys and other publicly provided info
- Exploration activity affected by probability that something will be found, value of deposit if found (which in turn depends on expected future prices)

Renewables / Unconventional

- Some similarities to conventional fossil fuels: firms attempt to 'discover' new technologies that will lead to economically viable alternative energy sources
  - R&D is an uncertain trial and error process

    (wind technologies; biofuels; oil sand extraction; fracking)
  - Level of activity depends on probability that something economically beneficial will be found
  - Level of activity depends on expectations of future profits (which depend on future prices)
  - Benefits from discovery accrue to firm that makes the discovery (akin to a deposit belonging to or being leased to the firm doing the exploration)

Drilling for conventional oil and gas

- Oil and gas often found in same deposit → both oil and n.g. prices likely to play a role in the expected return from finding a viable deposit
- Wildcat drilling: in fields that are not already producing or beyond limits of a known pool → low probability of success
- Extension / deeper / shallower drilling in areas around (and close to) an existing pool
- Development drilling: additional drilling once a discovery is made to 'delineate' the size of the deposit

(boundaries of definitions somewhat fluid ...)

Drilling Type Diagram from textbook

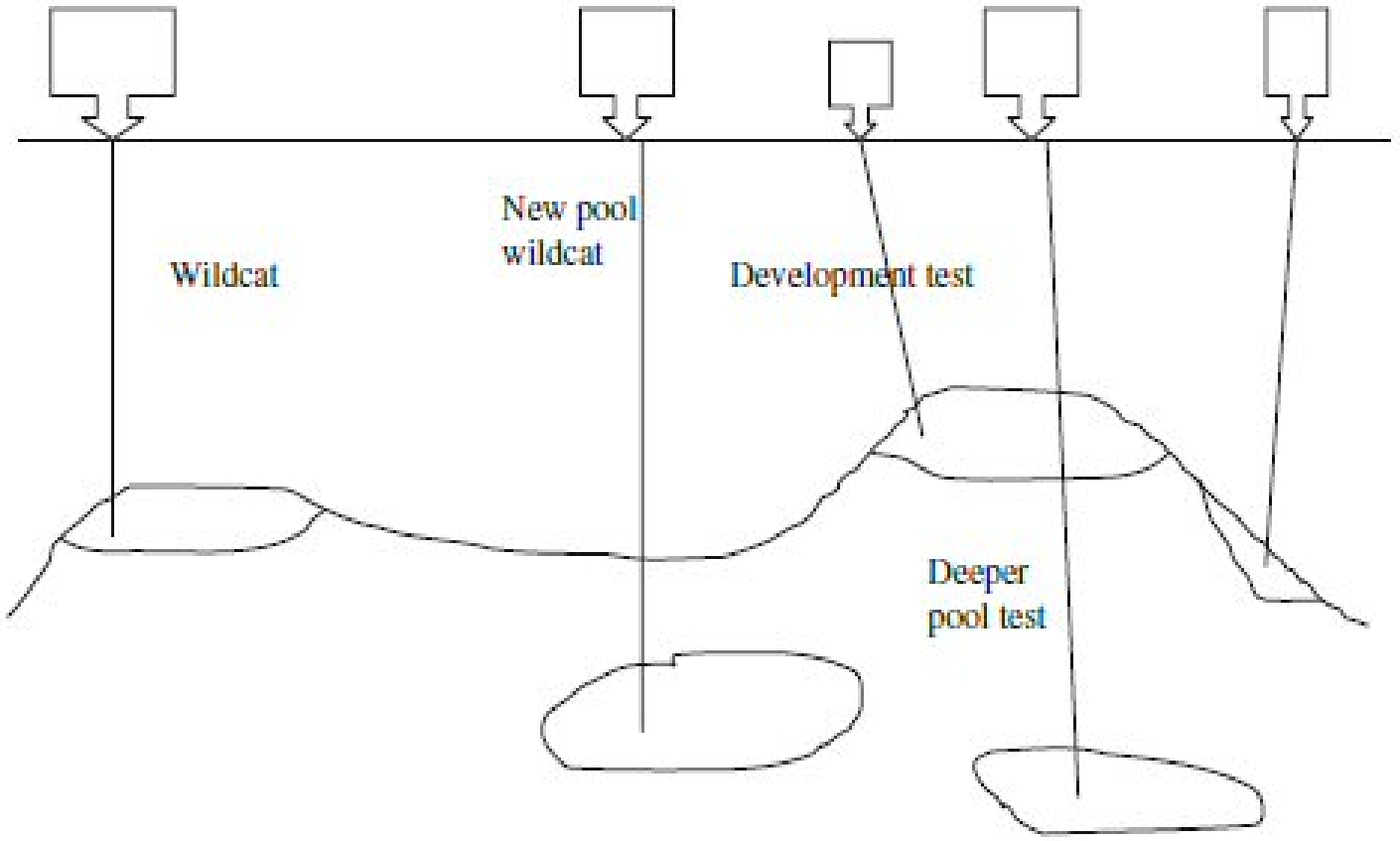

Fig. 8.2 Classification of exploratory wells

Expected returns from an exploration program

- Factors affecting whether or not to undertake and exploration program:
  - Probability of success (= 1 – Probability of failure)
  - If successful, what will be the amount / quality of the resource
    - May hit a big high-quality deposit; a big low-quality deposit; a small low-quality deposit; etc.
  - Associated with each possible outcome is a net present value (NPV)
  - If the probability weighted average of these NPVs (Expected Monetary Value) is positive, the exploration program should be considered.
    - (There may be other candidate exploration and/or investment programs with even higher EMVs, though. Could consider developing a 'backstop' technology instead of exploring for conventional energy)

