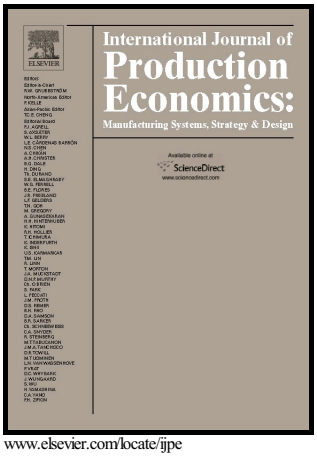

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Modeling competitive firms' performance under price-sensitive demand and cap-and-trade emissions constraints

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Abstract:

This study analytically examines the effects on profitability of using an emissions cap-and-trade policy. A game-theoretic Cournot model with two competitive firms producing goods, along with undesirable emissions, for a single market is investigated. Production costs are non-linear and product demand is price-sensitive. First, relationships are derived to maximize each firm's profit under a given emissions permit price and given emissions constraints, or caps. Production volumes for each firm at the equilibrium are determined with and without the assumption that emissions permit trading can occur. Relationships are then developed to investigate behavior as a function of emissions caps, the allocation of caps between firms, and the emissions permit price. Bounds on the ranges within which permit trading will occur are also determined. Results show the conditions under which profits rise or fall as emissions constraints are tightened. The conditions under which firms benefit equally from emissions permit trading are also developed. Finally, the analysis shows that the firm with the lower emissions intensity will never purchase emissions permits if its operational costs are higher than those of the competitor. Therefore, cap-and-trade will not necessarily provide an incentive for the firm with the lowest emissions intensity to increase its market share.

Keywords: Cap-and-trade, Emissions Regulation, Game Theory, Cournot Model, Optimization, Price-sensitive Demand

1. Introduction

The regulation of undesirable emissions has become increasingly important due to greater awareness of their negative effects on health and the environment. Emissions can be defined as an unwanted by-product produced at some rate proportional to that of the marketable end product. Emissions have the characteristic of often being released into the air, water or soil. As such they may have negative consequences which represent a future cost to society, although the magnitude may be uncertain. This is especially true regarding greenhouse gas (GHG) emissions and their relationship to climate change.

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