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Benders decomposition for a strategic network design problem under NAFTA local content requirements

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Abstract

Global production and sourcing strategies of multinational corporations are strongly influenced by the increasing number of Free Trade Agreements (FTAs). Based on the special local content requirements of the North American Free Trade Agreement (NAFTA) for automotive goods, the impact on strategic network design decisions is investigated. The presented model explicitly integrates the different NAFTA legal options to calculate the local content for automotive goods. Furthermore, it considers the possibility to underachieve the local content requirement and to pay penalty duties for NAFTA cross-border deliveries instead. Plant fixed costs have a significant impact on the local content fulfillment and have to be allocated in accordance with the actual plant utilization and the different local content calculation options. Due to the resulting non-linearity of the mixed-integer program, a solution algorithm based on Benders decomposition is presented. In addition, we introduce multiple Benders cuts to improve the efficiency and applicability to real-world planning problems. Compared to piecewise linearization approaches, the run-time can be improved significantly. In a numerical study, the impact of local content requirements on the strategic network design is shown and the different NAFTA options to calculate the local content for automotive goods are compared with each other. Furthermore, computational experiments are performed to evaluate the applicability and efficiency of Benders decomposition.

Keywords: local content, network design, Benders decomposition, non-linear mixed-integer program

1. Introduction

Automotive original equipment manufacturers (OEM) are increasingly confronted with complex tariff trade barriers, in particular local content (LC) requirements of Free Trade Agreements (FTA), like the North American Free Trade Agreement (NAFTA), the Mercado Comum do Sul (MERCOSUL) or the Association of Southeast Asian Nations (ASEAN). The number of listed FTA by the World Trade Organization (WTO) has skyrocketed in the last decades. By February 2014, 583 notifications of FTAs had been received by the WTO. Of these, 377 were in force in 2014 [1]. To promote trade and to boost the economy

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