



An Analysis of Maritime Ro-Ro Freight Transport Service Attributes through Adaptive Stated Preference: an Application to a Sample of Freight Forwarders

Angela Stefania Bergantino^{1*} and Simona Bolis²

¹ *Department of Economics, University of Bari, Italy*

² *IRE - Faculty of Economics, University of Lugano, Switzerland*

Abstract

In this paper we present preliminary evidence from a pilot study carried out with the primary objective of testing the validity of adaptive conjoint data collecting methods in analysing operators' preferences when redirecting current on-land transport services to a hypothetical maritime ro-ro service alternative. The analysis has focussed on a sample of freight forwarders. Through a combination of Revealed Preferences and Adaptive Stated Preference Experiments we have constructed a database of their preferences' toward the maritime ro-ro alternative using a set of transport service attributes: price, reliability, frequency, transit time, etc. We have estimated the relevant parameters through a Tobit model and have been able to calculate relative trade-off values among the significant attributes. The resulting ranking highlights the relative importance of reliability and frequency in the decision to switch to maritime services.

Keywords: Adaptive Stated Preferences; Conjoint analysis; Ro-ro maritime service; Freight transport; Freight forwarders.

1. Introduction

The growing interest towards a re-balancing of freight traffic over the different modes has, only recently, been accompanied by significant efforts to empirically identify the factors which might exert a significant influence on the choice of operators. Although the first large scale studies date back to the early nineties, only more recently, in fact, a sistematisation of the various experiments is taking place. It is now starting to form a relatively large sample of studies and of estimated values on the determinants of the

* Corresponding author: A. S. Bergantino (a.bergantino@dse.uniba.it).

operators' demand. Most of these studies focus on producers' preferences for transport services attributes. An increasing part of these studies recur to stated preference methodologies and, through differing estimating techniques, obtain an indicative valuation of the service characteristics identified as relevant for the interviewed sample (see, for instance, Regan and Garrido, 2001 and Danielis, 2002).

Our study differs from many of the previous papers on three accounts.

First, we have opted for an interactive approach which allows operators' preferences to be elicited on hypothetical alternatives. In particular, we carried out an adaptive stated preference experiment to collect an appropriate database and, given the characteristics of the data, estimated the relevant parameters through a Tobit model. The analysis has been carried out through two quantitative and qualitative surveys: a revealed preference study to obtain data on the characteristics of the "typical" transport performed by the company (functional to the stated preference experiment) and a stated preference interactive interview with a specific set of operator to learn about user preference for an hypothetical alternative service defined by a set of attributes: price, reliability, frequency, transit time, etc.

Second, most of the previous studies do not focus on a specific mode but, instead, leave the choice of the type transport mode to the respondent identifying only its attributes (Danielis, 2002). In our study, instead, we have restricted the modal choice to a maritime ro-ro service. Our decision has been dictated by the desire to analyse operators' preferences in relation to this specific mode of transport given the growing interest of policy makers towards the spin off of initiatives directed at stimulating a re-orientation of traffic flows towards the maritime mode, and, in particular, towards ro-ro services. This approach has enabled us to analyse transport service consumers' preferences for the maritime alternative and to identify the service attributes which most influence users' attitudes towards short-sea shipping ro-ro services.

Finally, we have chosen to focus our application on freight-forwarders instead of producers. The latter has allowed us to gain insight on a part of the market for transport service, which accounts, on average, for more than half of the transport decisions. Outsourcing of transport operations is, in fact, spreading rapidly and, as a recent study by Unescap (2002) points out, freight forwarders are increasingly assuming full responsibility over the complete cycle of the transfer of the freight from door-to-door. Selecting freight-forwarding agents allows, thus, to complete the picture of the preferences of consumers' of transport services: insights can be gained from a wider spectrum of possible uses. A comparison of the outcome of our study with those of the studies focussing merely on the producers' behaviour can help us to understand whether the preferences of these two set of transport service consumers tend to converge or to diverge and, thus, whether a need exists for taking differentiated policy initiatives.

The rest of this paper is organized as follows. In Section 2 we describe the methodology used to assemble the dataset, the criteria followed in identifying the sample and the design of both the revealed preference survey and the adaptive stated preference experiment. Section 3 contains a detailed description of the database and an illustration of the estimation procedure and main outcomes. It also contains a brief comparison of the main results of other EU studies. Section 4 briefly summarizes the main conclusions.

2. Data Base Construction Methodology

2.1 *The choice of Adaptive Stated Preference*

In the last few years, significant improvements have been made in the definition of a methodology capable of realistically interpreting the decision-making process of operators with respect to transport service choice. The superiority of stated preference techniques versus revealed preference techniques in these instances is generally accepted, mainly due to the characteristics of the data needed for the experiments. Application of revealed preference methods based on observed behaviour is, generally, not feasible in the context of freight transport since:

- the data on actual choices is usually commercially very sensitive and hence is not usually disclosed¹;
- the complexity of the freight transport decision requires the collection of large dataset on a number of variables and the observation of a great number of firms' decisions in order to take into account the heterogeneity of the context.

Revealed preference datasets, in fact, are based on the observation of actual choices; need a large number of observations; may include only existing alternatives; and require the choice set to be defined and the level of service information for the discarded option to be calculated. Moreover, important characterising variables (such as, for instance, time and cost) are often correlated and, due to possible measurement error, there might be bias in forecasting. Finally, for the specific scope of the study, the limited use of the maritime alternative, especially for certain routes and products, is an additional reason against the use of revealed preferences in this context. The existence of an alternative which is not sufficiently used is, in fact, analogous to analysing the choice of a new alternative (Tweddle et al. 1996).

Stated preference data, on the other hand, overcome these problems, although questionnaire design and choice of the relevant attributes² plays a major role in their efficacy. It has the advantage, with respect to standard revealed preference approaches, of allowing analysis in contexts in which it is not possible to "observe" the real behaviour of operators either for lack of data or because the alternative to be analysed is not yet used or available for use.

More recently, a growing body of literature has been emphasising the advantages of combining revealed preference and stated preference data in order to exploit the strengths of both³. In the present application, however, given the need to consider hypothetical services as well, this possibility is partially precluded and – although revealed preference techniques are used in gathering data on the current choices of the pilot sample and to select a "typical" transport for each company (the current choice) – the data are mainly collected through stated preference techniques.

