Chapter 8

Power Systems Investments: A Real Options Analysis

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ABSTRACT

Energy projects with extended life cycles and initial investments can be non-profitable under discount cash flow methods. Therefore, real options analysis has become relevant as a pricing technique for these types of projects, with private risks and high investment levels. Following this question, this study analyses different real options approaches to select the most acceptable for investing decisions in the energy sector. Combined cycle natural gas-fired plants constitute relevant generation assets that building decisions can mostly be studied by real options tools. Because traditional pricing approaches fail to consider the worth of flexibility, conditions for creating a significantly large options-based value can be found. Being unable to capture the value associated with the decision maker’s ability to react dynamically to changing market conditions, these assets constitute a fine example of flexibility, which contributes to increasing its intrinsic value.

The study employs a real options approach that doesn’t need to capture all the uncertainty and proposes a process that directly determines the uncertainty associated with the first period. The results support that its use can be considered fair. However, it shows that long periods of operation and poor adhesion to the geometric Brownian motion by the project returns might call into question its use in the energy market. The values for option pricing have remained inside acceptable ranges, but some shortfalls could be found. First, the study employs Monte Carlo simulations, which can be viewed as forward-looking processes, and option pricing problems need backward recursive solutions. Second, the study shows that its simplicity produces results as accurate as those gathered from approaches with added complexity and computational needs.

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INTRODUCTION

Risks and uncertainties such as electricity, fuel prices, and construction costs characterize the energy market (Thompson et al., 2004). In that sense, case studies for the energy sector are as relevant as they are for pharmaceutical research or hi-tech start-ups. Therefore, the energy market needs a flexible way to approach plant investments and decision-making processes. Investment timing is relevant for energy sector because of the need to trade off the supply and demand for electricity. Adjustments in investment timing place pressure on power prices.

This study will evaluate a model’s ability to define the optimal investment rule by considering uncertainties in the costs and revenues, assuming decision flexibility. Combined cycle natural gas-fired plants are relevant generation assets that building decisions can mostly be studied by Real Options Analysis (ROA), (Blyth, 2008). Because traditional pricing approaches fail to take into account the worth of flexibility, the conditions to create a significant large options-based value can be found in these plants. Being unable to capture the value associated with the plant manager’s ability to react dynamically to changing market conditions, these types of uncertainty origins offer a large options-based value. Because peaking power plants (as gas-fired) can react quickly to market prices, they constitute fine examples of asset flexibility, which contributes to increasing their intrinsic asset value.

Although decision tree analysis improves discount cash flow (DCF), the manager still needs to assign different probabilities to potential results and find out a suitable discount rate. By contrast, ROA simplifies these assumptions and makes the process of choosing discount rates no longer arbitrary. Possible results are assessed and underlying risk profile is recognised under an options-based framework.

Given the nature of the energy market, the problem in question arises from the need of an energy production company to know if its power generating plant project has financial viability. The company also wants to know if the present moment is the best time for beginning its investment, given the potential opportunities. Within the real options paradigm, this issue sets up as an evaluation of the deferment or delay option for a power generating plant investment. The real options approach applies derivative pricing theory to the analysis of options opportunities in real assets (Dixit and Pindyck 1994). It can be used to calculate plant values and optimal operating policies while considering plant characteristics. A power plant produces electricity at variable costs and if the (uncertain) electricity price exceeds its costs, it creates a positive contribution margin. Power plants can be seen as a strip of European call option or as path-dependent American Option. Since the expansion of the power plant’s variable costs is also uncertain, power plants can also be appraised as swap options (fuel against electricity). In another perspective, accounting for different plant construction lead times in the face of demand uncertainty can originate different optimal capacity planning strategies (Gardner and Rogers 1999).

Increased uncertainty enlarges the option value of a project by capturing the benefits from managerial/operational flexibility. However, option pricing models still need to bypass some practical shortfalls. Because the source of uncertainty should be traded, energy markets should be observed to calculate the volatility in electricity prices and assess their impact on revenues. Besides, as market data is scarce, it is usual to estimate expected input parameters with Monte Carlo simulations (Rode et al., 2001).

Considering all arguments, this chapter intends to explore the applicability of the approach taken by Brandão et al. (2005) for investments made in the electricity market. This assessment can be made through a feasibility study of an investment in a combined cycle natural gas-fired plant using an ROA. This chapter begins by introducing the