

Summary

Valuation of transport time and reliability in freight transport

This report shows the results of a study concerning shippers' and transport companies' willingness to pay for faster and more reliable freight transport. Our study demonstrates that this valuation can be estimated based on a stated preference (SP) survey. At the same time, we show that there are other and perhaps greater challenges related to such SP studies in the case of freight transport than in the case of personal travel. The report provides recommendations on how to use the results in cost-benefit analysis and points at further research needs.

1. Background

The aim of this project was to develop methods for valuation of reliability in freight transport and to obtain unit values for the valuation of transport time and transport time variability which could be used in cost-benefit analysis. We have focused on the benefits of faster and more reliable transport to *shippers* and *carriers*.

In principle, the economic costs of time spent in transport and of delays facing the *carriers* are related to the direct costs of for instance vehicles and drivers. The costs of the *shippers* are related to the cargo, in addition to the price they pay the transport firm for carrying the goods. Hence, we have conducted surveys both among transport firms and shippers which buy transport services ('hired transport'). In addition, a separate survey was carried out among those shippers which transport their goods themselves ('own account freight').

The value of reliability is a subject which has received considerable attention among transport researchers internationally during recent years. However, there are still few studies giving explicit recommendations on how to implement this valuation in economic calculations. The objective is that the value of reliability for travelers and goods should be a part of cost-benefit analysis just as the value of travel time savings and freight transport time savings is in today's practice. In our study we cite recent theoretical research on reliability which constitutes a basis for our study. We also provide a review of some empirical studies.

2. Survey

The survey was carried out using a questionnaire which includes three choice experiments. In these experiments, firms choose between transports where the costs, the transport time and the variation of transport time or the risk of delay or too early delivery vary. Through their choices, the firms show how important each factor is to them. This makes it possible to estimate monetary values of time and reliability.

The choice experiments were constructed based on information provided by the firm about an actual shipment or transport. This was done in order to make the experiments more realistic. In addition to questions about this specific shipment or transport, firms were also asked questions about the interpretation of reliability and the causes and consequences of delays.

We did not limit our survey to any specific types of firms within the shipper and carrier segments. All firms were invited to participate, regardless of for instance firm size, type of goods or choice of transport mode. This necessarily implies that the final sample was very heterogeneous. However, we did this in order to gain an overview in a field in which there has been done little research before.

The firms were selected from two e-mail databases and were sent e-mails with invitations to participate in the survey. In the main survey, invitations were sent to 9826 firms, most of them in the shippers segment. Approximately 5.6 percent of the shippers and 9.1 percent of the transport firms completed the whole questionnaire. The response rate was hence low, which is in accordance with previous experiences with conducting surveys among firms.

We have examined the characteristics of our sample and show that medium-sized and large firms are overrepresented compared to their actual share among Norwegian firms. There is also an over-representation of long-distance shipments and transports.

Before the main survey, we conducted pilot studies among a smaller sample of shippers and carries. These studies were very helpful, especially when adjusting the attribute levels used in the choice experiments in order to present alternatives which imply real trade-offs to most of the firms.

It is however hard to ensure that all firms make such trade-offs. For various reasons, some will not always consider all (or both) attributes when making their choices. As recommended in recent studies on SP methodology, we have taken this into account when analyzing the data. Still, we use a relatively simple model, which seems to have worked well in our case.

The methodology used in designing the survey and experiments and analyzing the data is to a large extent based on experiences from the Norwegian valuation study for personal travel.

3. Results

A central question concerning valuation in freight transport is which unit to use when calculating and presenting the unit values. In the case of the shippers, one would expect the amount of goods in a shipment to affect the costs of time usage.

A value per tonne would hence be useful in practical applications. We did not ask the firms about the exact weight of the shipment, but we did ask them to place it within an interval. Based on these answers, we have investigated the relationship between weight and value of time. We find that the value of time increases with weight, but that smaller shipments have a considerably higher value of time per tonne. We therefore stick to the “per shipment” representation.

In the case of the carrier, the whole transport is the most obvious unit of measure, as the operating costs which determine the valuation of time usage are relatively unaffected by the amount of goods transported. Table 1 shows the overall results for all three groups of firms.