¹ In a liberalised environment, freight rates are individually negotiated and held commercially confidential.

² On the importance of the correct specification of the influential attributes in SP analysis, the reader is referred to the detailed work of Cullinane and Toy (2000).

³ For greater details the reader is referred to: Ben Akiva and Morikawa (1990), Adamowicz et al. (1994 and 1997), Swait et al. (1994), Bradley and Daly (1997), Stopher (1998), Wardman (1998), Brownston et al. (1999), Louviere et al. (2000).

The methodology used falls within the broad family of conjoint analysis experiments, as we attempt to determine the value that individuals place on any product as equivalent to the sum of the utility they derive from all the attributes making up a specific transport service. The conjoint alternative scenario approach is a research technique used to measure the trade-offs people make in choosing between products and service providers. It was first developed in the marketing sector and has been largely used to predict consumers' choices for future products and services, and now it is a well-established procedure in transport studies⁴.

In particular, given the need to avoid offering the respondent options which are irrelevant for the respondent, we discard traditional stated preference techniques in favour of the adaptive stated preference (ASP). This interactive data collection technique amends attribute levels offered to the respondent during the experiment on the bases of the responses he gives. One significant advantage of this method in studying freight is that it makes it possible to cope with a wide range of "situations" which are comparable with the real world known by the respondent and that the experiment is trying to recover (type of commodity, time variance of attribute valuation, etc.).

The ASP experiment starts from an existing freight transport option chosen by the interviewed person. Usually this option is defined using revealed preference data and is elaborated in accordance with the person responsible for the mode choice: it is the "typical" transport of the firm (Fowkes and Tweedle 1996). Starting from this option, the ASP exercise implies asking the respondent to rate various hypothetical alternatives for performing the same transport task expressed in terms of the relevant attributes.

To our knowledge, this is the first ASP experiment performed with the scope of determining the preferences of operators in terms of service attributes of sea transport and of studying the potential reallocation of traffic from surface transport services to maritime ro-ro services⁵.

2.2 Identification of the Sample: Who and Where

Differently from many previous studies, which investigate producers or suppliers⁶, the present analysis has been carried out on a sample of freight-forwarders. The specific choice is based on the following reasons:

- first, it is increasingly common, especially for medium-long distance transfers, to delegate the decision on the mode to be used outside the firm to third parties: choosing freight-forwarding agencies makes it possible to intercept information from

⁴ In particular, in the context of freight transport, since the late seventies – with the pioneering work by Fowkes and Tweedle (1979) – stated preference techniques have been used, among others, by Bates (1988), Ortuzar and Palma (1988), Fowkes and Tweedle (1996, 1997), Fridstrom and Madslie (1994, 2002), Bolis and Maggi (1999, 2002, 2003), Bergkvist (2001), Fowkes and Shinghal (2002), Danielis and Rotaris (2002), and Maier and Bergman (2001, 2002). For a more detailed review of literature on stated preference experiments in the freight transport sector see also Regan and Garrido (2001).

⁵ A previous study carried out on the routes between Sicily and the Continent by Gattuso and Pastorino (1996) adopted standard SP methodology.

⁶ Among others: Bolis and (1999, 2002, 2003), Meier and Bergman (2001, 2002) and Danielis and Rotaris (2002).

a sector of the industry which accounts, on average, for more than half of the transport decisions, as outsourcing of transport operations is spreading rapidly⁷.

- Secondly, the focus on freight forwarders results in a sample which, although small, is homogeneous with regard to respondents' activity. Given the limited resources available, and in the light of extending the experiment, selecting producers would have limited the scope of the analysis to a specific productive sector or would have excessively constrained the dimension of the dataset for each industrial sector. On the other hand, choosing transporters, given the current situation of the Italian surface transport industry, would have probably led to interpretation problems due to the resistance of small operators to intermodal transport⁸.
- Finally, recent studies have demonstrated that freight forwarders are becoming "one-stop shop" specialist companies (KNP 2002). According to the results of the market review carried out by Unescap in 2002, this is part of a process that has led to the blurring of boundaries between what were formerly distinct activities. There is a growing body of evidence showing that "freight forwarders, from the perspective of the shipper, assume the role of the carrier; from the point of view of the actual carrier; they assume the role of the shipper" (Unescap 2002, p. 1).

All in all, selecting freight-forwarding agents instead of producers on the one hand allows insights to be gained from a wider spectrum of possible uses, and on the other hand, to gather a set of information on the subject who is really behind the decision-making process in transport attribute choices. Although the objective function of the freight forwarder would necessarily differ from that of the producer, it could reasonably be argued that, given the recent evolution of the market and of the contractual agreements in force, once the organisation of the transport service has been outsourced the real (final) decision maker, the shipper, would be the freight forwarder herself/himself. S/he would be the residual claimant to any cost-quality advantages obtained.

Also, in line with the scope of our investigation, we have restricted the interviewed sample to those freight forwarders who have a certain familiarity with the maritime mode and, given the purposes of this study, we have focussed the empirical application on a specific geographical context. In particular, we have analysed the preferences of freight forwarder localised in the north-west regions of Italy with respect to the possibility of accessing maritime ro-ro services from the port of Genoa. In order to present the participating freight forwarder with comparable alternatives, we have considered traffic-flows between origin-destination areas which are reachable from the area of the study both by sea and by land.

⁷ Recent surveys on the evolution of the freight forwarders business and type of services offered are contained in KNP (2002) and Unescap (2002). At the European level interesting insights are given by Logiq (1999).

⁸ Recent studies highlight (Tsamboulas and Kapros 2002) the widely differing expectations different groups of users have for transport service attributes, especially in relation to multimodal transport services, and they indicate that intermediaries have, in general, a more in-depth knowledge of possible alternatives. Moreover, when producers externalise the logistic and/or transport function they tend to be less concerned with the actual characteristics of the transport service chosen as long as terms and conditions of the contract are respected.

