

Summary:

Values of transport time and reliability for railway freight

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A reduction in average delay of one hour is worth five to six times more to users of railway freight than a corresponding reduction in regular transport time. The value of transport time savings is however also considerably higher than those currently used for cost-benefit analysis in Norway. Most railway customers show more interest in a later departure than an earlier arrival of the freight train. Consolidated goods imply higher values of transport time and delays than other goods. The most common consequences of delays are loss of reputation and additional costs for transport to the destination. This stated preference study supplements earlier studies of freight with better data on railway freight.

The costs of unreliability in transport networks is a subject attracting considerable attention within transport economic research. The benefits of reducing unreliability should be included in cost-benefit calculations of infrastructure projects. In the PUSAM project, we seek to develop tools to support decision-making in railway management for both train operators and owners of the infrastructure. The tools should be used for decisions which affect service reliability and be based on economic calculations.

In a recent study we investigated the value of transport time and reliability for freight using three data sets from a stated preference (SP) study among shippers and carriers (Halse et al 2010). This study included all transport modes, with road transport constituting the larger share of the sample. We showed that, both in terms of survey design and analysis, it was possible to use a methodology similar to that used in studies of personal travel. However, it was also clear that this is more challenging when the sample is as heterogeneous as it was in our case. The data on railway freight was too scarce in this study to derive recommended unit values for rail. The current study is a follow-up study with the intention to obtain better data for railways.

Data collection

In the current study we conducted an SP survey collecting 34 responses from firms which buy railway transport services from train operators. As the market is dominated by a few large companies, we collected responses from several of their subsidiaries. 26 responses were obtained from consolidating agents and four from the shipping industry. The remaining four respondents represent commodity owners which buy transport services directly from the train operator.

The survey was undertaken using a web questionnaire. The respondents were recruited from the customer database of CargoNet, which is the largest train operator for railway freight within Norway. After removing the firms which were identified as non-existent or outside the target group, invitations were sent to 227 e-mail addresses. This yielded 32 completed questionnaires, corresponding to a response rate of 14,5 percent. In addition, one respondent had answered the survey twice under supervision in a test-run before the Internet survey was launched. The answers of this respondent are included in the sample.

The point of departure of the choice experiments was a typical shipment which the respondent firm had shipped by rail. By shipment we mean one loading unit (container or other unit). The shipment was selected by the respondent, and the questionnaire contained questions about the shipment. Our investigation of the sample shows that it included shipments being carried along many different Norwegian rail corridors (as well as two corridors going to Sweden) and with many different types of goods. The average shipment weight and average shipping charge appear reasonable, according to CargoNet. The share of shipments containing consolidated goods is however somewhat higher in our sample than in the market as a whole.

Survey design and choice context

Each respondent faced three choice experiments with choices between two unlabeled rail transport alternatives. The attribute values were pivoted around the transport time and cost reported by the respondent. The experimental design is similar to that applied in the Norwegian valuation study for personal travel (Ramjerdi et al 2010) and our previous study of freight transport (Halse et al 2010).

In the first choice experiment, respondents received eight choices between transports with differing cost and scheduled transport time. Time and cost in the alternatives offered could be either higher or lower than in the reference situation.

The second choice experiment involved a random transport time. Each alternative had five transport time outcomes with equal probability. The other attribute was cost.

In the third choice experiment, scheduled transport time was the same as in the reference case. The difference between the two alternatives is cost, the probability of delay, and the length of the delay should it happen. One alternative always has on-time delivery with certainty.

After the first choice experiments, respondents received questions about preferred departure and arrival time of the freight train. 17 respondents answered that they would prefer a later departure time, and seven out of these were willing to accept an increase in the shipping charge to achieve this. 13 would prefer an earlier arrival time, and five were willing to pay for this. The willingness to pay was between NOK 100 and 545 per hour later departure and between NOK 113 and 1000 per hour earlier arrival, among those willing to pay.

Respondents were also asked how much delayed the rail transport would have to be for the delay to cause “consequences for further transport and delivery”. The

answer to this question varied between 0 minutes (immediate consequences) and two days, with a median of 2 hour 15 minutes. The most common critical limit was 1 hour delay (eight respondents). Those willing to pay for earlier delivery typically had low tolerance for delay.