Table 1. Results, all groups

Sample	Shippers using hired transport (N = 505)	Shippers with own-account freight (N = 114)	Carriers (N = 117)
Value of time, NOK/hour	71	331	449
Confidence interval for value of time	52 - 89	272 - 389	350 - 547
Value of expected transport time, NOK/hour	129	1444	305
Value of variability, NOK/hour standard deviation	83	<i>not significant</i>	<i>not significant</i>
Value of delay, NOK/hour	386	1361	872
Approximate average weight (roughly)	3,7 tonn	3,9 tonn	20,6 tonn

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As most of the shipments and transports in our sample had road as their mode of transport, our sample for road transport is quite large. Table 2 shows the results when only road transport is included. We do not have enough observations to present separate results for other modes of transport.

Table 2. Results, road transport

Utvalg	Shippers using hired transport (N = 395)	Shippers with own-account freight (N = 112)	Carriers (N = 107)
Value of time, NOK/hour	58	331	444
Confidence interval for value of time	43 - 73	272 - 389	347 - 541
Value of expected transport time, NOK/hour	101	370	435
Value of variability, NOK/hour standard deviation	69	<i>not significant</i>	<i>not significant</i>
Value of delay, NOK/hour	398	1360	1012
Approximate average weight (roughly)	3,8 tonn	3,6 tonn	12 tonn

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We examined how the results varied when we divided the firms into different subgroups based on firm characteristics or characteristics of the shipment or transport. In the case of shippers which buy transport services, we find as expected that the values of time and reliability are higher when the goods are of high value or described as “time-critical” and also when the shipping distance is high. We also find that small firms and firms within construction and building have a lower valuation of time and reliability.

When segmenting the shipments based on goods type, we find that certain types of goods are shipped as smaller shipments and have higher values of time relative to shipments size than other types of goods. Differences in the type of shipment hence seem to explain the rather weak relationship between weight and value of time found in our results.

Among both shippers with own-account freight and transport firms we find that the value of time is higher when the cargo weight is high. In the case of the transport firms, we further find a higher value of time if the customer is a retailer than if it is a wholesaler and that transports carried out for shipping agents or consolidators imply a relatively low valuation of delays. The value of time is also lower for shipments abroad. These results could imply that the carriers take other costs than just their own operating costs into account when making trade-offs between cost, time and reliability.

4. Recommendations

Shippers' valuation ('goods-based')

Our results indicate that the shippers have a non-negligible valuation of changes in transport time and transport time reliability. We hence recommend that this valuation, the ‘goods-based’ values of time and reliability, should be included in cost-benefit analysis. Our results based on data from shippers who use hired transport can be used for this.

Table 3 shows recommended goods-based unit values for road transport. The values are adjusted according to the cargo weight for each type of vehicle, and are therefore different from the values shown in table 4. The relationship between the value of time and the value of variability is considered fixed as we have no results indicating otherwise.

The common value for small and large trucks shown in the first line of the table is based on the average weight among all of these transports according to official statistics from Statistics Norway. Using this value would hence imply assuming that the distribution of transports between small and large trucks is about the same as it is in official statistics.

As explained below, we recommend that the unit values in table 3 are added to a second value, estimated using the factor cost method, which shows the decrease in costs to the carrier when transport time or variability decreases.

Table 3. Recommended goods-based values of time and variability per vehicle for road transport, based on results from shippers with hired transport

Unit	Assumed cargo weight	Value of time*	Value of variability**
All trucks	4,9 tonn (SSB)	72	85
Small trucks (total weight up to 3.5 tonnes)	237 kg (SSB)	23	27
Large trucks	11,87 tonn (SSB)	112	132

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*NOK per hour **NOK per hour standard deviation

The values per vehicle shown in table 3 are only valid for trips with cargo. If they are to be used in cost-benefit calculations for a road link, we recommend to take into account trips without cargo and truck driving for other purposes than freight transport. According to official statistics, this implies multiplying the unit values with 0.59 for large trucks, because 41 percent of the trips are made without cargo. In the case of small trucks, 82 percent of the trips are made either without cargo or for other purposes than freight transport. Hence, the unit values have to be multiplied by 0.18. If both types of trucks are treated together, the factor 0.38 can be used as a proxy.