2.3 Data Collection: The Revealed Preference Survey and the ASP Experiment

Once the participants and the geographical context to be covered by the study were identified, the data was collected in two steps. In the first phase a revealed preference survey was carried out – through the use of a questionnaire – to identify potential participants to the second stage and to obtain data on actual choices used in selecting a “typical” transport for customising the design of the ASP experiment. In the second phase, the ASP experiment was carried out on a sub-sample of the freight forwarding agencies that participated in the revealed preference survey. The main reason for performing a stated preference experiment, in this context, was the need to test the introduction of a new maritime transport service – on the route of interest for the respondent – alternative to the transport service currently chosen. The final sample constitutes the pilot group, and the estimations are based on the collected database.

2.3.1 The First Phase – The Questionnaire

The aim of the first phase of the interview was to determine whether the company was appropriate for the study and whether it was useful to include it in the second phase of data collection. Inclusion, in fact, depended not only on the willingness of the company to participate but also on its geographical coverage and on the type of traffic it served. In order to compare surface and sea transport it was necessary to identify operators that could consider the hypothetical alternative feasible, given the characteristics of their traffic. For instance, including companies serving the route from northern Italy to Sardinia would not be appropriate as no surface alternatives could be considered viable. Similarly, it would not be appropriate to include in the analysis those serving the routes Turin to Trieste since no sea alternative would be practicable. This part of the study was functional to the second part, the stated preference experiment.

The questionnaire elaborated contained questions directed at acquiring basic facts (products, destinations, typical modes, and so on) on the company’s activity and dimension and to understand its actual commodity and geographical coverage. A specific question was included in order to understand the role of the respondent in the organisation of the transport service, the characteristics of the contract and the level of independency from the producer in choosing the transport service. In particular, a section of the questionnaire was dedicated to the definition of the “typical” transport carried out by the company useful for customising the ASP experiment to the company in the context of maritime transport.

The sample has been obtained from the 165 freight forwarding companies belonging to the association of freight-forwarders related to the port of Genoa. About 20% of the companies did not reply to a first telephone contact (34 companies) and, of the remaining, about 15% affirmed of not having a stable working premise in the area of interest (18 companies) and about 10% had the same management as others in the sample (14). The relevant population was thus reduced to 99 units. Of these, about 39% declared that they were not interested in participating (38) without giving additional information and about 25% (25) declared they were not interested in participating as they specialised only in surface transport or had a geographical coverage which was not compatible with maritime transport. The questionnaire was thus sent to the remaining 36 companies (36% of the relevant population). The overall response rate, although

limited with respect to the total population, was relatively good with respect to the restricted group of freight forwarders identified as potentially suitable for the interview: 18 companies out of the 36 contacted replied (50%)⁹. From the information collected it appeared that only about 80% of the respondents could be fit for continuing with the second part of the study (14); however, at this stage, only 7 gave immediate availability to continue with the experiment (50%)¹⁰.

2.3.2 *The Second Phase – The Experiment*

The second phase of the study, which followed a thorough pre-test of all instruments, consisted in an interactive conjoint analysis interview carried out with the managers responsible for the mode choice for the companies participating in the pilot study. The “ASP experiment” was carried out with the support of a portable computer and software which presented a consistent, on-screen, series of scenarios adapting to the respondents’ choices.

The interviewing process is the following. On the first screen the respondent is asked to confirm the information on the “typical” transport operation performed by the company acquired through the revealed preference survey. The information is then used to customise the “current choice” of the respondent which becomes the “reference option” and does not change for the whole experiment.

On the basis of the relevant literature¹¹ and the outcome of the revealed preference survey, four variables are identified as most significant in depicting the transport service:

- price (P), i.e. out-of-pocket cost of transport, including loading and unloading;
- time (T), i.e. door-to-door transit time, including loading and unloading;
- reliability (R), i.e. as % of deliveries as scheduled;
- frequency (F), i.e. as % of service per week offered by the carrier.

The current choice, which consists of a value for each of the four service attributes identified, is reported at each iteration on the left-hand side of the screen, column A, and it is automatically assigned a rating of 100. It is assumed that among the existing alternatives, this is the preferred one, and thus it represents the operator current utility level.

From the second screen and for each subsequent iteration, two more options – B and C – appear next to column A. They report hypothetical alternatives which are

⁹ For a detailed illustration of the outcome of the analysis of the data retrieved through the questionnaires see: Bergantino and Bolis (2002 e 2005) and Bergantino et al. (2005).

¹⁰ Although a larger sample would have been desirable, even for the pilot study sampling costs are considerable and organising the meetings quite burdensome and time consuming. Interviews with relevant decision makers have to be agreed upon, set up, often postponed and have rarely been short enough to permit more than one to be conducted on the same day. Nevertheless, the interviewing process is still going on and, at the time of revising this paper, the companies contacted have significantly increased, generating a much larger dataset. Preliminary analysis of the integrated dataset show consistency of the results with the outcome of this first pilot study, which took place in September 2002.

¹¹ Among others, Fowkes and Tweddle (1996, 1997), Bolis and Maggi (1999), de Jong (2000), Maier and Bergman (2001, 2002), Fowkes and Shinghal (2002) and Danielis and Rotaris (2002). Extremely interesting is the ranking of the attributes most commonly used in analysing transport demand and users’ preferences contained in the detailed survey of Cullinane and Toy (2000).

automatically generated by the software and which are characterised by differing values of their service attributes. Column B always refers to the same mode of transport of the “typical” transport defined by the respondent (column A) while column C refers to a different mode of transport. The alternative mode of transport we propose across all experiments is always “maritime ro-ro service”. In our experiment, thus, the mode is not just another service attribute and its estimated value allows us to verify whether there would be an *a priori* preclusion for maritime transport.

The value of the four service attributes of each alternative are determined as follows:

- the first time the alternatives are presented (second screen), the information is taken on the basis of the known characteristics of the firms’ original transport service in terms of percentages (e.g. % discount or increase in price, % of shipments currently arriving on time, etc.)
- for the subsequent iterations, on the basis of the choices reported each time by the respondent.

In every repetition of the experiment, the hypothetical alternatives presented in column B and C thus change: new computer generated alternatives are presented and the respondent is asked to rank the two alternatives against option A on the basis of the value he/she assigns to the “new” service.

