Investment Under Multiple Sources of Uncertainty: A Real Options Approach

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Introduction

- The managerial flexibility a firm has on when, the scale or how much to invest contribute to the value of an investment opportunity. The value of the flexibility can be captured by Real Options Analysis (ROA).
- When an investment opportunity is contingent on uncertainty from multiple sources, the ROA value of the investment opportunity can be estimated by:
  a. Combining the multiple uncertainties into a single volatility parameter, "consolidated approach", or
  b. Specify each random variable in a Multidimensional Option Valuation Equation (MOVE) & solve equation.
- A CCGT power generation project which has flexibility on when to start is appraised. The project is exposed to 2 sources of uncertainty
  - Price of natural gas (input cost), and
  - Price of (output) electricity
- The research objective is to quantity the difference in value of the project estimated by the two approaches above.

Methodology

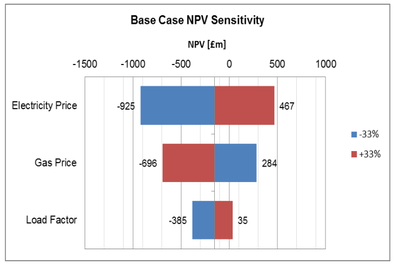
1. The investment opportunity is first appraised by the standard DCF analysis (base case).
2. Real option valued via the consolidated approach.
   i. MC simulation to define a new volatility parameter based on the uncertainty in the two primary variables.
   ii. Option to defer with project NPV & new volatility
3. Real option valued via solution of MOVE.
   i. Electricity and gas price variables each specified as GBM based on historical data
   ii. MOVE solved using a numerical PDE routine.

Results

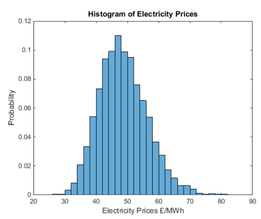
1. Base Case NPV Model

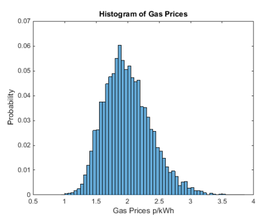
Base Case Results

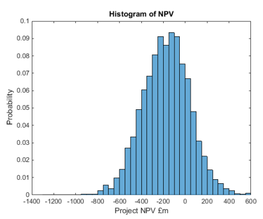
Parameter	Value
Av Elect Price	48.8 £/MWh
Av Gas Price	2.006 p/kWh
CAPEX	£543.05 m
NPV	£-156 m
NPV/CAPEX	-0.29
IRR	6.1%



2. The Consolidated Approach

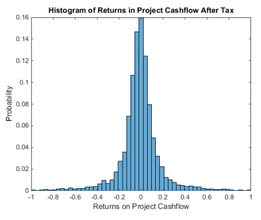




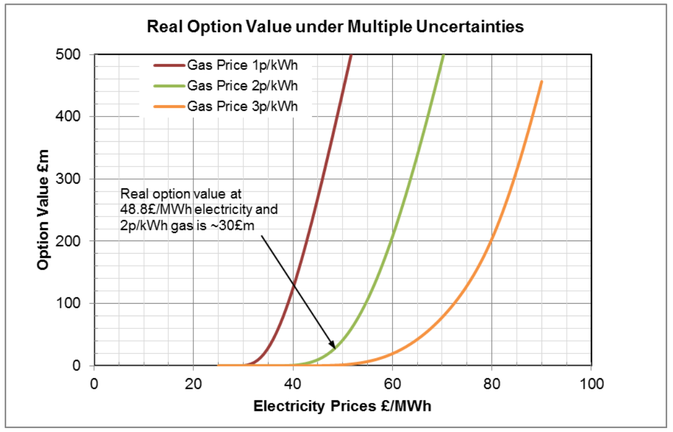


Real Options Value, Consolidated Approach

	Real Option Value (£m)	
Number of Timesteps	σ = 0.321	σ = 0.333
10	69.949	74.491
100	68.875	73.013
1000	68.707	72.889
10000	68.685	72.888
Exact (BS Formula)	68.683	72.887



3. Multiple Uncertainties Modelled Separately



Summary of Results

	Base Case NPV	ROA (#1)	ROA (#2)
@ electricity price, 48.8 £/MWh; gas price 2 p/kWh	£-156m	£70m	£30m
Volatilities		σ_R=33%	σ_E=22%; σ_G=26%

Conclusions

- The project (without flexibility) is not viable because of the negative base case NPV
- The flexibility to defer the project enhances the value of the investment opportunity.
- There is £40 m difference between the project value estimated using the two ROA approaches, due to the volatility estimates.
- It is believed that the consolidated approach introduces additional riskiness which inflates the value of the real option.

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