The goods-based unit values are based on the assumption that each truck carries one shipment, which is not true in the cases of consolidated shipments and distribution transport. We make this assumption because in official statistics, “trips with cargo” and “shipments” are to a large extent considered the same thing. Since our survey shows that small shipments often have high values of time relative to shipment size, this could however imply that the recommended values must be considered conservative estimates.

Concerning railway freight transport, recommended goods-based values of time and reliability exist as of today. Our data does not provide enough evidence to say anything about the magnitude of these, so we recommend sticking to these values until further studies have been conducted.

Value of reduced cost to the carrier (‘vehicle based’)

We do not recommend to use the results of our study as estimates for the *carriers’* valuation of time savings and reliability, because it seems likely (and the results indicate) that the transport firms have also the costs of the customer into account. It is therefore not clear which components enter this value. We recommend to add the shippers’ value as estimated in our study to a value which shows the reduced (increased) transport costs when transport time or transport time variability is reduced (increased). The best available estimate of this component of the value of time for road transport is the cost-based value of time recommended in the cost-benefit guidelines (‘Håndbok 140’) provided by the Norwegian Public Roads Administration (NPRA).

In our opinion, there is no risk of double-counting when adding the shippers’ value of time or reliability to a unit value based on the factor cost method, like the one used by the NPRA. The former is based on choice experiments where we

have asked the shippers to make trade-offs between shipment fare and fast/reliable transport. The results hence reflect what the firms are willing to pay (in terms of a higher fare) for a quality improvement, either faster or more reliable transport.

The fact that in reality, an infrastructure improvement reducing the time spent in transport normally also implies reduced transport costs leading to a reduction of fares, does not contradict this conclusion. It seems highly unlikely that buyers of transport services would take this into account when making hypothetical choices between alternatives with different prices. If so, it would mean that they do not take seriously the prices presented to them.

As of April 2010, the value of time recommended by the NPRA is 522 NOK when adjusting for inflation. Using this yields the overall values of time for large trucks shown in table 4. A recommended value of variability based on the costs of the carrier does not exist as of today, neither does such a value of time for small trucks.

Table 4. Recommended values of time (VoT) for large trucks, NOK per hour

Unit	Cargo	VoT of the goods	VoT of the vehicle*	Total VoT
Large truck, trips with cargo	11,87 tonnes	112	522	644
Large truck, all trips	11,87 tonnes	66	522	588

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**Adjusted for inflation, April 2010.*

Measuring travel time variability

For road transport, we recommend to use the standard deviation as a measure of reliability and hence calculate the benefits of reliability by looking at changes in the standard deviation. A central result in international studies is however that the valuation of variability also depends on the shape of the statistical distribution of transport times. We explain this relationship in our report and recommend to take this into account, preferably by adjusting the values.

We recommend that when using the value of variability, one should take into account differences in the distribution of transport times. This implies dividing the unit value by the so-called H-factor based on the survey and multiplying with the corresponding factor estimated for the actual road link. In our survey the H-factor is approximately 0.12, assuming an 'optimal probability of delay' of 9 percent.

5. Conclusion

Our study shows that the shippers' valuation of faster and more reliable transport can be estimated through a stated preference (SP) study. This yields unit values which can be used in cost-benefit analysis. Also the economic benefits to the carrier can be estimated in this way, but there is more uncertainty concerning what their valuation includes. In our study we point at several challenges concerning

valuation studies in freight transport which are related to the high degree of diversity and complexity of the freight market.

We recommend that researchers continue working on incorporating the reliability of travel and transport times in cost-benefit analysis. This requires further development of methods to measure transport time variability and/or delays. Equally important are methods for predicting the changes in reliability caused by improvements in infrastructure or other policy measures.

Also concerning the economic value, our results needs to be supplemented with further studies. One possible way ahead could be to study some subgroups of central interest in order to achieve more homogeneous samples and also to be able to ask more precise questions. By studying different groups separately one could also better reflect the differences between the groups in their valuation of reliability.