DISCRIMINATION AT THE PORTS – THE WELFARE EFFECTS OF GIVING COMMUTERS PRIORITY

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ABSTRACT
In transport, the problem of demand exceeding capacity often takes place with congestion as a result. The resulting delays imposes substantial efficiency loss. Price discrimination by peak-load pricing is a well-recognized way of handling the problem. Such schemes are, however, often politically controversial because it might disadvantage vulnerable groups of passengers. An alternative is the use of a priority scheme. In this paper, a framework positioned within the traditions of cost-benefit analysis (CBA) is established to analyse the welfare effects of granting one group of passengers' priority on transport modes characterized by limited capacity and low frequency. The case is a trial arrangement initiated at a rural car ferry crossing in Northern Norway ensuring that local commuters (traveling to and from work) can board at the desired departure. With respect to pricing, it is a stated objective of the road authorities that fares and discounts at ferries are equal throughout the nation. Hence, it is neither desirable nor legal for local political authorities to ensure local commuters a predictable transport alternative by price discrimination. The empirical evidence demonstrates that loss of social welfare caused by congestion problems at the port can be potentially reduced by introducing such a priority scheme. Recommendations are provided with regard to the required number of users required for the priority arrangement to render a positive net benefit for society. This ex ante information is useful for policy makers when evaluating whether to initiate such priority schemes to reduce efficiency loss in passenger transport markets.

Keywords: Welfare effects, Priority traffic, Scheduled services, Limited capacity, Ferry transport

INTRODUCTION

A particular feature of the demand for transport is that consumers consider the travel time in addition to monetary costs. Time has a price because it has alternative uses [*1*]. With special relevance for transport, Bruzelius [*2*] addressed the welfare economic effects of travel time savings. The time value is considered by the generalized transport cost of a trip, which is expressed by a single, usually monetary, measure combining most of the important costs that form the overall opportunity costs of the trip [*3*]. Generally, reduced generalized transport costs increases the consumer surplus and thereby the social welfare as well. Assessments of infrastructure projects indicate that time cost is one of the most important components of the generalized transport cost [*4*]. Therefore, the development of an effective transport system is an important transport policy objective in most countries.

It is commonly accepted that the maximum welfare for the society arises when market equilibrium matches the intersection between the demand and supply curves [e.g. *5*]. However, the basic model assumptions does not capture the particular features of transport service markets [e.g. *3*]. In addition to the fact that travellers consider the value of travel time in addition to money costs, particular characteristics of transport are the indivisibility of supply (limited capacity on vehicles), scheduled departures and systematic fluctuations in demand.

On trips using frequency-based transport modes, such as a bus or a ferry, waiting time can make up a large proportion of total travel time and, as such, of their generalized cost. Hence, any reduction in waiting time cost will, all else being equal, lead to improved social welfare [*6*]. During peak times, the available capacity is not sufficient to meet demand on scheduled services with capacity restrictions such as car ferries. Under these conditions, the increased time costs each new vehicle incurs for itself and other vehicles is not considered by each passenger; an effect widely discussed in the transport literature and dating back to Mohring [*7*].

A well-recognized common measure to handle peak-problems and reduce external effects of congestion is by price discrimination [e.g. *8*] implying that travellers are charged more during peak hours to reduce demand. However, such schemes might reduce the welfare of some groups in society who have to travel at particular times (i.e. parents who have to drive their children to kindergarten or workers who have to be at work at a fixed time). As a result, peak load pricing has distribution effects and could be politically controversial [*9*].

As an alternative solution to price discrimination, this article addresses the consequences of discriminating groups of users transport according to their valuation of time (VOT). That is, to give travellers with high time costs, such as people travelling to and from work (commuters), priority to board first. Consequently, total waiting time cost falls and social welfare increases. More specifically, the objective of the paper is to develop a theoretical framework for discussing the welfare effects of giving one group of passengers' priority to board first at frequency-based transport modes. Using data from the Norwegian ferry industry, the model will be applied to estimate the welfare effects of discriminating travellers using that particular mode of transport.

The structure of the paper is as follows. In Section 2, we establish a theoretical model framework for discussing the relationship between welfare effects of providing priority to a particular group of travellers on frequency-based transport modes. The model is applied in Section 3, using empirical data related to a trial arrangement in the Norwegian car ferry industry. Finally, conclusions and implications are presented in Section 4.

THE MODEL

Let us assume that policy makers will implement a priority scheme on a particular public transport route if the measure leads to improved public welfare, i.e., that the benefit to society of introducing such a scheme exceeds the cost. The priority arrangement is relevant solely for peak departures with capacity problems. The welfare effect, W, of providing commuters priority on a particular route is defined in (1).

$$W(D) = B(D) - C(D) \text{ where } \partial B/\partial D, \partial C/\partial D > 0 \quad (1)$$

In (1), the welfare effect, W, of granting boarding priority to commuters depends on the number of commuters, D, and is the difference between the benefits, B, and costs, C. It is reasonable to assume that both the benefit and the cost will be positively related to the number of commuters granted priority on a given route, D. The number of commuters comprises persons required to use the ferry to travel between home and work. In this model, it is assumed that the population of commuters is exogenously given and is influenced by neither the authorities nor the transport company.

