The Sensitivity of Optimal Rail-Road Terminal Locations to Intermodal Freight Costs Variations

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Abstract

In the last decades, the market of goods became globalized, increasing international trade relations and the demand for long distance transportation. As a consequence of the larger distances traveled and of the containerization of goods, maritime transportation became more efficient and reliable. In the hinterland, intermodal (rail-road) freight transportation emerged as a competitive alternative to truck-only transportation. In one of its possible meanings, intermodal freight transportation is the multimodal chain of container-transportation services [1] that, e.g., brings containers from (or to) the seaport by barge or rail to (or from) an intermodal terminal in the hinterland from where they are shipped by truck to their final destination (or origin).

This study focus on inland intermodal freight transport, in particular, on the rail–truck transport of cargo containers in Belgium. This european country has a long rail system and in the last years has readapted this system in order to handle with containerized cargo. Since 2004, some rail-road terminals have been built and new intermodal services between the seaports of Belgium have been established. In addition, with the aim of promoting the modal share of intermodal rail-road transport, the federal government of Belgium started subsidizing part of the rail transport cost and of the transshipments costs at the rail-road terminals. With these investments the intermodal freight flows in Belgium have increased.

The work presented here aims to study the competitiveness of rail-truck freight transportation in a small country like Belgium — it is estimated that for distance lower than 600 kilometers the rail-road transportation has higher operational cost than truck-only [2]. The work will focus: 1) on the study of the strategic decision of locating the rail-truck

intermodal terminals in Belgium; and, 2) on the analysis of the impacts that government subsidies have on the freight modal sharing and on the strategic location of these terminals.

The work to be presented will be divided in three main parts. In the first part we will introduce the concept of intermodal freight transport and discuss the challenges for promoting inland intermodal freight transport in the European Union and, in particular, in Belgium. A brief overview of intermodal freight modeling studies presented in the literature will also be provided.

In the second part, we will present the optimization model in which this study relies on. The main decision variables in this model are the location of intermodal terminals and the allocation of cargo between each origin-destination pair to either rail-truck intermodal transport or truck-only transport. The objective of this strategic decision model is to reduce general transportation costs, which can include long-haul rail or road transportation costs, transshipment costs, short-haul collection/distribution costs, and subsidies.

The third part will describe the model application to the Belgium case study. The problem consists on defining the best location for intermodal terminals in Belgium in order to minimize transportation costs. The transportation network is composed by the set of rail and roads links of the transport network in Belgium and in the neighboring countries, a set of freight generation centers (a centre per each NUTS 3 region), the seaports of Belgium (Antwerp, Zeebruge, Ghent, and Ostend), a set of potential sites in Belgium in which the intermodal terminals can be located, and the intermodal terminals located at neighboring countries close to the Belgium border. The demand from freight transport was considered to be the containerized cargo flows between the seaports of Belgium, the main generation centers in Belgium, and the generation centers at neighboring countries. The transportation costs by mode (road and rail) were calculated according to the models presented in the literature, in particular by Daganzo [2] and Janic [3]. For the intermodal transport, transshipment costs of handling the cargo at the terminals were added. Two cost analyzes were considering: the first regarding only the operational costs, analyzing the perspective of the shippers; and the second regarding both the operational and the external costs, such as accidents or air pollution, analyzing the possible perspective of the decision-makers and of the EU freight policies for internalizing the externalities. For both analysis, different subsidies scenarios were considered: from no subsidies at all, to different levels of subsidies to support part of rail transport costs and/or transshipment costs.

Preliminary results, considering NUTS 2 regions and only the port of Antwerp, show that by just considering operational costs the truck-only transport is the option chosen to do the majority of the freight journeys (Figure 1). Even when external costs are added to the objective function, few intermodal terminals are added to the network. Intermodal freight

transport starts to become competitive when the costs of rail transport and/or transshipment decrease, by being subsidized by the government (Figure 2). Like this, the intermodal freight transport can become very competitive, even for short distances inside Belgium. It is also shown that the demand flows from the border regions of the neighboring countries of Belgium are all served by the intermodal service. This offers some insight that, despite of the small area of the country, due to its location, Belgium is a promising candidate to promoting intermodal transport in the European perspective.

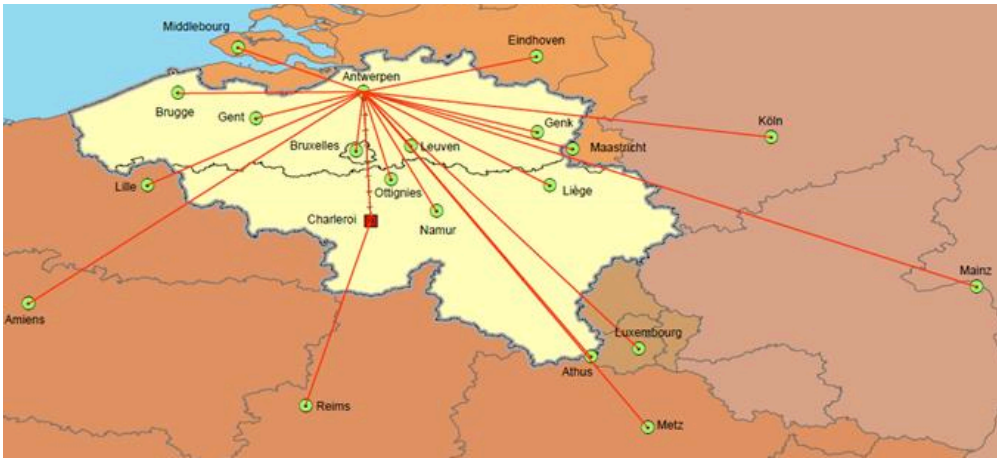

Figure 1 - Solution considering operational costs: single terminal location at Charleroi

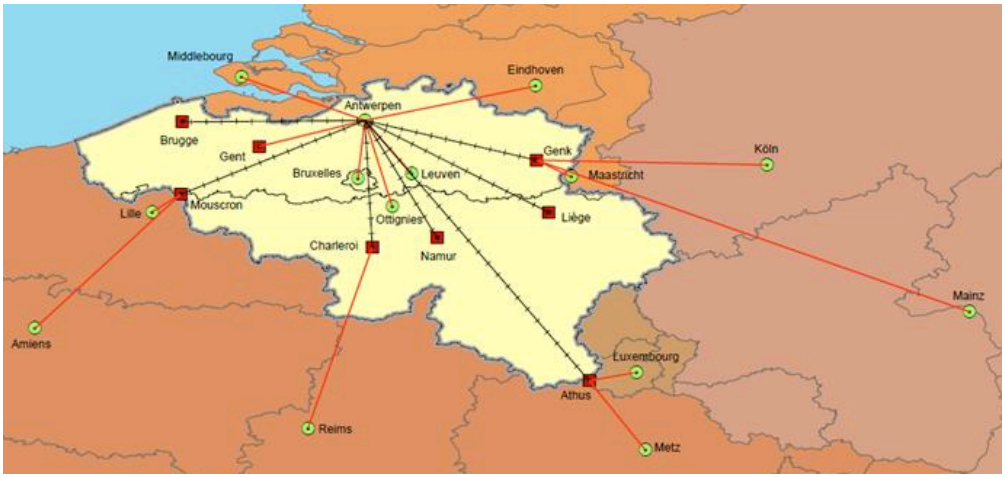

Figure 2 - Solution considering operational costs and subsidies for rail transportation and transshipment: eight terminals located

References

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