

Evaluating the effect of environmental regulations on a closed-loop supply chain network: a variational inequalities approach

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Extended abstract

Global climate change has encouraged international and regional adoption of pollution taxes and carbon emission reduction policies. Europe has taken the leadership in environmental regulations by introducing the European Union Emissions Trading System (EU-ETS) in 2005 and by developing and promoting a set of policies destined to lower carbon emissions from transport sectors. These environmental policies have significantly affected the production choices of European energy and industrial sectors.

In this paper, we propose a closed-loop supply chain network design problem that includes raw material suppliers, manufacturers, consumers, and

recovery centers. The objective of this paper is to formulate and optimize the equilibrium state of this closed-loop supply chain network assuming that manufacturers are subject to the EU-ETS and a carbon tax is imposed on truck transport. The model is optimized and solved by using the theory of variational inequalities.

Our analysis shows that the combined application of the EU-ETS at manufacturers' tier and the carbon tax on truck transport negatively affects the goods' production level. A decrease of the efficiency level of the recycling process operated by the recovery centers generally leads to a reduction of the quantity of ecological good produced. On the contrary, a lowering of the collection activity conducted by consumers at demand markets does not significantly modify the production of the ecological good.

Keywords: Closed-loop supply chain network, environmental regulations, variational inequalities.

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