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Transportation Research Procedia 16 (2016) 146 – 157

Transportation Research Procedia

www.elsevier.com/locate/procedia

2nd International Conference "Green Cities - Green Logistics for Greener Cities", 2-3 March 2016, Szczecin, Poland

Predicting market allocations, user benefits and wider economic impacts of large infrastructure investments for freight transportation

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Abstract

Conventional cost-benefit analyses of infrastructure projects are often partial analyses in which only the transport market is assessed while adjacent markets are neglected. For large infrastructure investments, however, this is more often than not an unrealistic assumption, especially in the case of investments affecting urban areas where markets adjacent to the transport markets are believed to exhibit a large number of externalities. This paper suggests an alternative approach to tackling the problem; namely, modeling the entire Norwegian economy in a general equilibrium setting. We have developed a Spatial Computable General Equilibrium (SCGE) model for Norway that takes into account urban dynamics through New Economic Geography features. This means modeling centripetal and centrifugal economic forces that produce changes in urban clusters. We use it to calculate direct benefits and the wider economic impacts of infrastructure investments for freight transport in selected case studies. For one particular case study, we find wider economic impacts of 17.0% of the direct benefits for passenger transport and 3.7% for freight transport. This suggests, first, that appraisal of infrastructure projects is to underestimate the real benefits and, second, decisions based on conventional wider economic impact analyses that only take into account passenger transport will tend to overemphasize passenger transport relative to freight transport. We argue that goods and labor demand effects, i.e. effects in markets adjacent to the transport market, are important if we are fully to realize the effects of infrastructure investments.

Peer-review under responsibility of the organizing committee of Green Cities 2016.

Keywords: Spatial computable general equilibrium modeling; SCGE; general equilibrium; wider economic impacts; transport appraisal.

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Peer-review under responsibility of the organizing committee of Green Cities 2016.
doi:10.1016/j.trpro.2016.11.015

1. Introduction

In most countries, disaggregated four-step passenger transport models with a detailed road network are used when infrastructure investments are being appraised, and Norway is no exception in this regard (i.e. partial market analyses in which only the transport market is taken into account). Norway also utilizes a transport model for freight, one in which goods demand is held constant and the logistics chain is adapted to minimize logistics costs given the new infrastructure (de Jong and Ben-Akiva, 2007). These models calculate (direct monetary) the benefits of larger infrastructure projects, their main strength being the extremely disaggregated representation of the transport market and infrastructure networks. However, this approach has two shortcomings: First, since demand is held constant for freight transport, it is impossible to predict how the demand for goods adapts to the lower transport costs. Second, it is generally believed that larger infrastructure projects will have repercussions throughout the economy. Hence, without taking the rest of the economy into account, it is not possible to assess how these repercussions will manifest, nor the effect they may have on the benefits of the infrastructure investment.

This paper suggests an alternative approach in a general equilibrium setting where all transactions in the Norwegian economy are taken into account. We have developed a Spatial Computable General Equilibrium (SCGE) model for Norway of the New Economic Geography (NEG) class (Krugman, 1991). This class of models effectively takes into account urban dynamics through centripetal and centrifugal economic forces that produce changes in urban clusters. The model is inspired by, among others, RAEM (Ivanova, Heyndrickx et al., 2007) and RHOMOLO (Brandsma, Ivanova et al. 2011), and is directly based on an updated version of the original PINGO model (Hansen and Ivanova, 2012). The main reason this particular model stands out is the quality of input data; data regarding national accounts from the central statistics bureau and of passenger and freight transport from the national transport models are of high quality.

This approach not only makes it possible to calculate the direct welfare benefits in standard project appraisal, but also the wider economic impacts. Moreover, it makes it possible to forecast the general effect of an infrastructure project on supply, demand, prices and allocations through the repercussions it has on the economy. Our SCGE model is effectively linked to the Norwegian national transport models for both passenger transport and freight transport. Runs with these transport models produce LoS data and trip matrices that are used as input data for the SCGE model. Thus, the SCGE model combines the best of two worlds: the detailed transport network from the network models at the lower level and macroeconomic effects in a general equilibrium setting at the upper level.

In this paper we discuss urban dynamics in light of direct welfare effects and wider economic impacts; we present the main features of the model and, through a case study, show how these can be calculated for freight transport. First, we present the background to cost–benefit analyses and the wider economic impacts, and, second, the prototype of the model. Third, we conduct the case study for freight transport appraisal.

2. Background: Cost–benefit analyses and wider economic impacts

Conventional cost–benefit analyses (CBA) consider the priced consequences of projects, typically the direct user benefits of a project in addition to direct external effects on emissions or accident rates. CBAs are usually conducted as partial market analyses in which the effect in the primary market (the transport market) is assessed partially, while all prices in secondary (adjacent) markets are assumed to remain constant. In reality, the effect of a large infrastructure project will have repercussions throughout an entire economy.

Economic theory states that if markets adjacent to the transport market are complete, the benefits arising from price and allocation changes in secondary markets will only be a redistribution of the user benefit calculated in a partial CBA (Jara-Diaz, 1986). Hence, considering effects in adjacent markets in such a perfect competitive environment will lead to double counting of welfare effects (Mohring, 1993).

A central assumption behind the economics of conventional CBAs is that of complete markets. If it is no longer realistic to assume that the secondary markets are complete, there may be additional benefits to those calculated in the CBA, benefits known as wider economic impacts (WEI). The two most important imperfections in secondary markets effectively leading to WEIs are “market power” and “agglomeration effects”. Market power characterizes a situation in which a producer can earn positive revenues by setting the price higher than it would have been in a perfect competition scenario. This leads to a lower number of traded commodities in equilibrium and thus to inefficient