Research in Transportation Business & Management xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Research in Transportation Business & Management

Analyzing competition in intermodal freight transport networks: The market implication of business consolidation strategies

Hamid Saeedi [a,*], Bart Wiegmans [a], Behzad Behdani [b], Rob Zuidwijk [c]

[a] Transport and Planning Department, Delft University of Technology, Netherlands
[b] Operations Research and Logistics Group, Wageningen Univerity, Netherlands
[c] Rotterdam School of Management, Erasmus University, Netherlands

ARTICLE INFO

Article history:
Received 2 October 2016
Received in revised form 15 January 2017
Accepted 16 February 2017
Available online xxxx

ABSTRACT

To cope with an intense and competitive environment, intermodal freight transport operators have increasingly adopted business practices —like horizontal and vertical business integration—which aim to reduce the operational costs, increase the profit margins, and improve their competitive position in the market. These strategies and business practices could potentially affect the competition level in the IFT market by increasing the market concentration. The impact can be on the separate submarkets (e.g., transshipment market or main-haulage market) or the whole market for IFT services at the network level. To investigate the impact of these business practices on the market structure of IFT networks, we present a model to analyze the market structure of IFT submarkets and extend the results to the network level. Using this multi-level market analysis model, we can evaluate the decisions made by firms and the market outcomes that result. The application of the presented model is also illustrated using a numerical example. The numerical example shows, for instance, that the impact of a merger, as a business practice, on the competition level in an IFT market —and its submarkets— depends on the merger type (horizontal and vertical). Furthermore, different indicators that "represent" market structure and competition, might react differently to a merger in an IFT network.

1. Introduction

Global freight transport has grown steadily in the last two decades (Gudmundsson, Hall, Marsden, & Zietsman, 2016). Because road transport has been the dominant modality for hinterland transport, this growth has resulted in congestion and other external effects such as emissions and noise nuisance (Macharis & Bontekoning, 2004). Intermodal freight transport (IFT) involving rail and inland waterways as the main transport links is believed to provide an attractive alternative to road transport (Kim & Van Wee, 2011). In particular, the European Commission has initiated a considerable number of research programs that are designed to stimulate IFT (Commission of the European communities, 2001; Votano, Parham, & Hall, 2004). Also, growing attention has been paid to develop new practices for the design, planning, and execution of IFT and its performance (Bontekoning, Macharis, & Trip, 2004). Many IFT operators have increasingly adopted business practices to improve their competitive position in the market by reducing the operational costs and increasing the profit margins. Some of these IFT business practices, for example, mergers and acquisitions and other horizontal and vertical business integrations, could lead to market structure changes and decrease the competition level in the IFT network. Antitrust authorities may scrutinize and limit such practices, because they could harm consumer welfare (Mazzeo & McDevitt, 2014). Antitrust authorities evaluate the decisions made by firms, based on the expected market structure outcomes.

The analysis of market structure and concertation measures for IFT service can be done at several different levels. First, the analysis can be performed for separate segments (e.g., the market for transshipment operators or the market for main-haulage operators). Some literature has analyzed specific segments of IFT markets; see for example (Sys, 2009; Wiegmans, 1999; Makitalo, 2010; Merikas, Merikas, Polemis, & Triantafyllou, 2013). However, due to the multistage characteristic of IFT services, the segmental analysis gives an incomplete view of the IFT market. Moreover, none of these papers has explicitly studied the impact of business practices on the IFT market structure. To fill these gaps, we present a model that analyses IFT services at the network level, and we refer to it as the Intermodal freight transport market structure (IFTMS) model.

First, we distinguish a number of submarkets that correspond to the services provided: pre-haulage, end-haulage, transshipment, main-haulage, and so on. Second, the IFTMS model incorporates a flow optimization model to assign the capacities on links, nodes, and paths to the IFT network services in a consistent way. Next, the concentration indices—like *CR* or *HHI* (OECD, 1990)—for these IFT submarkets are calculated. The Concentration Ratio Index (CR_x) is the sum of the market

* Corresponding author.
E-mail address: h.saeedi@tudelft.nl (H. Saeedi).

http://dx.doi.org/10.1016/j.rtbm.2017.02.009
2210-5395/

shares of the x largest players, and the *HHI* is the sum of the squares of the market shares of all players in that market. In this manner, the model helps analyze the IFT market at the network level. We can also measure the impact of anticompetitive practices on the market structure of the IFT network.

The paper is structured as follows. Section 2 concerns the literature review, and Section 3 introduces the IFTMS model to analyze the market structure of the IFT network. In Section 4, we apply our model to an illustrative example case to measure the impact of horizontal and vertical integration on market structure and competition level of the IFT network and its submarkets. Finally, the last section presents the conclusions and management implications and indicates further research directions.

2. Literature review

2.1. Intermodal freight transport market structure analysis

Intermodal freight transport (IFT) is defined as "unitized freight transport by at least two transport modes" (Commission of the European communities, 2001). In the IFT market, different actors (pre- and end-haulage operators, main-haulage operators, terminal operators, and intermodal operator) are active in their respective submarkets (see Fig. 1) to deliver door to door continental transport service. The IFT market encompasses all actors operating in all submarkets.

