GREENING OF MARITIME TRANSPORTATION: A MULTI-OBJECTIVE OPTIMIZATION APPROACH

Ali Cheaitou, Pierre Cariou

This article is motivated by growing concerns related to CO2 and SOx emissions from shipping in the hope that ship operators will consider the environmental impacts of their activities when attempting to maximize profit. The study aims to compare the results from two main optimization approaches to solve this multi-objective optimization problem in order to account for the sensitivity of demand to transit time and therefore its effect on revenue. Results are used to investigate whether taxes on the amounts of CO2 and of SOx emitted are relevant to larger goals of environmental sustainability and emission reduction as well as how to minimize emissions while maximizing profits in the global shipping industry based on based on sailing/transit time.

APPROACH:

This research utilizes a mixed-integer nonlinear MOO model and a single objective mixed-integer nonlinear programming model to optimize the vessels sailing speed, the number of deployed vessels, and the number of transported containers by a liner service operating between a range of ports located in continent A to another range of ports located in continent.

MAIN FINDINGS:

- The optimal solution of the profit subproblem differs from the environmental optimal solutions,especially when demand is sensitive to the sailing speed/transit time. However, the gap in this difference may be narrowed through the usage of a tax on emissions reduces the gap between economic and environmental optimal solutions, but a larger amount is needed when demand is elastic.
    - Additionally, a tax on SOx is more efficient than a tax on CO2.
- The degree of sensitivity of demand to transit time is a key parameter to understanding the difference in the optimal solutions and, therefore, the effectiveness of policies implemented to provide incentives for ship operators to reduce the environmental impacts from their activities should consider this factor.

the GREEN SHIPPING PROJECT