



# Taste heterogeneity and latent preferences in the choice behaviour of freight transport operators



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## ABSTRACT

In this paper we show that individual attitudes of road carriers and their latent preferences toward specific freight service attributes do play a role in determining their mode choices. Specifically, we contribute to the empirical literature on freight agents' mode choice by exploring the role of the "perceived importance" of the most relevant service dimensions in determining the attractiveness of two alternatives to "all-road" transport: logistics terminals and road–sea intermodal services. This is carried out through a revealed/stated preference experiment and a mixture of logit framework. Our results support the hypothesis that operators' attitudes towards time, punctuality and risk of loss/damage can significantly enhance the explanatory power of the choice model, thus providing useful information for policy-makers to improve the regional freight mobility system. The "all road" option is preferred by hauliers concerned with the risk of loss/damage but it is, instead, disregarded by those assigning great relevance to punctuality. We also found substantial heterogeneity among respondents: larger firms tend to assign a lower value to time but a higher importance to the risk of loss/damage, especially if shipments are not frequent. In addition, the relevance of service reliability is higher the reliability greater the load size. Finally, we find that the nature of the transported goods significantly influences the choices of operators: when consigning perishables, hauliers tend to prefer the flexibility of a road-related mode. Any policy aiming at fostering the growth of intermodal transport and logistics and to remove obstacles to implementing rationalisation policies in the field of freight transport should take account of these elements.

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## 1. Introduction

The choice of transportation solutions for freight transport is a complex task that involves a great number of agents, with different tastes, perceptions and criteria for the selection of transport alternatives (Woxenius and Bärthel, 2008). Understanding the factors behind these choices is pivotal for a number of

reasons. On the one hand, from a business perspective, the information can be used in setting-up and marketing new transport and logistic services. On the other hand, from a public policy perspective, the information can be used for the development and use of forecasting models (e.g. for infrastructure investments) or for designing international, national or regional transportation related-measures (e.g. promotion or support for certain transport modes). A typical example of this is the current focus on promoting intermodal transport as a means of reducing congestion and environmental impact from transport related emissions. The growth in freight transport demand registered over the last decades has led, in fact, in many areas, to saturated transportation systems (road networks, in particular), with the consequence of low efficiency and highly negative impacts on the environment. In order to obtain savings in energy consumption, economies of scale and a more sustainable development, many countries have increasingly considered intermodal freight transport. In particular, the Ro/Ro (roll on–roll off) road–sea transport mode

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(Stopford, 1999) has been gaining consensus, at least at political level<sup>5</sup>. This type of intermodal transport uses ships – ferries – designed to carry rolling-stock cargoes for the longest segment of the trip. These ships do not require cranes to load or unload cargo, but trailers are driven on and off the ship's decks<sup>6</sup>.

Many EU initiatives (for instance, Marco Polo I and II) and country specific incentives grant growing support for this transport solution. Insular and less accessible regions should be particularly prone to benefit from the Ro/Ro alternative. However, in many cases, such as for instance Sicily, the largest Island in the Mediterranean and the largest among the Italian regions, transport policies have not been very effective in developing Ro/Ro services nor services functional to the rationalisation of freight mobility.

One of the reasons is that it is difficult to design and to evaluate a policy aiming at achieving a modal shift without a sound understanding of users' preferences and, until now, to our knowledge, no specific study has been carried out in this area<sup>7</sup>. In this paper, we focus on a case study carried out in Sicily where, until now, the development of sea-road intermodal transport services is limited: road captures about 30% of non oil inbound and outbound cargoes albeit Sicily is an island and the land connections from Calabria, the neighbouring region, are qualitatively scarce (Tagliacarne-Unioncamere, 2012). The widespread use of “all-road” transport penalises both the regional economy and the local and national environment.

Considering the above, the research aims at identifying the factors which mostly affect road freight agents' choice behaviour, focusing the analysis on the possibility of using road–sea combined transport and logistic terminals. While the first option would generate both internal and external cost savings through the substitution of road transit with the maritime connection, the latter would reach this result through load factor optimisation. Such terminals are, in fact, break-bulk facilities which can promote a more efficient and sustainable organisation of transport, functional to the development of intermodal transport. They contribute to the optimisation of load factors through truck-to-truck transshipment and consolidation of freights (Daganzo, 1987). This is particularly useful for small scale operators, which cannot otherwise benefit of scale and scope economies and, thus, for Sicilian road haulage industry which is severely fragmented, as it is in the rest of Southern Italy, the so-called *Mezzogiorno*<sup>8</sup>. These terminals

<sup>5</sup> Particularly useful is the review of the Institute for Global Maritime Studies (2008) in depicting how coastal shipping could reduce traffic congestion.