In the competition literature, the term "relevant market" is used to describe areas where competition takes place (Sys, 2009). This relevance lies in both the product or service and the geographic dimensions. In market theories, there are traditionally four main categories of market structure: perfect competition, monopolistic competition, oligopoly, and monopoly (Carlton & Perloff, 1999). Sometimes, the oligopoly market is divided into subcategories. For example, Shepherd (1999) categorized oligopoly into loose oligopoly, tight oligopoly, super tight oligopoly, and dominant player oligopoly. Ultimately, the structure of a market will be determined based on the degree of market concentration. Only a few scientific papers have contributed to the structural analysis of (parts of) the IFT market. For example, Wiegmans (1999) analyzed the IFT market in the EU qualitatively based on an extended version of Porter's model of the competitive forces to identify the stakeholders in the terminal market and find the potential for economic benefits. Makitalo (2010) investigated the Finnish rail industry market by using Delphi techniques and revealed the largest market entry barriers. According to Macharis & Bontekoning (2004), most papers analyze only selected parts of IFT, but there is no paper that analyzes business practices in the whole IFT market. In several other research studies (e.g., Crainic, Florian, Guelat, & Spiess, 1990; Jourquin, Beuthe, & Demilie, 1999; Southworth & Peterson, 2000; Janic, 2007; Wiegmans, Hekkert, & Langstraat, 2007; Wiegmans, 2005), parts of the IFT network are modeled and optimized. In the supply chain literature, competition between supply chains is defined (see e.g., Zhang, 2006; Zhang & Jie, 2011). Rice & Hoppe (2001) show that supply chain competition does not have a unique definition. They have undertaken a Delphi study among supply chain experts from industry and academia to find different interpretations of the concept of competition among supply chains. The findings reveal that supply chain versus supply chain is not the only existing form of competition, and the methods that companies use to compete are complicated. They categorized the findings in three different categories: actual competition between supply chains, competition in supply network capabilities, and competition in supply chain capabilities led by the master channel (the company that is most powerful on a supply network). Our focus is on the first category as actual competition among IFT chains. Another interesting work about competition among supply chains is the paper by Antai (2011). He has developed a conceptual model for competition among supply chains using the ecological niche approach. In his approach, the source of the competition is the overlap in the resources that are used by different supply chains. Then, by presenting indices and measures, such as niche breadth and niche overlap, he defines the index of competition among two supply chains. "Niche breadth" is a set of different resources that a supply chain uses, and "niche overlap" is an index that shows the degree of overlap between the niche breadth of two different supply chains. The idea concerning the source of competition is further elaborated when we analyze concentration inside the transshipment (node) and main-haulage (link) submarkets.

Market concentration refers to the extent to which a certain number of producers or service providers represent certain shares of economic activity expressed in terms of, for example, volume (i.e., the throughput of different players) (OECD, 1990). Other indicators such as capacity, revenue, added value, capital cost, or other financial or nonfinancial indices can also be used to calculate the degree of concentration in the IFT market (Scherer, 1980). In this paper, we use the volume of different players as indicator. There are many indices to measure the degree of concentration, such as the Gini Index, the Concentration Ratio Index, the Herfindahl-Hirschman Index, and the Entropy Index. The most often used ones are the Concentration Ratio Index (*CR*) and the Herfindahl-Hirschman Index (*HHI*) (US Department of Justice and the Federal Trade Commission, 2010). Typically, the concentration index is calculated for the four largest players (*CR*4). The main disadvantage is

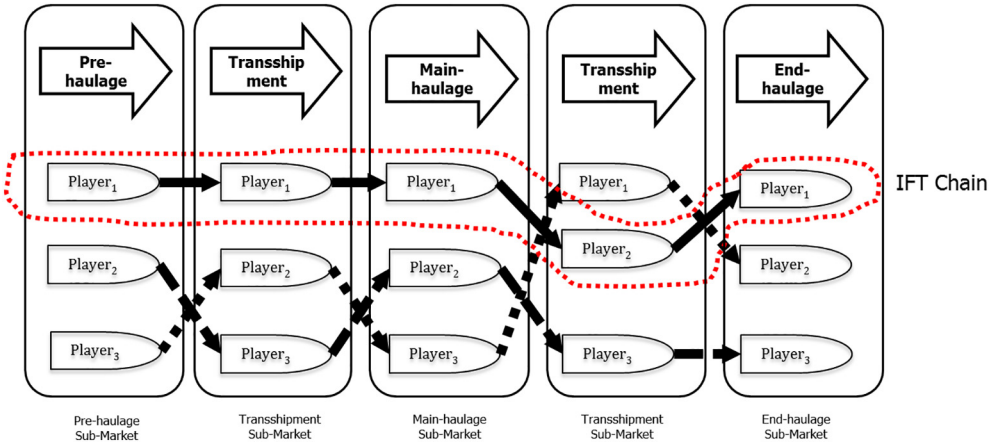

Fig. 1. Different actors inside a corridor of an IFT network.
Source: adapted from Chandrashekar & Schary (1999).

Please cite this article as: Saeedi, H., et al., Analyzing competition in intermodal freight transport networks: The market implication of business consolidation strategies, *Research in Transportation Business & Management* (2017), http://dx.doi.org/10.1016/j.rtbm.2017.02.009