The information about preferred departure time and arrival time and critical arrival time is not used as input to the experiments or analysis of the SP data, but is useful for comparison and interpretation of the results.

Stated preference results

The SP data were analyzed using multinomial logit models. The small data set is not very suitable for running mixed logit models, since a few observations can have very large impact on the estimated average coefficient values. To identify lexicographic choice behaviour, respondents were asked whether they took both attributes into account. The answers to this questions are quite consistent with observed choices. 11 of the respondents (32.3 percent) stated that they took only one attribute into account in the first choice experiments, of which seven only cared about cost. In both of the two other choice experiments nine of the respondents reported that only one attribute mattered to them.

Other studies have shown that this sort of choice behaviour could be handled in several ways, and that not taking it into account is likely to affect the results. We argue that this is especially important when there are few attributes and the attribute values are highly (negatively) correlated. Due to the small sample, advanced methods are not very suitable. Instead we simply set utility to zero for the attributes which the respondent reported to have ignored. As expected, this yields a higher estimated value of transport time savings than when all observations are treated the same.

In the analysis of the first choice experiment, utility is assumed to be linear in time and cost. In the second choice experiment, cost, mean transport time and the standard deviation of transport time enter linearly in the utility function. Since the results clearly indicated that variability of transport time had not been taken into account here, no further analysis of this experiment was undertaken. The reason for this result could be small sample size or problems with the experimental design.

Several model formulations were tested on the data from the third choice experiment. The results indicate that utility is not linear in expected delay. Increases in the delay length do not seem to matter as much when the delay is already over some certain length. In the main results we nevertheless report an average value of expected delay for all delays, since this is convenient to use in practice.

In many cases, it is convenient to have values of transport time savings and delay per tonne of goods. We have hence both estimated models where transport time is expressed as total transport time per shipment, and models where utility depends on transport time multiplied by weight of the shipment. There are no clear indications that one model specification is better than the other.

The sample is too small to assess the effect of most background variables, and segmenting by more than one variable will give very imprecise results. We have however segmented between consolidated goods and other goods, something which consistently results in higher values of transport time and reliability for consolidated goods.

The results recommended for further use are shown in table 1. The reported values for all goods are weighted based on statistics received from CargoNet on the overall railway freight market in Norway. Other weights can be applied if statistics are available, for instance for specific corridors.

Table 1. Values of transport time savings and expected delay. Norwegian kroner (NOK 2011) per hour. Values in euros (2011) in parentheses.

Unit value	Consolidated goods	Other goods	All goods
Value of transport time savings per shipment	404 (€51.9)	113 (€14.5)	192 (€24.6)
Value of transport time savings per tonne	47 (€6.0)	7 (€0.9)	13 (€1.7)
Value of expected delay per shipment	2545 (€326.7)	764 (€98.1)	1245 (€159.8)
Value of expected delay per tonne	278 (€35.7)	35 (€4.5)	72 (€9.2)

To gain more insight into the importance of fast and reliable transport, we have conducted some additional analyses of the data collected by Halse et al (2010), where road is the dominant mode of transport. The motivation is that this dataset is richer, and that many of the same factors should determine the valuation of transport time and delays in both road and rail freight.

In these analyses, we analyse the choices made in the choice experiments using multiple explanatory variables to explain the valuation of transport time or expected delay. We find that, among shippers as well as for carriers, the willingness to pay for reducing transport time and expected delay is higher when transport costs per tonne are already high, and lower when the distance is long.

Qualitative characteristics of the shipment or transport seem to have less of an impact, but some effects can be identified. Textile goods imply a high value of transport time and expected delay, while chemical goods imply low values of both. The value of transport time savings is also lower for timber, while there is no significant difference in the value of expected delay between timber and most other goods.

Shipping companies value transport time and reliability less than other transport companies do. Willingness to pay for reducing transport time and delays is also higher among those conducting local transports, and lower among those carrying bulk cargo.

In addition, we find that the valuation of transport time is higher in choice situations where transport time (in one alternative) increases relative to the reference, than in situations where it decreases. It is also higher in choice situations where the cost is lower than its reference value.