<sup>6</sup> As it is well known, the Ro/Ro combined transport presents several advantages: it does not need complex handling and loading equipments; it imposes minimal investments and maintenance costs (since transport operations are carried out by sea); it reduces the number of trucks on the road network thereby mitigating the environmental impact of freight mobility; it makes the journey of truck drivers far less tiring and risky with respect to the “all road” alternatives; if the driver follows the cargo to the destination, the time spent on board is not counted for driving time limit, eliminating the need of a costly two driver-solution; finally, it allows to exploit economies of scale by assembling hundreds of trucks on the same vessel.

<sup>7</sup> Freight operators' preferences for maritime services in Italian mainland regions has been explored, comparing attitudes towards Ro/Ro short sea shipping, by Bergantino and Bolis (2005 and 2008) and, on more recent data, by Bergantino (2009). The outcomes seem to support the hypothesis that preferences are differently distributed according to firms' location and territorial infrastructure endowment. It would be useful, thus, to investigate operators preferences in peripheral areas. The Ro/Ro alternative has been the focus of interest of a number of studies carried out in Mediterranean regions, see, among others, the interesting analysis of: García-Menéndez et al. (2004), Blayac (2007) and Feo et al. (2011). Particularly useful in the definition of maritime service alternatives to land transport is the work of Puckett et al. (2011) and Brooks et al. (2012) and the work of Train and Wilson (2008), which focuses on the alternative between rail and barge services in the USA.

<sup>8</sup> The reader is referred to the work of Dallari and Brenda (2009) and of MIT (2011).

also improve demand-supply coordination and provide several value added services on-site, such as packaging, quality controls, info-mobility facilities, etc. These two solutions, thus, represent, for road operators, the opportunity of better organising their business so as to increase efficiency and, for society, a promising strategy for a more sustainable freight mobility system. The final outcome of the research are useful insights for the policy makers on the potential benefits of such transshipment centres and on the strategies for more competitive road–sea intermodal services in the freight industry.

We use a database collected through a combined Revealed Preferences (RP) – Stated Preferences (SP) survey on ninety road freight firms located in Sicily. They have agreed to participate to the natural experiment for eliciting their preferences for transport attributes and for specific characteristics of the two options.

Recent advances in discrete choice modelling, have promoted the treatment of attitudes and perceptions affecting decision-making to get a more realistic representation of the choice behaviour (see for instance Ben Akiva et al., 1999, 2002; Morikawa et al., 2002; Walker, 2001; Walker and Ben Akiva, 2002). Rating data, such as responses to attitudinal and perceptual survey questions, are used as indicators of important causal variables that are not directly observable. Following this literature, mostly focusing on passenger travel behaviour, we developed a discrete choice model with attitudinal variables for the freight market. So, we could test the impact of the perceived importance of some relevant transport attributes on road freight operators, when faced with intermodal and logistic services. In detail, we integrated a discrete choice model with latent variables extracted from the responses to survey questions on attitudes, to produce a framework in which the system of equations is estimated simultaneously (hybrid model). In order to allow for heterogeneous responses of carriers to travel time variations and correlations among alternatives, the latent factors were incorporated into a mixture of logit framework (Bolduc et al., 2005).

Hence, in line with only a small subset of other studies in the area, our empirical work shows the applicability of the latent variable approach to real world freight transport modelling and allows for agents' heterogeneity. Furthermore, as few other freight transport studies, this research uses disaggregated data and stated preference techniques. In particular, the estimates show that attitudes towards time, punctuality and risk of loss/damage can significantly enhance the explanatory power of the choice model, thus providing useful information for Sicilian policy-makers to improve the regional freight mobility system. We also found that hauliers' different attitudes toward service attributes do play a role: smaller firms tend to assign a higher value to time, while the risk of loss/damage is more important for greater operators, especially if shipments are not frequent. In addition, relevance of service reliability is higher the greater the load size. When consigning perishables, hauliers tend to prefer the flexibility of a road-related mode, as they do when assigning greater importance to the risk of loss/damage; instead, the “all-road” option is less competitive for punctuality-orientated carriers. Any policy aiming at fostering the growth of intermodal transport and logistics should take account of these elements.

Section 2 illustrates the scientific background of the research, followed by a description, in Section 3, of the mixed RP–SP survey carried out to produce the choice observations for model estimation. Section 4 details the specification and the estimation of the mixture of logit model used to simulate carrier behaviour. In Section 5 the preliminary analysis for incorporating latent attitudes into the choice model is reported, while Section 6 presents the estimated mixture of logit model integrated with latent factors. Section 7 highlights the implications of the estimation results for the regional policy and section 8 contains some concluding remarks.

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