In choosing the rating, the respondent has to use a value scale carefully illustrated by the interviewer. This ranges between 0 and 200¹². The iterations continue until, for each variable in turn – starting with price –, indifference is reached. In other words, once variations in prices as a function of the rating given by the respondent in the previous iteration do not lead to a variation in the rating, the new screen presents options in which the remaining attributes change values following the same procedures. The process continues until convergence is found for all attributes or at the 20th iteration¹³.

3. Data Analysis and Estimation Methodology

Given the characteristics of the experiment, the formulation of the two alternatives, and respondents’ choices, each answer given during the experiment is taken as a separate observation. The database is thus made up of 239 observations, an average of 34 observations per respondent.

3.1 Descriptive Statistics

The sample used for the estimation was obtained using the observations gathered during the interviews. Table 1 contains the main characteristics of the data collected

¹² It is extremely important that the respondent rank options in their desired order, having a clear understanding of the scaling, so to indicate as accurately as possible their strength of preference (Tweedle et al. 1995).

¹³ Each iteration generates two responses therefore, in the case that all 20 iterations are run, we would obtain 40 observations by each respondent.

with regards to the “typical” transport services described by each respondent and used as the benchmark for the experiment (column A).

The shipment generally carried out by the “average” company participating in the pilot study lasts two days, it is relatively frequent (every 2.5 days), it is delivered at the expected time more than 80% of the time and costs about 1.3 euro per kilometre. The data collected seems to be relatively coherent across the seven cases.

Table 1: “Typical” transport (average values).

<i>Variable</i>	<i>Measurement unit</i>	<i>Mean</i>	<i>Min</i>	<i>Max</i>
Price	(euro)	1,573	1,215	2,350
Time	(hours)	56	50	90
Reliability	(%)	84	50	100
Frequency	(times x month)	12	8	40
Mean length	(km)	1,143	800	2,000

Table 2 shows the mean and the median values of the hypothetical offers presented to the seven respondents. Interestingly, although both mean and median values of the variables Time, Reliability and Frequency are all below the values of the current option, the mean value of the rating is always above 100 (the rating of the reference alternative, the “typical” transport): the shippers always prefer the new services offered. It therefore seems that the savings in cost more than compensate for the reduction in the other attributes and that there is no mode-specific preclusion.

The mean and the median of the difference between the value for each attribute of current service and the hypothetical alternative is shown in Table 3. Across all experiments, the hypothetical services offered a mean discount of about 35%, a mean reduction in travel time of about 4 hours, a mean decrease in reliability of 3,6% and, finally, a mean reduction of frequency corresponding to a service supplied about four times less per month. The mean probability of choosing the alternative service is about 50%.

Table 2: Hypothetical offers: mean values of service attributes.

	<i>Cost (Euro)</i>	<i>Cost (Index)</i>	<i>Time</i>	<i>Reliability</i>	<i>Freq</i>	<i>Rating</i>
Mean	994.2	60.3	60.5	81.7	12.5	105.8
Median	935.2	57.5	64.0	81.0	8.0	110.0

Number of observations: 239.

Table 3: Hypothetical offers: mean values of the difference in service attributes.

	<i>DiffCostindex</i>	<i>DiffTime</i>	<i>DiffRelia</i>	<i>DiffFreq</i>	<i>Pa</i>
Mean	21.3	-2.9	-3.9	2.5	0.5
Median	21.6	0.0	0.0	..1	0.5

Number of observations: 239.

It can be seen that the options presented have been considered unacceptable seven times and that all the zero-values are concentrated in the first experiment (see below). From the raw data it is possible to see that these values are related to changes in the level of reliability: the respondent considered the levels of reliability of the hypothetical offers to be too low, notwithstanding any compensatory decrease in price. The respondent considered reliability an essential attribute of the transport service and any

alternative transport service which implied significant changes in the level currently guaranteed represented, for her, a non-viable option. As it can be seen, the remaining ratings indicate that convergence was generally found relatively easily.

3.2 Estimation Results

The estimation has been carried out separately for each company in order to avoid estimation problems linked to the well-known problem of repeated and non independent observations¹⁴. The procedure chosen to estimate the empirical model is the Tobit ML estimator¹⁵. The dataset, in fact, contains a number of zero values corresponding to those alternatives which, given the value of their attributes, have received a rating of zero. Since we can assume that those zero values correspond, in principle, to cases in which the latent variable – the indirect utility – might take negative values (i.e. unacceptable levels of reliability which would compromise the respondent activity), we can treat the zeros as a result of censoring and non-observability and thus apply the Tobit estimator.

The results of the estimation are shown in Table 4.

Table 4: Estimation results on ASP data.

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Exp. Sign
Intercept	1,29	-15,61**	-7,67	-4,68	-9,15	12,58	-9,79*	+
Cost	-0,48**	-1,13**	-0,74**	-1,35**	-1,11**	-1,57**	-0,99**	-
Time	0,70	-0,13**	-1,18*	-1,56*	0,81*	-1,14**	-0,97*	-
Reliability	1,41	5,42*	1,99*	1,64*	-0,18	6,11*	1,57	+
Frequency	1,18**	-0,71	7,13**	10,13**	9,90**	6,29**	12,99*	+
Use of ro-ro	-9,11	15,61	-22,64*	8,05	-12,40	10,57*	14,59*	
Adj. ρ^2	15%	49%	28%	59%	54%	48%	39%	
N. obs.	41	27	33	31	35	41	31	239

*=5% ; **=10%

All coefficients (β_i) refer to the effect of a change in the respective variable (i) on the respondent's utility (rating). The coefficients of cost, time, and frequency are generally significantly different from zero. In particular, the coefficient of the variable cost is always significant at the 10% level with an expected negative coefficient. Intuitively, in fact, an increase in cost generates a decrease in the respondents' utility. Frequency and time also have, in general, the expected positive sign as an increase in the difference in frequency and journey time between the current option (A) and the alternative ($i = B$ or C) is likely to have a negative impact on the probability of continuing to choose the current service. The only exceptions are for frequency, case 2, and for time, case 1 and case 5. For the first two cases, however, the coefficients are not statistically different from zero.

