PREFERENCES FOR FREIGHT SERVICES IN SWEDEN

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INTRODUCTION

The Swedish rail company has been divided into two separate organisations, one that is responsible for the infrastructure - Swedish Rail - and one that is operating the services. Swedish Rail is a government agency and bases its investment decisions on cost-benefit analyses of all proposed projects. The same is true for investments in road infrastructure, where the National Road Administration is responsible. The benefit of investments aimed at improving capacity and reliability for freight traffic has been difficult to estimate since little has been known about how different firms value improvements in transport time and reliability. This contrasts with the situation for passenger traffic where many studies have been carried out and where knowledge is reasonably good. For rail traffic, the lack of knowledge is especially a problem when investment decisions concern the northern part of Sweden where relatively few passengers travel, but where a lot of freight is transported over long distances.

To improve the situation, Transek AB has carried out three different projects commissioned by Swedish Rail and the National Road Administration. The projects have been carried out with advice from Hague Consulting Group. The first two projects were started in 1989 and early 1990 and concerned preferences for rail services (Widlert 1990). A pilot study of valuations for lorry transport was also carried out. The third project was started during the autumn of 1991 and will be completed during March 1992. The third project deals with valuations of lorry services and the choice between rail and lorry (Widlert and Lindstedt 1992).

1. Methodology

The projects all relied primarily on Stated Preference techniques to estimate the within-mode valuations of rail and lorry service factors. Transportation managers in companies spread out over the whole of Sweden were interviewed. Since prices of actual transports often result from negotiations with the transporter, and therefore are confidential, the managers were asked to describe "typical transports" which they did not have to identify completely. They were instructed to think of one actual transport that was as typical as possible according to a number of criteria. Successively in the three projects, the managers were asked more and more detailed information about the transport (in the last project we even collected information about destinations at the city level for each transport). Still, the concept worked very well and few companies refused to give information on prices (only 1% in the last project).

Portable computers and Hague Consulting Group's "MINT"-program were used for the interviews. In the first two projects, where only within-mode valuations were studied, each company was given up to three different choice experiments, with a maximum of 18 pairwise choices in each experiment. In the third project, each company was given two within-mode experiments and one mode choice experiment ("within-mode" experiments obtain trade-offs between the characteristics of transports for a single mode).

1.1 Within-mode Stated Preference experiments

In the Stated Preference exercises, the following factors were varied for the typical transport:

- price
- transport time
- frequency of shipment not arriving on time
- number of rail connections per week (only for rail)
- probability of damage (only for lorry)

The interviewee was asked to make a number of pairwise choices where the reported levels for the factors in the typical transport were varied systematically. The following levels of change were used in the within-mode experiments for both rail and lorry:

Table 1 Percentage changes in within mode experiments

	percentage change in value for typical transport			
price	0	+5	+10	+15
transport time, rail-wagon	0	-15	-30	
transport time, rail-whole train	0	-5	-15	
transport time, lorry	0	-15	-30	
frequency of delays	0	+50	+100	
probability of damage	0	-25	-50	

Different changes were used for the time factor if the typical transport only consisted of one rail car (or a limited number of cars) than if the typical transport consisted of a whole train. In the first case, the possibilities to shorten the door-to-door transport time are much greater (since transport times are quite long today). All levels were extensively discussed, both in a reference group and with staff working to market freight services at the rail company.

1.2 Between-mode Stated Preference experiments

For the mode choice experiments, each company was classified as a rail or lorry transporting company, with the likelihood depending on the proportion of actual transports by the company using the two modes. The same factors as in the within-mode experiments were varied in the mode choice experiments.

As in the within-mode experiments, the companies were asked to describe a typical chosen transport (a rail shipment if the company was classified as a rail transporter, a lorry shipment if it was classified as a lorry transporter). The values for both the chosen and the non-chosen alternatives were varied in the experiments. The actually chosen mode was typically made less attractive, and the non-chosen mode more attractive. The values for the non-chosen mode were constructed using variations on the values for the chosen. That means that (almost) no questions were asked about the actual values for the non-chosen mode attributes. The values for the non chosen mode were specified considering the fact that rail on average is 20% cheaper and takes 30% longer compared to road today. A wider range of variations than in the within-mode experiments was used to make certain that enough companies would decide to switch mode during the experiments.

A major problem is the fact that many companies would find it difficult to switch mode in a short time horizon. The companies were instructed to consider the long run possibilities to switch mode, if they made the necessary investments (in rail connections, etc.), and the necessary changes in their production structure. Companies that are essentially captive to their present mode were identified. This was the case for 55% of the lorry shipments and for 20% of the rail shipments.

