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Gas Trading with Tariff Versus Sanction as a Networked Game

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Abstract

The economies of many geographic markets are dependent on fossil fuels, e.g., gas. Due to geopolitical tensions, some geographic markets may decide to partially or totally halt their gas trades. We therefore propose a model which casts the optimal taxation problem as a networked game in two settings: a) perfect competition, where a global market operator is responsible for adjusting the export prices, leading to a partial equilibrium; b) a variational approach, where the export prices are determined endogenously as dual variables of the supply-demand balances. Our model is built on an agent based representation of suppliers and generators interacting in a certain number of geographic markets. We aim to assess the impact of tariffs or sanctions on the geographic markets' imports of gas and on their utility. To that purpose, the optimal taxation problem is framed as a Stackelberg game where a regulator at the upper level is responsible for the sanction definition considering different criteria, while the geographic market at the lower level reacts by adjusting their exports and trade prices. We derived closed-form expressions for the export prices, and proved that the Stackelberg equilibria can be explicitly mapped to the perfect competition equilibria. Finally, considering a degree of bounded rationality on the part of stakeholders, we rely on Prospect Theory to extend the optimal taxation games to in situations involving risks linked to the behavior of other market stakeholders.