

# THE IMPACT OF CARBON EMISSION TRADE SCHEME ON SHIPPING INDUSTRIES IN DIFFERENT ECONOMIC CONDITIONS

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## ABSTRACT

World seaborne trade is highly related to the global economy, namely the business cycle of the world economy also influences the world seaborne trade. With the rapid development over the last decades, the emission in shipping sector has aroused the concern of the whole nation. Based on this, this study uses average world GDP to identify three business cycles as prosperous, steady and sluggish. Then, by combining the equilibrium strategy with a cap and trade mechanism, this study proposes a bi-level multi-objective model with business cycles for carbon emission allowance allocation in maritime transport, in which the upper and the lower level are decision maker and shipping companies, respectively. The objectives for the decision maker is to minimize the maximal carbon intensity and maximize the minimal allocation satisfaction, while shipping companies focus on the economic benefit maximization. To solve the proposed model, a solution method which integrates an interactive evolutionary mechanism and a fuzzy logic controlled genetic algorithm is developed. Results show that the cap and trade mechanism plays a vital role in mitigating maritime transport carbon emissions. In addition, carbon emission allowance allocations also indicate that the proposed method can provide efficient ways of mitigating carbon emissions for maritime transport, and therefore assisting decision makers in formulating relevant strategies under multiple business cycle scenarios.

**Keywords:** carbon emission trading schemes (ETS), container shipping, bulk shipping, tanker