

Table 1
Studies of external costs in the EU.

Title	Acronym/ authors	Year	Purpose and content
Concerted Action on Transport Pricing Research Integration	CAPRI	1998	An assessment of European research projects on transport infrastructure pricing models from the 4th European R&D framework programme.
Real Cost Reduction of Door-To-Door Intermodal Transport	RECORDIT	1998–2001	The fostering of intermodal costs in Europe.
Acceptability of Fiscal Measures & Organizational Requirements for Demand Management	AFFORD	2001	An assessment of pricing acceptability and its impact on the fiscal system.
Unification of accounts and marginal costs for Transport Efficiency	UNITE	2003	The development of a methodology for calculating the marginal costs and unification of accounts costs to implement a more efficient transport system. Specifically, delivers 8 reviews in the case of the Spanish study.
External costs of transport	INFRAS-IWW	1999–2004	The development of a calculation methodology and the results of total and average social costs.
A meta-analysis of western European external cost estimates	Quinet	2004	Demonstrates the variability in the estimate of the external costs of transport after an exhaustive review of European studies
Developing Harmonized European Approaches for transport costing and project assessment	HEATCO	2005	The development of guidelines for establishing a model of transport costs at the European level, which also includes Switzerland. Specifically, delivers 1 review of the average costs of infrastructure and operation and indicates the variability ranges of European countries.
Implementing Pricing Reform in Transport EFFECTIVE Use of research on pricing in Europe	IMPRINT	2005	The definition of a costs methodology for infrastructure use. Establishes the consensus between politicians, transport operators and experts on the calculation of a costs model and the implementation of a new pricing system.
Use of Revenues from Transport Pricing	REVENUE	2003–2005	An assessment of the impact of the pricing policy on the yield generated and its effects in terms of territorial and social fairness, efficiency and acceptability.

Table 1 (continued)

Title	Acronym/ authors	Year	Purpose and content
Generalization of Research on Accounts and Cost Estimation	GRACE	2006	Research on the marginal costs in transport case studies.
Economic and Socio-Environmental Account of overland passenger transport in the Autonomous Community of Madrid in 2004	Monzón et al.	2007	Introduces criteria for calculating the socio-environmental costs of metropolitan passenger transport.

Source: Spanish Road Pricing Model “Modelo Español de Tarificación de Carreteras”, [Monzón, Vassallo, Di Cimmo, and Pérez-Martínez \(2008\)](#) and this paper.

increase sustainability over time. This situation is not exclusive for Spain and can be transferred to other European countries. This study aims to assess whether there has been a reduction in the external costs of road and rail freight transport in the past couple decades and it to obtain the first estimation values against which future developments may be compared.

This paper has 3 main sections: the methodologies used for assessing the external costs and the subsequent reduction in the externalities of surface freight transport modes in Spain, the fundamental factors that could influence the external costs, and the technological measures that could reduce the external costs even further. Section 1 provides a summary of studies on the estimation of the external costs and offers in depth analyses of the methodology applied in the EU Handbook. The EU methodology is used to first offer an estimation of the external costs of surface freight transport in Spain. The authors then propose an alternative methodology for estimating unit external costs that is tailored to Spanish conditions. The study’s sourcing of unit costs, which is based on the EU standard values from the reference EU Handbook on transportation external cost methodology ([Maibach et al., 2008](#)), is compared with the authors’ individual estimations. Moreover, for both modes of surface transport under review, this study demonstrates the results in absolute economic terms (total costs and cost per externality) and unit efficiency (Euro cents/tonne-kilometre). Section 2 describes the factors that could influence the external costs. Additionally, Section 2 indicates how the relationship between the volume of transported goods and the external costs depends on a series of fundamental factors, such as the handling factor, average length of haul, proportion of journeys with no load, modal share and the intensity of fuel use (and the related intensity of externalities). By analysing the evolution of these fundamental factors in Spain, this study could be applied to the future development of externalities, such as accidents, atmospheric pollution and climate change. Finally, Section 3 reflects on the current and future situations related to the external costs of surface freight transport, and it explores avenues for reducing these costs in the future based on technological measures.

2. Assessment of external costs

2.1. European studies

European studies concerned with estimating the external costs of transport highlight the importance of internalising the external costs. Thus, these studies begin by defining methodologies that develop models of external costs. All of these studies stress the need to consider the external costs in the taxation system and the infrastructure pricing system (Table 1). The studies emphasise that the current tax collection system (particularly the taxes on fuel and