Given the focus of our study, of particular relevance is the dummy ro-ro, which should pick up the valuation of the willingness to use the maritime mode. Although the

¹⁴ On the issue of how to tackle the issue in a particular context, the reader is referred to Maier and Bergman (2001, 2002). Although the solutions they adopt are valid and would be relatively easy to apply, in this particular pilot study, given the limited size of the database, we prefer to proceed with separate estimations.

¹⁵ For greater details on the estimation procedure, the reader is referred to Bergantino et al. (2005).

coefficient takes quite differing values among the different case studies, it is generally not significantly different from zero. Except for case 3, for which the parameter is negative and significantly different from zero, it is possible to infer that there is no “a priori” reluctance of the respondents to use ro-ro services. In particular, freight forwarders in the pilot study do not seem to have strong preferences either way.

From Table 4 it can be noted also that, in general, the coefficients have very low values for all the variables and for all case studies. This implies that the marginal impact of a change in a variable on the propensity to change from the current solution to a hypothetical one is small. The respective elasticities would thus be small as well (see also Bolis and Maggi 1999).

In Table 5 we report the monetary valuations of tradeoffs (MVT) between attributes. For each attribute (i), the values are obtained as the ratio of its parameter estimates (β_i) to the cost parameter estimate (β_c).

$$MVT_{ic} = \frac{\beta_i}{\beta_c} \quad (1)$$

Table 5: Trade-off ratios of transport service attributes to cost (absolute values – in Euro per Ton.).

Value	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Corrected average **
VOT	(-1.44)	0.11	1.60	1.16	-0.73	0.73	0.98	0.64
VOR	(-2.92)	-4.80	-2.70	-1.22	(-0.16)	-3.89	(-1.59)	-3.15
VOF	-2.44	(0.63)	-9.68	-7.52	-8.95	-4.01	-13.12	-7.61

^aThe values in parenthesis are not significantly different from zero at the 5% confidence level.

^bThe corrected average includes only the values of the trade-off relative to coefficients which are significantly different from zero, at least at the 5% confidence level.

The values in parenthesis refer to parameters which are not significantly different from zero at least at the 5% confidence level. The corrected average is calculated excluding values which are not significantly different from zero.

Each column of Table 5 reports the amount of money that the respondent would be willing to pay (in case of a positive value) or to receive as compensation (in case of a negative value) for a one-unit variation in the specific service attribute (MVT). The ratio of the service attributes to the cost coefficient yields, in fact, the monetary values of an attribute at the margin and hence gives an idea of how changes in attributes are traded off against a monetary change in transport costs. In the case of time this is the Value of Time (VOT), in the case of reliability and frequency this is Value of Reliability (VOR) and of Frequency (VOF), respectively. As can be seen, an hour reduction of journey time is on average valued 0.44 euro per ton, while a 1% reduction in reliability would require a compensation of almost 3 euro per ton, and a one step reduction in the frequency supplied would require just above 7 euro per ton¹⁶.

While the values of both VOR and VOF are relatively high for most cases, in general the VOT is comparatively low. In general, it seems that for the sample analysed, frequency is the most precious attribute of the service required: this is true for cases 3 to 5 in particular. For these operators, the willingness to pay for an increase of frequency is significantly greater than for changes in any of the other variables. In particular, in case

¹⁶ The reduction in frequency of services varies between twice daily (upper value) and once every two weeks (lower value).

5, the willingness to pay for frequency is more than tenfold the value related to overall journey time. Moreover, the lowest value, corresponding to case 2, is not statistically significant.

Although the sample considered is extremely small and not representative of the category, it is interesting to note that, as expected, freight forwarders tend to give a higher value to factors which enlarge their freedom of choice and the regularity of service than to those elements, like time of journey, which are more easily taken into account in planning their activity.

3.3 Brief description of the case studies

Given the limited amount of data collected in this first pilot study, in order to gain a deeper understanding of the results that are presented in the next section and to place the main findings into the appropriate context, in this section we discuss the outcome of the seven experiments in the light of the general characteristics of the forwarding companies obtained through both the questionnaire and the direct interviews.

CASE 1

Typical Transport: From: Parma (I) To Badaioz (F) ; Via: Moncenisio; Distance: 1500 km; Volume: 60 m³ ; Mode: road; Transport performed by: road haulier; Shipments per Year: 20 (every two weeks). Product Transported: machinery Product value/consignment: 100000 Euro; Transport Cost/consignment: 1125 Euro.

Forwarding agent 1 operates mainly for firms producing machinery and its main markets are France and Spain. It does not perform the transport itself but contracts it out to well-known road haulers or shipping companies; the concern for granting his direct customers the quality of service required induces the respondent to work with a level of reliability of 100% and thus different levels of reliability become not relevant. Apart from cost, the only service attribute which appears significant for case 1 is frequency (VOT and VOR - not significant; VOF 2.5 Euro for 1 additional shipment/months).

CASE 2

Typical Transport: From: Guastalla (I) To Barcellona (E); Via: sea; Distance: 900 km; Volume: 25/26 tons; Mode: ro-ro; Transport performed by: the firm; Shipments per Year: 500 (two each days). Product Transported: steel tube Product value/consignment: 75000 Euro; Transport Cost/consignment: 1175 Euro

This is a very important Italian carrier, leader in the national and international markets. Along this route the company operates by sea, and the transport manager evaluates this mode of transport as very uncertain by definition: the company, when choosing to use maritime services, seems to take into account the fact that a one-day delay in consignment has to be expected and places high value on reliability (VOR takes, in fact, the highest value of the sample). VOF is not significantly different from zero while VOT, although significant, has an extremely low value (12 cents per ton per hour); the lowest of our sample. The latter is a clear indication of the way ro-ro transport is perceived. Operators are quite willing to adopt it for shipments which do not require high frequency of service nor low travel time: both characteristics which can be taken account of while planning the operation. They, however, are less likely to accept

failures in reliability levels. Respondent 2 is willing to pay almost 5 euros for improvements in 1% reliability for ton shipped.