1.3 Analysis

The results from the stated preference experiments were analysed using logit analysis. For the mode choice analysis, the SP mode choice data was combined with the SP within-mode valuation data. When combining the different data-sets, scale factors were estimated to take account of unexplained differences in variance in the different data-sets (see Ben-Akiva and Morikawa 1990 or Bradley and Daly 1992 for a description of the method).

2. Data collection

Companies from all parts of Sweden were sampled. In the projects that dealt with rail valuations major rail transporters were sampled from statistics over actual shipments during a certain time period. For the third project (lorry valuations and mode choice), manufacturing companies were sampled from a national register of companies. The following types of companies were selected:

- agricultural
- forestry
- food
- wood
- paper pulp, paper
- chemical
- iron, steel, metal
- mechanical
- energy

The selected companies were first sent an introductory letter, then contacted by telephone to arrange for a personal interview. The interviews were done at the companies with transportation managers that were responsible for transport of goods from the companies. It was not unusual that more than one person from the company attended the interview. On average, the interviews took about one hour.

Table 2. Response rates

project 1	95 %
project 2	88 %
project 3	81 %

The high response rates shown in table 2 reflect the high degree of interest and co-operation shown by the contacted companies.

One very strong impression from the data that has been collected is the extreme heterogeneity of the freight market (when compared to the passenger market). This heterogeneity shows both in the size of the companies, the number of transports they make per month, and in the size and value of the typical shipments.

In addition to the interview data, we also used time and cost data for rail and road transports that were produced by the National Road Administration. These data were used for the RP analysis of actual choices in the mode choice part of the study.

3. Preferences for rail and train

Relative values of the factors that have been included in the experiments have been inferred from the estimation results. It is necessary to stress that the values are only *the interviewed companies valuation* of the changes. Costs for producing the transportation service are not included in the values. When we look at values of time for example, we take account of the value of the reduced transport time that is connected to interest on the transported goods, the value to be able to make a fast delivery, etc., but not the fixed or the variable costs of the mode used for producing the service. In other words, the values represent "willingness to pay" for the user benefit side of the cost-benefit picture.

3.1 Differences between typical transports

The typical lorry and rail shipments are very different. The average transport time is 54 hours for the rail transports and 18 hours for the lorry transports. The average price is 27 800 SEK for the rail transports and 2 500 SEK for the lorry transports. Expressed per rail car, the rail price is 4 600 SEK. Average values of goods for the transports differ less: the value per rail car was 256 000 SEK and the value per lorry 300 000 SEK.

3.2 Time values

The average value of time savings for rail transports is estimated at 40 SEK per hour per shipment, or 6 SEK per rail car and hour. This is approximately 50% more than only the interest cost for the goods. For lorry shipments the average time value is 30 SEK per hour per shipment.

If we segment the data according to the value of the goods we get the results that are shown in table 3.

Table 3. Time values for transports with different value

	value of goods	time value, SEK per hour per rail car or lorry
Rail transport	low	4
	high	8
Lorry transport	low	10
	high	35

The table shows, as expected, that time values vary with the value of the transport, but the relationship is far from proportional. For lorry transports, the average value of the transported goods is 25 times higher in the "high" group than in the "low" group, but the value of time is only 3.5 times higher.

3.3 Delays

The results indicate that reliability is a very important factor for the companies in the study.

Half of the companies that transport by rail are affected if the transport does not arrive the right time during the planned arrival day. The other half are affected if the transport does not arrive on the right day. 25% of the companies are affected if the transport arrives one hour late. The indication is that different companies are affected very differently by delays, but that the valuation on average is high.

Among the companies that transport by lorry, 25% indicate that they are affected if the transport does not arrive the right time during the day.

Each percent change in the frequency of delays is valued at 60 SEK per rail car and 280 SEK per lorry for the companies that are affected if the goods do not arrive at the right time of the day. For companies that are affected only if the goods do not arrive on the right day the corresponding values are lower - 40 and 110 SEK.

3.3 Damage

Probability of damage has only been studied for road transport. The variable is defined in terms of promille of goods damaged during shipment. The value is on average 270 SEK per promille change per shipment.

3.4 Number of connections

Changes in the number of rail connections per week turned out to be of little importance to the interviewed companies. In many cases, the company itself determines the number of connections (when the company transports a whole train). For the other companies, changes in the number of connections showed very little value relative to the other factors.

3.5 Summary of valuation results

The results show that values generally are much higher for lorry transports in monetary terms, per vehicle, than for rail shipments. Large changes in one mode that changes the market share can therefore cause changes in the average values. One main conclusion of the study is that investments in rail infrastructure with the aim of improving conditions for freight traffic should give priority to capacity improvements that reduce the probability of delays. With the results obtained, it may be difficult to justify major investments to improve transport time for freight by rail, unless they can also be offset by reductions in rail operating costs.

