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THE EFFECT OF FLUCTUATIONS IN NATURAL GAS PRICES ON COMPETITION IN ELECTRICITY MARKETS

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Overview

Over the past three decades, the electricity sector in many countries transitioned from an integrated monopoly to one with a competitive generation market. As a result, independent power producers (IPPs) are now exposed to risks previously borne by the end-users.

The use of gas turbines has been fast increasing in electricity markets due to the recent discoveries of natural gas throughout the world, and the rapid improvement of CCGT technology. In countries where natural gas markets are competitive, IPPs are exposed to large fuel cost risk in addition to other risks. This is because fuel cost constitutes approximately 80% of the variable costs of a gas power plant, and the price volatility of natural gas is larger than that of other fossil fuels due to limitations of gas storage and transportation.

In spite of its growing importance, the effect of fuel cost risk on competition and on capacity investment in liberalized electricity markets did not attract much attention in the academic literature. The seminal work of Dixit and Pindyck (1994) presents a framework for analyzing capacity investment under uncertainty, but it does not investigate capacity investment under uncertainty of fuel prices in an oligopolistic competition.

Method

In this article we build on Tishler et al. (2008) to study the effect of fuel cost uncertainty on capacity investment in oligopolistic electricity markets. Our model consists of a two-stage decision process. In the first stage the firms decide on their optimal capacity, conditional on the perceived uncertainty in fuel cost and in the demand for electricity. Equilibrium prices and quantities are determined in the second stage.

Results

The study shows that marginal revenue and optimal capacity in an oligopolistic competitive electricity market increases the more natural gas prices fluctuate. Furthermore, due to the convexity of the profit function, the expected operating profit, conditional on the fuel cost distribution function, is higher than the profit at the expected fuel cost. Hence, an expected-profit maximizing firm, when given the choice of securing the expected price of fuel, versus procuring fuel at the spot market, would prefer the spot market.

Finally, for a firm with the objective of minimizing the probability of default rather than maximizing its expected profit, we find conditions under which fuel price hedging can reduce the probability of default and the conditions under which fuel price hedging leads to higher optimal capacity. These conditions depend on the number of electricity producers in the market and on the parameters of the demand function for electricity.

Conclusion

An expected-profit maximizing firm would increase its exposure to the electricity market, the more natural gas prices fluctuates. However, a firm's whose strategy is focused on minimizing the probability of default would limit its exposure and hedge the fuel price risk.

References

Dixit, A. K. and Pindyck, R. S., 1994. Investment under Uncertainty. 1994. Princeton University Press, Princeton.

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