CASE 3

Typical Transport: From: Udine (I); To: Tallin (FIN); Via: Germany; Distance: 2000 km; Volume: 45 m³; Mode: road; Transport performed by: road haulier; Shipments per Year: 100; Product Transported: machinery; Product value/consignment: 50000 Euro; Transport Cost/consignment: 1750 Euro

As for case 1, this forwarding agent does not perform the services in-house. It operates mainly with shipping companies; in fact, about 95% of his shipments are performed by sea (equivalent to 1500 shipment per year) and only 5% by road. It is specialised in the transport of machinery. As in case 1, for the company it is very important work with “well-known” shipping companies or road haulers. It is mainly for this reason that we have noted credibility problems when performing the experiment: “we can’t evaluate a service if we don’t really know who is going to carry it out!”. The estimation outcome, are, however, quite interesting: Respondent 3 shows the highest willingness to pay for a variation improving travel time, the second highest for the possibility to be granted the availability of an additional shipment per month. Also the value of reliability is relatively high (VOT 1,6 euro; VOR 2,7 and VOF 9,6 euros). All the estimated coefficients are significant.

CASE 4

Typical Transport: From: Goole (GB); To: Brescia (I); Via: France; Distance: 1000 km; Volume: 24 tons; Mode: road; Transport performed by: road haulier; Shipments per Year: 100; Product Transported: Refractory materials; Product value/consignment: 25000 Euro; Transport Cost/consignment: 700 Euro

This shipping company operates only on international markets, mainly Great Britain/England and the U.S. The availability of the services along these routes, where little or no alternatives exist, is very important. From the estimation it appears, in fact, that the respondent places a high value on frequency (VOF 7.5 euro per ton), while it is less concerned with journey time and reliability (VOT 1,16 and VOR 1,2).

CASE 5

Typical Transport: From: Milan (I); To: Barcelona (E); Distance: 900 km; Volume: 8 tons; Mode: road; Transport performed by: road hauler; Shipments per Year: 100; Product Transported: furniture; Product value/consignment: 50000 Euro; Transport Cost/consignment: 1500 Euro

This company operates mainly on the Spanish market; there is no evidence of a modal preference and during the interview the respondent stated that when using maritime transport services, time is not very important: “one additional day of travel time is not so influential in the modal choice process of the firm”. On the contrary, frequency is very relevant, as the company serves with regularity one main market. The estimated coefficients confirm the statements of the director of the company: the respondent’s VOF is the most relevant service attribute (VOF - 8.92 euro per ton for one more shipment per month), while VOR is not significantly different from zero. The valuation of journey time seems to be negative for respondent 5: the magnitude of the coefficient is, however, relative small.

CASE 6

Typical Transport: From: Bari (I) To Parma (IT); Via: Adriatica; Distance: 800 km; Volume: 30 m³; Mode: road; Transport performed by: road haulier; Shipments per Year: 40 (every week). Product Transported: food: 10000 Euro; Transport Cost/consignment: 750 Euro.

This forwarding agent operates mainly for firms producing food products and its main markets are south of Italy. It does not perform the transport itself but contracts it out to small road haulers; the concern for granting his direct customers the quality of service required induces the respondent to work with a high level of reliability (100%) and frequency. The respondent has stated that he would not be interested in any level of reliability different that 100%. Reliability and frequency are thus the most relevant attribute of the transport service. His willingness to pay/accept is, however, generally more limited than the other respondent.

CASE 7

Typical Transport: From: Foggia (I) To Milan (IT); Via: Adriatica; Distance: 900 km; Volume: 50 m³; Mode: road; Transport performed by: road haulier; Shipments per Year: 25 (every two weeks). Product Transported: machinery Product value/consignment: 100000 Euro; Transport Cost/consignment: 2000 Euro.

This forwarding agent operates mainly for firms producing machinery and its main Italian markets are in the north of Italy. It does not perform the transport itself but contracts it out to either road haulers, train operating companies, shipping companies; His main concern seems to rest with reliability; he cannot take into consideration any variation of the current level of reliability as he generally forwards component parts of mechanical systems. The respondent valuation come out explicitly from the estimation: the concern with time is very limited (VOT 0,98), frequency of service is, instead, extremely highly valued, while reliability appears not significant. The respondent has not accepted any variation if reliability levels during the interview.

3.4 Comparing the Preliminary Results of the Pilot Study with Those of Other European Studies: A Brief Comment

As it had been anticipated it would be interesting to compare the outcome of our analysis with that of studies carried out on the preferences of producers in order to understand whether there are significant differences among the two groups of transport service users. Although a comparison between the absolute values assigned to the single service attributes by the respondents of different studies might be quite difficult to carry out given the different approaches used (also in the definition of the specific variables), a comparison of the relative ranking yields interesting insights. Some common traits, in fact, emerge: as can be seen from Table 6, which reports the relative ranking of the estimated values of the most relevant variables taken from a selection of recent European studies, there seems to be agreement in assigning the lowest value to the variable time among the three main service attributes considered.

Table 6. Ranking of the values of time, reliability and frequency of a selection of European studies (A = higher value between time, reliability and frequency).

<i>Studies</i>	<i>VOT</i>	<i>VOR</i>	<i>VOF</i>
Maier and Bergman (2002)	C	A	B
Danielies and Rotaris (2002)	C	A	B
Bolis and Maggi (2002, 2003)	B	A	C
Our study	C	B	A

The findings on the relative weight of trade-off ratios of our pilot study seem thus in line with the outcomes of similar research carried out in other European contexts. In particular, the results of our study show that reliability and frequency are the two key determinants in users' choice of transport mode. Just as producers, freight forwarders are, thus, more concerned with reliability and frequency than with the duration of the trip. However, in our study, in contrast with the other studies, the relative importance of these two attributes are reversed, with the former assuming a greater weight.

The outcome is not unexpected and can be easily justified: although with all the drawbacks of the exiguity of the sample, our study, focussing on the choice of maritime transport versus currently used alternatives, has highlighted the specificity of the context. In transport services performed by sea the availability of regular transport – i.e. a regular frequency of the service demanded – becomes a strong decisional factor for firms which have to abandon the currently used mode of transport. In this context, reliability assumes a secondary role: a decrease in reliability is easily taken into account by price changes and by contractual agreements. The unavailability of service when needed would, instead, completely preclude the use of the mode. Moreover, being a freight forwarder an intermediary in the transport process, he sees the possibility of responding to the needs of the client by granting the availability of the services when required as a relevant aspect of the quality of the service he himself offers.