4. Choice of transport mode

4.1 Mode choice model

In the mode choice analysis, all of the collected data was used:

- SP-choice between different rail alternatives (within-mode)
- SP-choice between different lorry alternatives (within-mode)
- SP-choice between lorry and rail for companies who use lorry today
- SP-choice between lorry and rail for companies who use rail today

All data was reported by the interviewees or reported as part of the SP experimental designs. The intention is to combine the SP-data with RP-data of the actual choices. Problems with calculating those data has delayed that analysis.

The mode choice model was estimated with the typical transport as the unit of analysis. The following model was estimated:

Table 4. Mode choice model

variable	parameter	t-value
constant for lorry	-0,0487	1,1
price, SEK	-0,0019	20,7
transport time, hours	-0,0155	4,2
frequency of delays % (right time during day)	-0,2448	10,5
frequency of delays % (right day)	-0,0911	5,4
probability of damage, promille	-0,4636	11,1
weight, tons - rail	0,0075	2.4
lorry connection - rail	-1,6570	3,3
whole train - rail	2,2330	2,5
several customers - lorry	1,4430	3,6
forest - lorry	1,7570	2,2
other - lorry	-2,3020	3,1
furniture and machines - lorry	2,3300	2,3
inertia	-2,6690	6,3
scale lorry-lorry	0,8655	11,3
scale rail-lorry	0,3755	10,3
ρ^2	0,2190	
number of observations	7 046	

The price variable measures the price in SEK for the whole transport from door to door and the time variable the total time from door to door in hours.

The model contains two variables for delays, one for transports that must arrive at the right time during the day and one for the transports that only have to arrive on the right day.

Heavy transports have a higher probability to be transported by rail. If it is necessary to use lorry at one or both ends of the rail transport (if the factory and/or the customer do not have a rail connection) the probability of the rail alternative is substantially decreased.

If the rail alternative represents a whole train, the probability of the train alternative increases. When whole trains are transported for one company, the company has much more influence on departure times, etc, which makes the train alternative more attractive.

When the typical transport contains goods to more than one customer, the probability of the lorry alternative increases.

There are dummy variables for three different types of companies in the model - forest industry, a small group of "other" companies and transports of furniture and machines.

The model also contains a number of different correction variables. Those variables correct for different biases and for inertia. The inertia variable takes the value of 1,0 if the alternative is the same as the actually chosen one. The negative parameter shows that the companies are less likely to choose the same alternative in the SP-game as they actually use. Probably the companies felt that the games intended to make them switch mode (which they actually did), and responded more strongly to this than the variable levels justified. The inertia variable at least partly corrects for this bias.

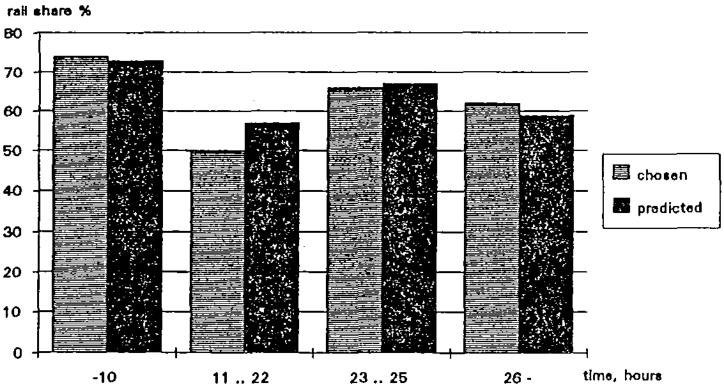
The last three parameters are scale factors that correct for differences in variance in the unexplained part of the utility function in the different data sets. The scale factor is (arbitrarily) set to 1.0 for the within-mode choice between different rail alternatives. The scale factor is as expected highest for the choice between different lorry alternatives, and smaller for the mode choice data.

4.2 Validation tables

The model in table 4 is fairly simple. Most variables are generic to all types of transports, regardless of the type of good that is transported, the type of company, the size of the transport, the value, etc. A common opinion is that separate models are necessary for such different categories. To test that, validation tables have been produced for different segments. In those tables, the actual SP-choices for different types of alternatives are compared to the predicted choices according to the model in table 4.

The validation tables only show small differences between actual and predicted choices for different segments. One fairly typical example is shown in graph 1 where the rail share is compared for transports with different transport times. The table shows the rail share in the hypothetical alternatives where the rail alternative on average has been substantially improved and the lorry alternative has been made substantially worse.

Graph 1. Difference between actual SP-choices and predicted choices



The conclusion from the validation tables is that the comparatively simple model reproduces the choices for different segments quite well. Given the great heterogeneity of freight transport, it is probably the case that the differences inside such groups are just as important as the differences between the groups.

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