Complete Decision-Tree Analysis Using Simulation Methods: Illustrated With an Example of Bitumen Production in Alberta Using Steam Injection

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Draft: 20 Sept 2006

The SPE (Society of Petroleum Engineers) held a workshop in Banff, Canada in 2003 to discuss the future of real asset valuation in the upstream petroleum industry. One suggestion that came out of the workshop was that methods should be developed that will allow the use of decision tree analysis for value estimation:

1) not only in the exploration and appraisal phases of the asset life cycle as is now predominantly the case, but throughout the asset life cycle; and

2) in such a way that the decisions to be analysed are made not only in response to the resolution of geological uncertainty, as is also now predominantly the case, but also in response to the resolution of price and other commercial uncertainty.

This will require, amongst other things, a significant expansion of the computational technology available to implement decision tree analysis with complex policy spaces in the face of complex structures of underlying uncertainties.

Work has been going for several years in financial markets to deal with similar issues using methods based on subtle combinations of simulation and optimisation. Two of these combinations - the Longstaff-Schwartz simulation-projection method and the stochastic programming method - have been applied recently to valuations in the mining industry in situations that are analogous to those faced by the upstream petroleum industry.

In this paper, we show how the Longstaff-Schwartz method, as it has been adapted for use in a mining context, may be applied to the analysis of value in the development of a bitumen deposit in Alberta using steam injection, where the underlying uncertainties are price movements in the bitumen produced and the natural gas used to produce the steam. The analysis is complicated by the fiscal regime that brings to bear at each time the past price history through a particular form of ring-fenced resource rent royalty.

We have begun to explore how to present information about the management decision policy that creates the value determined. This is complicated by the large number of variables upon which management decisions may depend.