Increases in journey time, which assume an extremely low value, are considered strictly linked with the maritime alternative and are immediately internalised in the reorganisation of the transport service adopted when deciding to view the ro-ro alternative as viable.

4. Concluding Remarks

In this paper we have presented preliminary evidence from a pilot study carried out with the primary objective of testing the validity of adaptive conjoint data collecting methods in analysing operators' preferences when redirecting current on-land transport services to a hypothetical maritime ro-ro alternative. Secondary objectives, though not less important, have been to obtain a preliminary rating of the transport attributes included in the stated preference experiment and a first on-the-field test of the soundness of the selection carried out with respect to the analysis of the maritime ro-ro context. Also, it has been a test of the appropriateness of selecting as respondents freight forwarders in their vest of transport service users.

The application has involved a small sample of freight forwarders localised in the area of influence of the port of Genoa. Freight forwarders have been preferred to producers in order to gain insights from a wider spectrum of possible uses and, at the same time, to verify whether the preferences of this set of users would differ widely from those of the

producers. Choosing freight-forwarding agencies has allowed us to intercept information from a sector of the transport industry which accounts, on average, for more than half of the transport decisions, as outsourcing of transport operations is spreading rapidly. At the same time, it has allowed us to obtain a sample which, although small, is homogeneous as to the type of activity carried out by the respondents and their knowledge endowment. Given the limited resources available, selecting producers would have limited the scope of the analysis to a specific production sector or excessively constrained the dimension of the dataset for each industrial sector. Although the objective function of the freight forwarder would necessarily differ from that of the producer, the recent evolution of the market and of the contractual agreements in force would generally place the freight forwarder in a position to be the residual claimant to any cost-quality advantages obtained. In any case, this is true for the sample interviewed.

The current study has allowed us to test our methodology and the strategies adopted for carrying out the experiment. The specificity of the design used has been to always characterise the alternative service as ro-ro. In so doing we tried to stimulate, during the experiment, an explicit focus on such mode. Although the results presented in this paper relate only to a very limited group of potential users with obvious consequences on sample representativeness, some preliminary considerations on the outcome can be drawn. We are aware that, in order to validate the results, it would be necessary to compare them with the final outcomes of a follow-up research project currently being carried out involving freight forwarders localised in northern and in southern Italy.

The study seems to confirm that, as expected, adapted stated preference techniques represent a valid option to estimate the attitude of operators for maritime ro-ro transport services. Overall, initial evidence is encouraging and offers some understanding of the determinants of the maritime transport choice.

First of all, the data collected seems to indicate no *a priori* preclusion of the maritime alternative and, in particular ro-ro services, on the part of operators. The valuations placed on the attributes of the transport services by the freight forwarding companies interviewed are generally consistent. The empirical evidence confirms that freight rates are not the only determinant of modal choice, but that in choosing the sea other factors play a relevant role as well. Most notably, and in line with the results of other studies, reliability and frequency seem to be the key factors in the choice of the transport service alternative. However, between the two attributes, in contrast with other studies concentrating on land transport and producer responses, the ranking of reliability and frequency are inverted. When evaluating the maritime alternative, freight forwarders, in fact, seem to assign a higher ranking to frequency than to reliability.

According to our estimation – which, however, due to the limited database should be taken with the appropriate scepticism – freight-forwarders seem to value a 1% improvement in reliability at about 3 euro per ton and a variation in frequency just above 7 euro per ton. The difference in the findings could be easily justified on the basis of two elements: first, a single producer might consider a change in the frequency of service easier to adapt to than a change in its level of reliability; secondly, a freight forwarder, who often aggregates more than one shipment, might give a higher weight to frequency of service since it contributes more than reliability to solve transport coordination problems and to respond faster to different requests by clients. Journey time, in line with other studies, is significantly less valuable than the time lost for low levels of reliability or for low frequencies. From the sample it appears that it is

unanimously considered to be the least relevant attribute: the value of time is calculated to be, on average, about 50 cents per ton.

In conclusion, taking the outcome of the preliminary estimation into consideration, it would appear that in order to improve the use of the maritime ro/ro, it is important focus on actions which improve the reliability and the frequency of service.

Acknowledgments

The authors are indebted to Prof. Rico Maggi of the Institute of Economic Research (IRE) of Lugano and to Prof. Carla Canali of the Economics Department of the University of Parma for their support. Our thanks also go to Michel Beuthe, Mons, for his helpful comments on an earlier version of this paper. The authors would like to thank the participants to the Nectar Workshop - Cluster on Freight Transport and Intermodality, held in Lugano 12/13 November 2004, and in particular Romeo Danielis for their useful comments and suggestions. The usual disclaimer applies for all remaining errors.

Financial support from MIUR – Cofin 2003 grant no. 2003134052 – “Prospectives of short sea shipping in the Mediterranean area” is gratefully acknowledged.

References

- Adamowicz, W., Louviere J. and Williams, M. (1994) “Combining revealed and stated preference methods for valuing environmental amenities”, *Journal of Environmental Economics and Management* 26: 271–292.
- Adamowicz, W., Swait, J., Boxall, P., Louviere, J. and Williams, M. (1997) “Perceptions versus objective measures of environmental quality in combined revealed and stated preferences models of environmental valuation”, *Journal of Environmental Economics and Management* 32: 65–84.
- Ben Akiva, M. and Morikawa, T. (1990) “Estimation of switching models from revealed preferences and stated intentions”, *Transportation Research A* 22: 485–495.
- Bergantino, A.S. and Bolis, S. (2002) “Motorways of the sea: is this a real alternative to all-land transport? Some preliminary valuations on the North Tyrrhenian sea routes” (Paper presented to the 2nd STRC Conference, Ascona, Switzerland, 21st–22nd March).
- Bergantino, A.S. and Bolis, S. (2005) “An Adaptive Conjoint Analysis of Freight Service Alternative: Evaluating the Maritime Option” in: Schintler, L. and Reggiani, A. (eds) *Methods and Models in Transport and Telecommunications: Cross-Atlantic Perspectives*. Berlin: Springer Verlag, (forthcoming).
- Bergantino, A.S., Bolis, S. and Canali, C. (2005) “A methodological framework to analyse the market opportunities of short-sea-shipping: the adaptive stated preference approach”. In: Jourquin, B. (ed) *Towards better performing European Transportation Systems* (forthcoming).
- Bergkvist, E. (2001) Freight transportation – valuation of time and forecasting of flows. *Ph.D. Thesis*, Department of Economics, Umea University, Sweden.
- Bolis, S. and Maggi, R. (1999) “Adaptive stated preference analysis of shippers’ transport and logistics choice”. In: *Proceedings of the 8th World Conference of Transport Research*. Pergamon, Elsevier Science, The Netherlands.
- Bolis, S. and Maggi, R. (2002) “Stated preference – evidence on shippers’ transport and logistics choice”. In: Danielis R (ed) *Domanda di trasporto merci e preferenze dichiarate – Freight transport demand and stated preference experiments*. F. Angeli, Milan.
- Bolis, S. and Maggi, R. (2003). "Logistic Strategy and Transport Service Choices. An Adaptive Stated Preferences Experiment", in *Growth and Change - A Journal of Urban and Regional Policy*, Special Issue STELLA FG 1, Vol. 34, No 4: 492-504.
- Borruso, G. and Polidori, G. (2003) *Trasporto merci, logistica e scelta modale*. F. Angeli, Milan.

