UNIVERSITY OF CAMBRIDGE | Energy Policy Research Group

Increase-Decrease Game under Imperfect Competition in Two-stage Zonal Power Markets - Part I: Concept Analysis

EPRG Working Paper 1837

Cambridge Working Paper in Economics 1869

M. Sarfati, M.R. Hesamzadeh, P. Holmberg

Abstract This paper is part I of a two-part paper. It proposes a two-stage game to analyze imperfect competition of producers in zonal power markets with a day-ahead and a real-time market. We consider strategic producers in both markets. They need to take both markets into account when deciding what to bid in each market. The demand shocks between these markets are modeled by several scenarios. The two-stage game is formulated as a Two-stage Stochastic Equilibrium Problem with Equilibrium Constraints (TS-EPEC). Then it is further reformulated as a two-stage stochastic Mixed-Integer Linear Program (MILP). The solution of this MILP gives the Subgame Perfect Nash Equilibrium (SPNE). To tackle multiple SPNE, we design a procedure which finds all SPNE with different total dispatch costs. The proposed MILP model is solved using Benders decomposition embedded in the CPLEX solver. The proposed MILP model is demonstrated on the 6-node and the IEEE 30-node example systems.

Keywords Two-stage game, Zonal pricing, Two-stage equilibrium problem with equilibrium constraints, Wholesale electricity market

JEL Classification C61, C63, C72, D43, L13, L94

Contact par.holmberg@ifn.se
Publication November 2018
Financial Support