Emerald

FREIGHT TRANSPORT MODELLING

EDITED BY

Moshe Ben-Akiva • Hilde Meersman • Eddy Van de Voorde

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In Memory of Prof. Marvin L. Manheim

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INTRODUCTION

Chapter 1

Recent Developments in Freight Transport Modelling

Moshe Ben-Akiva, Hilde Meersman and Eddy Van de Voorde

There can be no doubt that the economic globalization of the last decades and the growing need for flexibility in modern enterprises have transformed freight transport and turned it into a major public policy and corporate domain. Freight transportation research has reflected this evolution and is quite justifiably attracting ever closer attention.

Transportation is not just the product of social and economic activity. Good and reliable transport remains a sine qua non for sustained economic growth. Since production and consumption of goods and services are usually physically separated, the distance between the two needs to be bridged by means of at least one mode of transportation.

Similarly, relocating production activities, often from high-cost to low-cost countries, can only be achieved through better, cheaper and more extensive transportation services. The other side of the picture is that an unrestrained expansion of passenger and freight transport will create substantial negative externalities such as air pollution, congestion, accidents and damage to infrastructure. Consequently, if the relevant policies remain absent, the social costs of mobility may exceed the benefits.

Quite a number of international organizations, including the World Bank, IMF, UNCTAD, OECD and many others, have acknowledged the need for effective transport policy. However, implementing and, as the case may be, adjusting such transport policy is not a straightforward proposition. Continuous monitoring and effective insights are required to afford decision-makers the ability to successfully design and pursue transport policies while responding adequately to new challenges. Despite prolific research on passenger transport in the 1970s and 1980s, the pace of economic globalization since the 1990s has caused researchers and policymakers to shift their primary focus to freight transport.

As the late Professor Marvin Manheim emphasized in quite a few of his publications and in his opening address to the 8th World Conference on Transport Research (Antwerp, 12–16 July, 1998), effective and sound resolutions for such issues require a new and broader transport analysis. This book aims to contribute to such

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an analysis by presenting the insights of a wide and international range of experts with a view to pushing forward frontiers in freight transport modelling. Hence, it is intended for transport researchers in general and for those working on freight transport modelling in particular. It guarantees value added for experienced researchers and doctoral students alike. Moreover, the link with transport policy and management will be of interest to transport decision-makers in both government and industry.

In order to capture the complexity of freight transport systems, researchers have proposed a wide array of models. De Jong, Van de Riet, and Kroes (2004) characterized such models as consisting in one or more mathematical–empirical relations designed to describe and explain the behaviour of a transport system. Ultimately, by taking into account that any transport system is subject to exogenous shocks and/or policy measures, these models can provide insight into possible future evolutions in freight transport.

Small and Winston already asserted in 1999 that freight models must also represent special characteristics of transport markets, most importantly the interactions within or involving the transport system. Ideally, a whole range of important factors, such as localization, trade issues, destinations, infrastructure, shipment and parcel size, timing and frequency of shipment, quality of service, transportation mode, routing, costing and inventory holdings, as well as possible interactions with passenger transport, should be entered into the equation.

To complicate matters further, due attention must be paid to the dynamic nature of transport systems. Some decisions need to be taken consecutively and require harmonization in order to optimize the transport and logistics chain. Others are to be taken simultaneously and may involve a high degree of interaction. Finally, freight transport models must allow for a considerable time lag between a decision and its implementation.

Thus far, the majority of freight transport models that have been put forward deal with specific topics and tend to be designed to deal with a limited number of interactions. The main constraint on the development of more elaborate freight transport models is the limited availability of data, especially at the level of individual firms.

Looking back at past decades, the modelling of freight transport demand has evolved from a non-structural, aggregate engineering approach that is conventionally used for traffic management and routing decisions to a structural, disaggregate approach. The aggregate models utilize global data on shippers and shipments to identify general relations resulting from underlying behavioural assumptions. The more sophisticated models rely on flexible functional forms and test such traditional restrictions as homogeneity, economics of scale and separability. With new empirical methods and growing availability of firm-level data, transport modellers have turned their focus on more behavioural disaggregated analyses.

In the literature, one can find various examples of both aggregate and disaggregate freight transport modelling. There are a number of studies providing extensive overviews of the state of the art in freight modelling (see, e.g. Tavasszy, 2006). Three important fields are identified: the modelling of the relationship between

transportation and economic activity; logistic decision-making and processes; and the linking of traffic flows and networks.

As Small and Winston (1999) have quite rightly pointed out, '*economists have primarily, though not exclusively, focused on mode choice*'. Over the past two decades, transport researchers have clearly broken with this tradition, as evidenced in this book.

1.1. Content of the Book

The book consists of three parts. The first part deals with freight transport modelling from a global (international) point of view. The second part considers freight modelling from a regional perspective. The final part concentrates on the local/urban level.

The global section encompasses four chapters. The opening contribution, by Hilde Meersman and Eddy Van de Voorde, discusses the relationship between economic activity and freight transport. By applying stability and co-integration tests, the authors show that gross domestic product (GDP) is not the best indicator for modelling this relationship in the long run. There are several reasons for this. Some have to do with the changeable composition of GDP, others have to do with the altered relationship between freight transport and economic activity due to the globalization of the economy, policies aimed at decoupling freight and economic activity and changing business behaviour (time-based competition, labour vs. transport costs, …). All this makes reliable long-term aggregate forecasting of freight transport on the basis of GDP very difficult indeed. A number of alternatives are suggested for estimating a reliable relationship between freight and well-chosen relevant indicators of economic activity. The general conclusion is that more specific disaggregate approaches are needed that are based on detailed microeconomic underpinnings of the behaviour of shippers and freight transport companies.

Ennio Cascetta, Vittorio Marzano, Andrea Papola and Roberta Vitillo discuss Multi-Regional Input-Output (MRIO) models for freight demand simulation at national level. They specify a model with elastic trade coefficients and a multimodal freight supply model on a European geographic scale. From the demand side, an elastic trade coefficient MRIO model is presented and some relevant macroeconomic feedbacks are discussed that are incorporable into the model. From the supply side, a critical review is presented of the complexity of the multimodal freight networks and the corresponding modelling requirements. From a practical standpoint, the implementation of an MRIO model at European level is reported, describing in particular both the database and the supply model for the calculation of transport impedances required by the trade coefficient model. Finally, the authors present some simple applications of the implemented MRIO model with elastic trade coefficients, before drawing conclusions and outlining some research suggestions.

In their contribution to freight choice analysis and market research, Moshe Ben-Akiva and Gerard de Jong start from the observation that most freight transport models applied by national, international and regional authorities ignore