- Bradley, M. and Daly, A. (1997) "Estimation of logit choice models using mixed stated preference and revealed preference information". In: Stopher, P. and Lee-Gosselin, M. (eds) *Understanding travel behaviour in an era of change*. Pergamon Press, London.
- Brownston, D., Bunch, D. and Train, K. (1999) "Joint mixed logit models of stated and revealed preferences for alternative fuel vehicles", *Transportation research part B* 34: 315–338.
- Cullinane, K. and Toy, N. (2000) "Identifying influential attributes in freight route/mode choice decisions: a content analysis", *Transportation Research part E* 36: 41–53.
- Danielis, R. (ed) (2002) *Domanda di trasporto merci e preferenze dichiarate – Freight transport demand and stated preference experiments*. F. Angeli, Milan.
- Danielis, R. and Rotaris, L. (2002) "Characteristics of freight transport demand in the Friuli Venezia Giulia region: a summary". In: Danielis R (ed) *Domanda di trasporto merci e preferenze dichiarate – Freight transport demand and stated preference experiments*. F. Angeli, Milan.
- Danielis, R. and Rotarsi, L. (2003) "Le preferenze degli utenti del servizio di trasporto merci: i risultati di un esperimento di conjoint analysis condotto in Friuli Venezia Giulia". In: Borruso, G. and Polidori, G. (eds) *Trasporto merci, logistica e scelta modale*. F. Angeli, Milan.
- Fridstrom, L. and Madslie, A. (1994) "Own account or hire freight: a stated preference analysis". *Working paper*, Institute of Transport Economic, Norway.
- Fridstrom, L. and Madslie, A. (2002) "A stated preferences analysis of wholesalers' freight choice". Danielis R (ed) *Domanda di trasporto merci e preferenze dichiarate – Freight transport demand and stated preference experiments*. F. Angeli, Milan.
- Fowkes, A.S. and Tweedle, G. (1996) *Modelling and forecasting freight transport demand*. Mimeo, ITS-University of Leeds, Leeds.
- Fowkes, A.S. and Tweedle, G. (1997) "Validation of stated preference forecasting: a case study involving Anglo-continental freight". In: *European Transport Forum – 25th Annual Meeting, Proceedings of Seminar F, PTRC*, London.
- Fowkes, T. and Shinghal, N. (2002) "The Leeds adaptive stated preference methodology". Danielis R (ed) *Domanda di trasporto merci e preferenze dichiarate – Freight transport demand and stated preference experiments*. F. Angeli, Milan.
- Gattuso, D. and Pastorino, M.N. (1996) "L'applicazione del metodo SP per l'analisi di scenari di mobilità delle merci fra Sicilia e Continente" Serie: *Rapporti Scientifici*, CISUT, Università degli studi di Reggio Calabria, Reggio Calabria.
- de Jong, G. (2000) "Value of freight travel-time savings". In: Hensher, D.A. and Button, K.J. (eds) *Handbook of transport modelling*. Pergamon, London.
- Louviere, J., Hensher, D. and Swait, J. (2000) *Stated choice methods*. Cambridge University Press, Cambridge, UK.
- KNP (2002) *Freight Forwarding Market Report 2002*, Key Note Publications Ltd, London.
- Maier, G. and Bergman, E.M. (2001) "Stated preferences for transport among industrial cluster firms", *European Research in Regional Science*, 1.
- Maier, G. and Bergman, E.M. (2002) "Conjoint analysis of transport options in Austrian regions and industrial clusters". In: Danielis, R. (ed) *Domanda di trasporto merci e preferenze dichiarate – Freight transport demand and stated preference experiments*. F. Angeli, Milan.
- Ortuzar, J. de D. and Palma, A. (1988) "Stated preference in refrigerated and frozen cargo exports". PTRC SAM.
- Regan, A.C. and Garrido, R.A. (2001) "Modelling freight demand and shipper behaviour: state of the art, future directions". In: Hensher, D. (ed) *Travel behaviour research – The leading edge*. Pergamon, London: 185–215.
- Stopher, P. (1998) "A review of separate and joint strategies for the use of data on revealed and stated choices", *Transportation* 25: 187–205.
- Swait, J., Louviere J. and Williams, M. (1994) "A sequential approach to exploiting the combined strengths of SP and RP data: application to freight shipper choice", *Transportation* 21: 135–152.
- Tsamboulas, D. and Kapros, S. (2000) "The decision making process in intermodal transport". *Transportation Research Record* n. 1707, Washington DC.
- Tweedle, G., Fowkes, A.S. and Nash, C.A. (1995) "Impact of the channel tunnel: a survey of Anglo-European unitised freight. Results of phase I interviews". *Working paper 443*, Institute for Transport Studies, University of Leeds, Leeds.
- Wardman, M. (1998) "A comparison of revealed preference and stated preference models of travel behaviour", *Journal of Transport Economics and Policy* 22: 71–91.

Unescap (2002) "Major Issues in Transport, Communications, Tourism and Infrastructure Development: Developments in Multimodal Transport and Logistics", Bangkok.