ELECTRICITY INVESTMENT BEHAVIOR IN RESPONSE TO CLIMATE POLICY RISK

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Overview

In the past few years the EU carbon dioxide emission prices have been highly volatile due to the uncertainties in the policy formation process. This additional policy uncertainty is also recognized by the industry players which protest against it. For example, Shell has threatened to halt investment in Europe if the EU pushes ahead with its plans to auction emissions permits. According to the Telegraph on Thursday 10 April 2008, Shell France director Christian Baime told a European Parliament debate that auctioning permits would be costly, adding: "It's impossible. So there will be no more investments by Shell in Europe". It is open question, however, whether the protests are due to real difficulties caused by the carbon policy inefficiencies or whether they are opportunistic leverage. Inspired by this example, we investigate what are the effects of the carbon price uncertainty and different policy instruments on the company level investment decisions. Our research is also motivated by the gap in the existing literature as previous research (e.g., Blyth et al., 2007; Reedman et al., 2006; Birge and Rosa 2000) has not looked at the problem from the risk management perspective of an individual company, accounting for financial performance ratios, risk aversion, and the existing portfolio of the company.

We research the effects of the policy uncertainty by developing a dynamic investment model for an electricity generating company which is making a decision to invest now, or later, in one of the power generating technologies (e.g., coal, gas, nuclear). The analysis is done in a setting which includes (i) uncertainties related to the carbon and electricity prices, (ii) real options, to delay the investment decision and/or later add a CCS facility, and (iii) various financial performance measures, such as conditional cash flow-at-risk (Rockafeller and Uryasev, 2000; Kettunen and Salo, 2008), extended net present value, and return on capital expenditure to characterize different types of companies. The problem is approached using a detailed asset liability model.

We demonstrate in this setup how the uncertainty in carbon price evolution affects different types of technology and different types of companies. By varying the financial performance criteria we can reflect (i) small risk averse or large competitive players, (ii) highly capitalized or leveraged asset bases (iii) incumbent, vertically integrated or new, independent power producers. In addition, we analyze the effects of different policies, such as the use of carbon price caps, floors, free allocation for new built plants, and the effects of different national emission allocation policies.

Methods

We apply multi stage stochastic optimization with recourse. The key attribute of this stochastic optimization approach, e.g., Birge and Louveaux, (1997), is that it realistically represents optimal decision-making at each stage in the context of what has happened to prices, and with rational conditional expectations for what might happen. Thus, the model provides optimal decisions at each time period across all possible future outcomes contingent on the past decisions and current and historical prices. It is thus possible to account for path dependent decision making. Furthermore, the stochastic programming approach allows a detailed representation of the cash flows including depreciation and tax effects in each time period. This would be difficult to achieve in the alternative conventional dynamic programming approach, where the real cash position is aggregated into the terminal period of the model. With the real cash position available in each time period, we can consider risk or other performance related constraints on cash positions on any desired time period.

Results

First, carbon price uncertainty effects are significantly different depending on the characteristics of the companies. For example, large diversified players (which can take more risk, can borrow money with lower interest rate, or have existing portfolio of power plants) are better off investing early while independent power producers are better off waiting and learning from the carbon price evolution and then investing only under favorable circumstances. Thus, the carbon price uncertainty can be an entry barrier for new entrants.

Second, competition in terms of lower electricity prices results in the postponement of investments. However, technological competition in terms of an early introduction of the CCS technology in price setting plants encourages earlier investments.

Third, policies such as, employing a floor on carbon price or providing free allocation for new build encourages earlier investments, whilst setting a cap on carbon price, or having a more frequent and uncertain national allocation plans, provide an incentive to postpone the investment.

Fourth, a detailed asset-liability model including real options is essential in the investment analysis, as simple NPV may significantly underestimate the value of an investment and propose misleading investment decision.

Conclusions

The effects of various carbon policies and market instruments on investment can depend on the characteristics of the companies, and therefore may promote market structure as well as technology change. A detailed asset-liability model including real options is essential in the investment analysis as simple NPV may significantly underestimate the value of an investment.

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