Decision Tree (Fig 8.6)

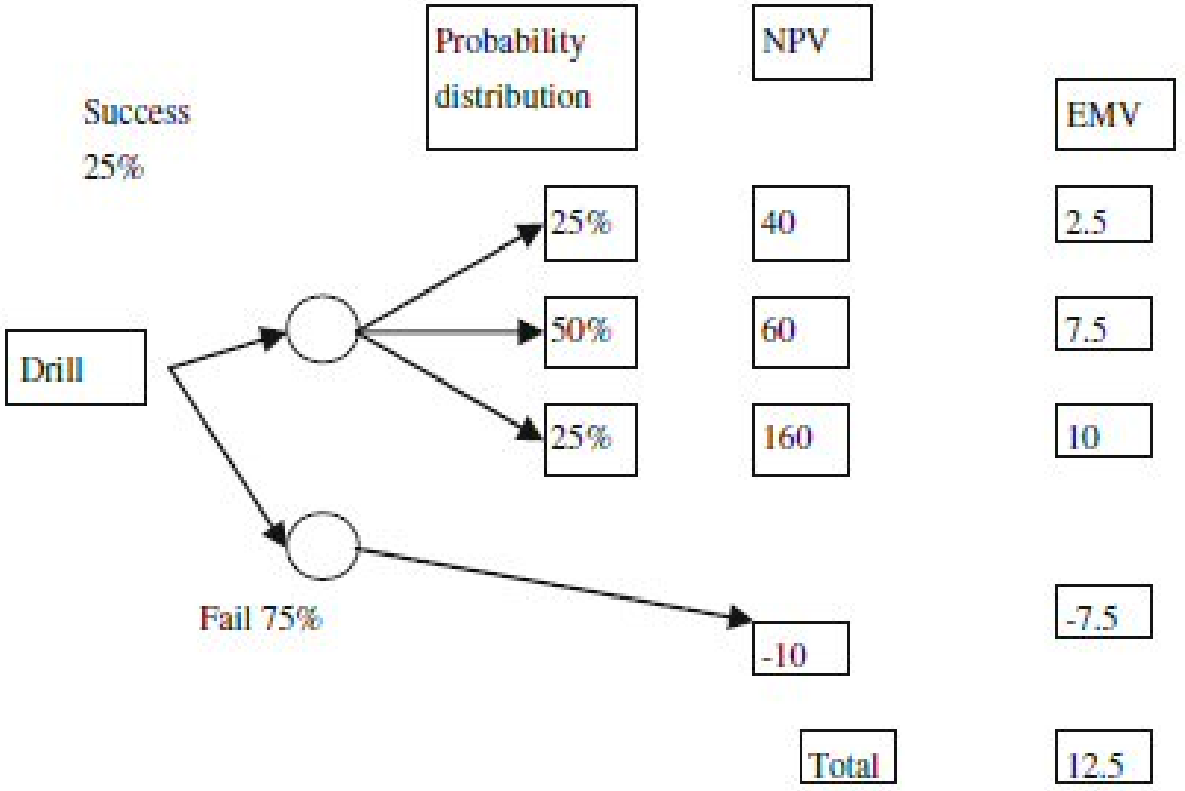

Fig. 8.6 Decision tree for exploration decision

Textbook Example

- In the textbook example, the probability of failure is 0.75 (in which case lose -10)
- The probability of finding a low value deposit (NPV of 40) is (1^{st} stage prob of success) x (2^{nd} stage prob of low value) = 0.0625
- The probability of finding a medium value deposit (NPV of 60) is (1^{st} stage prob of success) x (2^{nd} stage prob of med value) = 0.125
- The probability of finding a high value deposit (NPV of 160) is (1^{st} stage prob of success) x (2^{nd} stage prob of high value) = 0.0625

EMV = 0.75 x (-10) + 0.0625 x 40 + 0.125 x 60 + 0.0625 x 160

= -7.5 + 2.5 + 7.5 + 10 = 12.5

Institutional Details / Legal Framework

- How exploration proceeds depends on what the rules are in a particular jurisdiction
  - Concessionary system:
    1. A firm must obtain permission in order to explore / develop / produce in a given area.
    2. Only one firm has the right to operate on a given tract.
    3. Firm may have to pay for these rights (amount that a firm is willing to pay will depend on expectations regarding what will be found, what profits will be)
    4. Government usually collect royalties on production (affects the profits from producing and selling the resource)
       - (3) and (4) mean that developing fiscal policies regarding resource exploitation must take into account the interrelationship up-front payments and royalties (see Busby, Dachis and Dahlby (2011))

Institutional Details / Legal Framework

- How exploration proceeds depends on what the rules are in a particular jurisdiction
  - Contractual Arrangements including:
    1. Joint ventures (ex., Oil Sands development in the 1970s, where R&D was important: Syncrude consisted of "a consortium of oil companies and the federal and provincial governments"). http://www.energy.gov.ab.ca/About_Us/1133.asp#1970s
    2. Production sharing agreements: 'host' and contractor share profits (or losses).
    3. Service contracts: host hires the services of the contractor for a set fee. Contractor does not share in the profit or loss.