ARTICLE IN PRESS

Case Studies on Transport Policy xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Case Studies on Transport Policy

journal homepage: www.elsevier.com/locate/cstp

Policy implications from the economic valuation of freight transport externalities along the Brenner corridor

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ARTICLE INFO

Keywords:
Transport externalities
Economic valuation
Rail incentives
Brenner corridor
Transport policies

ABSTRACT

Due to the morphology and the presence of high slopes, the transalpine infrastructures generate relevant external costs that affect local populations and cannot be ignored. Their inclusion into transport policies and mobility plans has become an important issue, which is directly supported by the EU. This paper quantifies, economically valuates and compares local air pollutants, global air pollutants, noise, congestion and crashes caused by road and rail freight transport along the regional stretch of the Brenner (the transalpine corridor with the highest traffic volumes). Unitary external costs are equal to about €2/t_{net} for road and €0.01/t_{net} for rail. According to the current modal split (70% road–30% rail), this means more than €55 M of yearly external costs. A more rail-oriented modal split could noticeably reduce these costs. Aware of this potentiality, the freight department of the Autonomous Province of Bolzano is going to adopt this quantification to determine the subsidies granted to transport actors in order to incentivize the shift from road to rail. This measure, which is part of a broader set of policies, should be seen as propaedeutic and integrative, in light of the main infrastructural intervention: the forthcoming new Brenner high capacity railway line.

1. Introduction

Transport externalities have become one of the main issues to be considered by mobility planners. They can be defined as the set of impacts on environment, society and economy caused by the mobility sector, which affect the community and are not borne by those actors who actually cause them (Danielis, 2001). Together with agency and owner costs, operator's facility costs, user costs and operator's usage costs, the externalities have to be included in a correct evaluation of transport infrastructures, measures or policies (Sinha and Labi, 2007).

Transport externalities in the European Union (EU) were quantified at more than €500 billion, which was equivalent to 4% of the EU gross domestic product (CE Delft, 2011). Hence, their internalisation is a relevant issue, since it allows making such effects an active part of the decision-making process. This may lead to a more efficient use of infrastructure, which should reduce the drawback effects of transport activity and improve the fairness among users. For these reasons, the EU is particularly aware of a fair definition of unitary external costs. After the first publication (INFRAS/IWW, 1995), several updates have been released in the following years–the last one being the report elaborated by Ricardo-AEA (2014). The discussion is not limited to the academic world, but it has also practical consequences that affect the fare system. The recent amendment of the "Eurovignette" directive (EU, 2016), which sets common rules on distance-related tolls and time-based user charges for heavy goods vehicles (HGVs), was necessary in order to redefine freight transport external costs. Moreover, the subsidies given to rail transport companies to make this transport mode more competitive are based on a correct evaluation of the transport externalities generated by each transport mode.

Despite the importance of this issue, it is quite challenging either to find a consensus over the categories to be included in the evaluation, or to define a fair unitary price for each indicator. The choice depends on subjective aspects, such as: personal beliefs of policy-makers, technical issues (difficulties to find a common methodology to quantify and valuate the impacts economically) and geographical scale of the analysis. As far as the last point is concerned, the transalpine corridors are one of the most delicate stretches of the European infrastructural network, due to the presence of slopes and the morphology of the valleys (Nocera and Cavallaro, 2016a). Particularly, the Brenner axis is the corridor with the highest volumes of passenger and freight transport (Lückge et al., 2017), thus being worthy of a particular attention.

This paper aims at analysing the current freight transport condition along a specific stretch of the Brenner corridor, i.e. the South Tyrolean one. In this Italian Autonomous Province, the local freight department has decided to introduce subsidies for rail transport, which are based on a real quantification of the external costs generated by each transport

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https://doi.org/10.1016/j.cstp.2017.11.008
Received 31 July 2017; Received in revised form 16 October 2017; Accepted 30 November 2017

system. This study quantifies and valuates such quantities economically. Then, it describes the ongoing political process and the synergies with other initiatives along the Brenner axis. The paper is structured as follows: sections two and three set the boundaries of the analysis, by defining respectively the externalities and the geographical context. Sections four and five aim at quantifying and economically valuating the unitary contribution of road and rail vehicles, with regard to each externality and to aggregated values. Finally, section six concludes this paper by describing the practical implications of these findings and relating them to other currently ongoing measures and policies, in order to define a coherent policy contribution for rail transport along the entire corridor.

