Strategic port competition in multimodal network development considering shippers' choice

Abstract

Ports are developing dry ports in overlapping hinterland to gain competitive edges and relieve congestion. However, the impact of sequential port competition in multimodal network design where two ports sequentially locate dry ports considering dry port capacity is under-investigated. The possible correlation of inland transport routes to a port due to unobserved attributes and parameter calibration are overlooked in shippers' choice model. We formulate a nested logit model to describe the joint choice of shippers on port, transport mode and dry port considering dry port service and range, custom clearance time, reliability, freight shipment size, and ship call frequency using calibrated parameters based on data collected by revealed preference and stated preference techniques. A Stackelberg game theoretical model is established for the two ports, and two algorithms are adapted to obtain Stackelberg equilibrium solution. We find that inland transport cost, inland transit and custom clearance time are more appreciated in multimodal transport than in road transport. Reliability and large-scale freight shipment are key factors for choosing multimodal transport. When the dry port location strategy of one port in Stackelberg equilibrium is its only dominant strategy in Nash game, Stackelberg equilibrium solution would be the same as pure Nash equilibrium

solution. Leader port's dry port location strategy in Stackelberg equilibrium could be different from its dominant strategies in Nash game. Dry port location strategy could be affected by port service charge and waiting time. The methodological approach and outcomes can provide a framework for competitive ports sequentially developing multimodal networks in overlapping hinterland and help identify modal shift policies towards sustainable inland transport alternatives.