OPERATIONAL VERSUS MANAGERIAL FLEXIBILITY: THE CASE OF RENEWABLE ENERGY

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Overview

Selecting a power plant project leads to arbitrate between operational and managerial flexibility. Both increase the value of a project and must be compared before taking a decision. IEA (2008) defines operational flexibility as the ability to "respond rapidly to large fluctuations in demand and supply, both scheduled and unforeseen variations and events, ramping down production when demand decreases, and upwards when it increases". In contrast, the managerial flexibility exploits "the timing and scale of the investment" (NASDAQ, 2016). This arbitrage is not straightforward since each type of flexibility affects different phases of a project. This paper aims at quantifying the flexibility value and enabling comparison.

We focus on the case of renewable energy. We can thereby investigate the strategic aspects of choosing between operational and managerial flexibility without discussing variable costs. We compare an investment in an intermittent renewable energy, e.g. wind turbines, with investing in a storage hydropower plant. The former has low operational flexibility since its generation timing is determined by meteorological variables. But these technologies generally enable a sequential construction, e.g. one turbine after another, leading to a high managerial flexibility. In contrast, storage hydropower, as a peaking technology, possesses a large operational flexibility. The operator can store energy to supply electricity during peak price hours. On the other hand, its managerial flexibility is low since this technology is hardly scalable. To sum up, intermittent energy has low operational flexibility and high managerial one, while hydropower represents somehow the opposite case.

Methods

The Net Present Value (NPV) is considered to estimate the operational flexibility, which is represented with the quantile of the selling price (q). The value tends to q=1 when the operational flexibility increases. For instance, on a yearly basis, a base load plant or a wind turbine sells electricity at an average price (q=0), while a flexible power plant can manage to supply peak price periods only (q>0). Its mean revenue is higher, thus increasing the NPV. Therefore, the operational flexibility value, V_o, is :

$$V_o(q)=NPV(q)-NPV(0)$$

The degree of managerial flexibility depends on the options (Dixit and Pindyck, 1994). We consider the option to wait (duration from 1 to n years) and to stage (number of turbines from 1 to m), also called sequential option. We compute the flexibility value by means of a Least-square Monte-Carlo's approach (Longstaff and Schwartz, 2001).

Our analysis is based on the three most common price models used in the energy sector, i.e. geometrical Brownian-motion (GBM), mean-reversing and jump-diffusion models. We consider all of them since they can figure out various issues. For instance, the impact of new policy is often assessed with a jump process (Hasset and Metcalf, 1999). They are parametrized with the data of various European day-ahead power markets. They are commonly considered as the most representatives for assessing the electricity's value. They also give access to the longest time series (up to 15 years) in this field.

Results

With the opening of the market to competition, power utilities face more risk and uncertainty, thus requiring managerial flexibility. Power plants should be able to cope with and adapt to any unforeseen evolution of the market. Our results confirm that the managerial flexibility easily compensates for the lack of operational flexibility. This situation plays in favour of small and scalable power plants, e.g. new renewable energy.

Utilities should increase their projects' managerial flexibility and estimate its value. Many corporate still focuses only on the classic Net Present Value and the Internal Rate of Return to evaluate the profitability of a project. In the former monopoly position, this approach was justified by the low level of uncertainty. We show that nowadays it is no longer relevelant.

This means that the institutional context should also evolve. Most of the authorizations and water rights are inflexible. Flexible contracts may represent a win-win solution for public bodies and utilities. One should however recognize that other problems can emerge, for instance the hold-up problem.

Conclusions

Our results are relevant for decision-makers in the public and private sector. The electricity price distribution allows us to determine the most profitable technologies. It depends on the tradeoff between managerial and operational flexibility thus influencing the energy mix.

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