2. External costs from freight transport: a selection of the indicators

In order to obtain a reliable evaluation of transport externalities, the guidelines developed by the EU (Ricardo-AEA, 2014)

suggest considering the following costs: local air pollution, global air pollution (or greenhouse gases, GHGs), noise pollution, crashes, congestion, building and maintenance of the vehicles and infrastructures, fuel production and the infrastructural marginal costs, i.e. the additional costs of maintenance caused by a higher level of traffic. This paper adopts the indicators suggested by Ricardo-AEA (2014), adapting them according to the context and the aim of the evaluation. Hence, only the first five indicators are selected: local pollution, global pollution, noise pollution, crashes and congestion (Table 1). The exclusion of the last two items depends on the nature of the study. Regarding the fuel production, which affects both local and global air pollutants, the exclusion depends on both conceptual and practical aspects. Referring to the former aspect, if the analysis is limited to South Tyrol, it does not include the evaluation of the *Well-to-Tank* phase, which occurs outside the territorial boundaries. As for the latter one, this choice reduces the numerous sources of uncertainty over the phase of fuel production and distribution (Edwards et al., 2014). Regarding the infrastructural marginal costs, this assessment evaluates the externalities caused by different transport modes according to the current condition, which does not include a traffic variation. These choices allow the definition of coherent limits according to the aim of the research. The macroscale approach adopted in this paper can be justified by the transnational nature of the transalpine transport and by the adoption of a method that is not too much site-specific, in order to obtain comparable results with other territorial contexts. Indeed, the South Tyrolean stretch of the Brenner axis is considered as the central part of the corridor Munich-Verona, which in turn is the core of the Scandinavian-Mediterranean Trans European Network corridor n°1 (from Finland to Malta). These values can thus be included into a broader context.

The local pollutants included in the economic valuation are carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), lead (Pb) and particulate matter (PM_x). They represent five of the six criteria pollutants, recognized as responsible for health diseases. Since the sixth criteria pollutant (ozone, O_3) is not directly produced by vehicles, yet formed in the low atmosphere as a secondary pollutant, it cannot be directly assigned to the transport sector. As a consequence, it is not included in our evaluation. The global pollutants considered are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Together, they constitute almost the total emissions of anthropogenic GHGs (EEA, 2016). As far as other externalities are concerned, sections four and five provide better specifications.

3. The South Tyrolean stretch of the Brenner corridor

The Autonomous Province of Bolzano is located in the northern part of Italy and it is surrounded by Austria and Switzerland (north), by the Lombardy Region (west), by the Autonomous Province of Trento (south) and by the Veneto Region (east). The Province covers a surface of around 7400 km^2 and has a population of over 500.000 inhabitants. The main road network is composed of a highway (Modena-Brenner, A22, 116 km) and a network of national roads (815 km) and provincial roads (1321 km). The railway network is around 290 km long and consists of four lines with a standard gauge: Brenner (Brenner-Salorno, 120 km), Bolzano-Merano (32 km), Val Venosta (Merano-Malles, 60 km), Val Pusteria (Fortezza-San Candido, 65 km). Moreover, there is a local line with a narrow gauge (Renon, 12 km).

South Tyrol counts eight transalpine passes, one with Switzerland (Tubre) and seven with Austria (Resia, Rombo, Brenner, Vizze, Gola, Stalle, Prato alla Drava). The Brenner corridor (Fig. 1) is the most important one. Due to its low height (1,378 ma.s.l.) and its relatively modest slopes, it allows the transfer of a large number of vehicles and quantity of goods. The historic railway, the highway A22 and the national road S.S. 12 (mostly for medium/short haul traffic) compose this

Table 1
List of the externalities considered to evaluate the impact of freight transport along the Brenner axis in South Tyrol.

Externalities caused by freight transport along the Brenner axis in South Tyrol				
Externality	Indicator	Abbreviation	Unit of measurement	Infrastructure
Local air pollution	Carbon monoxide	CO	g	Highway
	Sulphur dioxide	SO_2	g	
	Nitrogen dioxide	NO_2	g	
	Lead	Pb	g	
	Particulate matter	Pm	g	
Global air pollution	Carbon dioxide	CO_2	g	Highway
	Methane	CH_4	g	
	Nitrous oxide	N_2O	g	
	CO_2 equivalent	CO_{2eq}	g	
Noise pollution	Day equivalent continuous noise level	L_{day}	dB	Highway, railway
	Evening equivalent continuous noise level	$L_{evening}$	dB	
	Night equivalent continuous noise level	L_{night}	dB	
	Day-evening-night equivalent continuous noise level	L_{den}	dB	
Crashes	Fatal crash	–	n°	Highway, railway
	Severe injury crash	–	n°	
	Slight injury crash	–	n°	
	Property-damage-only crash	–	n°	
Congestion	Congestion degree	–	%	Highway, railway
	Occupation of the tracks	–	%	