Author(s): Mel T. Devine

Organization(s): University College Dublin

Email Address: mel.devine@ucd.ie

Title: An EPEC approach for modelling an oligopoly with a competitive fringe

Abstract: An EPEC approach for modelling an oligopoly with a competitive fringe

Sellers in a market have market power when they can strategically maximise their profits by influencing the level of demand through the selling price they set. Such behaviour often occurs in modern liberalised electricity markets and electricity market models should characterise it. Mixed Complementarity Problems (MCPs) have been typically used to model market power in electricity markets. However, when market power is characterised by an oligopoly with competitive fringe, myopic and unrealistic behaviour result from MCPs. Consequently, there a very few models of such an electricity market structure. In this work, we develop an Equilibrium Problem with Equilibrium Constraints (EPEC) model for an electricity market characterised by an oligopoly with competitive fringe. The EPEC models two types of players: price-making firms, who have market power, and price-taking firms, who do not have market power. The model allows all firms to invest in new generating technologies. To solve the model, we employ the Gauss-Seidel diagonalization algorithm. Furthermore, to provide an initial solution to this algorithm and hence improve computational efficiency, we utilize the Leyffer-Munson optimisation approach. The results indicate that an EPEC model can overcome the myopic behaviour observed in MCP models. While the EPEC considered provides multiple equilibria solutions for investment decisions, market prices and consumer costs were found to remain the same across each equilibrium. In addition, the model shows how it may be optimal for price-making firms to sell some of their electricity below marginal cost in order to de-incentivize price-taking firms from investing further into the market.

Key words: Market power; bi-level optimisation; Equilibrium modelling