A common framework for assessing costs and benefits against each other is the cost-benefit analysis (CBA). CBA is well suited to evaluate welfare effects of public investment projects [e.g. *10*] and has been an important tool for evaluating and ranking transport investments for several decades [*11*]. According to the Norwegian Public Roads Administration (NPRA) [12], the costs and benefits of road infrastructure projects should be discounted over a lifetime of 40-years using a discount rate of 4%.

Net benefit for travellers

The net benefit for travellers, B, of introducing a priority arrangement is determined by how the sum of traveller's time cost is affected as specified in Equation (2). The benefits in (2) comprise three elements including both private and external effects. The first parenthesis from the left addresses waiting time savings for allowing commuters with higher VOT to board instead of non-commuters with lower VOT. For further discussion on the valuation of waiting time for travellers by ferry, we refer to Hanssen [*13*]. Second, the middle parenthesis includes the advantage of being able to disembark first so that the average speed can be increased (do not need to overtake buses, tourists, or trucks). This would be of particular importance in a country such as Norway where most ferries are located in rural areas in which roads are winding and the opportunities to pass other vehicles are rare. Finally, the last parenthesis to the right is an option value related to having the opportunity to exercise the priority. This is because public transport is also valued for its potential utilization, not only for its actual use [*14*]. The fact that option values may form a potentially relevant benefit category in public transport policy appraisal has been established by Geurs et al. [*15*]:

$$B(D) = ((T_C - T_N) \times H_1 \times \alpha \times D) + (T_C \times H_2 \times \alpha \times D) + (\gamma \times D) \quad (2)$$

In (2), T_C and T_N are valuations per unit of time for commuters and non-commuters, respectively. The number of hours (time use) is indicated by H_1 for waiting time at the port and H_2 for reduced travel time from port to destination by being able to disembark first. If such an arrangement does not provide the advantage of disembarking first, the value of H_2 is zero. The proportion of commuters boarding when capacity is full, and thereby exercising their priority right, is indicated by α being a relative measure ranging from 0 (no users) to 1 (all commuters exercise priority option). The parameter α is given by the number of commuters using the priority right over the total number of commuters taking part in the arrangement. Hence, the number of actual users of the arrangement is $(\alpha \times D)$. Finally, the last parenthesis includes the option value, γ, related to having the right to priority boarding. The option value has a positive pecuniary value ($\gamma > 0$) and is independent of whether the commuter exercise the right (independent of α).

Let us address the first element of (2) in more detail. The benefit relates to the fact that each time a commuter utilizes the priority right, leaving a non-commuter waiting for the next departure, there will be a positive welfare effect because the commuter has a higher willingness to pay for reduced waiting time. Hence, the benefit occurs solely if a non-commuter is displaced. This difference in time value is not considered by the individuals, and is an external effect related to reducing the time value of congestion. By subtracting the waiting time cost of non-commuters ($T_N \times H_1$) from the commuters ($T_C \times H_1$), we find the marginal change in net benefit related to waiting time when the number of travellers who use the priority increases by one. International time value studies suggest $T_C > T_N$ [see *16*], implying that $\partial B/\partial D > 0$. Since net benefit is positive for each commuter, total benefits increases with the number of commuters. Moreover, it is clear that $\partial(\partial B/\partial D)/\partial H_1 > 0$ and $\partial(\partial B/\partial D)/\partial \alpha > 0$ so that for a given difference in time valuation ($T_C - T_N$), the benefit increases when waiting time, H_1, increases and a larger part of the commuters makes use of the arrangement, α.

The second element in (2) addresses the benefits of being able to disembark first from the ferry when the on-board portion of the trip is completed. This benefit relates to the fact that traffic is heavy when all vehicles are released simultaneously upon arrival, and a queue will form at a point. This is of particular relevance for low-capacity rural roads, which are frequently found in areas where car ferries operate in Norway. Being able to disembark first reduces the need to overtake other vehicles, resulting in a higher average speed for the commuter and reduced time consumption. This effect can, in principle, be either negative or positive. However, because commuters use private cars and have above average high time costs, it is reasonable to expect them to meet the speed limit to a larger extent than larger vehicles and tourists. The variable H_2 represents time savings for this advantage and the benefits increase with the time value of commuters, T_C, and is solely relevant for those who exercise their right to priority boarding, α.

Cost elements

It is reasonable that the administrative cost, C, of a priority scheme on a route depends on the number of travellers who are granted priority on a given route. The relation between cost (C) and the number of commuters (D) is defined in Equation (3). Non-administrative costs, such as increased time costs for non-commuters by being displaced by commuters are included in the net benefit assessment in (2).

$$C(D) = \beta_0 + \beta_1 D \text{ where } \beta_0, \beta_1 > 0 \quad (3)$$

In (3), the cost component β_0 is independent of the number of commuters traveling the route. These fixed implementation costs are imposed on the transport authorities because they must inform passengers of the change in regulations on this particular route. Such information could be distributed by advertisements in local media and/or by arranging town-hall meetings. Moreover, there are start-up costs related to preparing the infrastructure at the terminals. Once established, the infrastructure handles all priority boarding; the costs for both construction and maintenance are assumed to be independent with respect to the number of users, D. At a car ferry terminal, for example, there is a need for road signs to clearly indicate that a separate queue-line is dedicated for commuter vehicles.

The costs varying with the number of commuters is represented by parameter β_1 in (3). These are annual administrative costs of organizing the arrangement. Applications from commuters who want to be provided priority must be processed, and lists and access cards for people eligible for priority must be maintained. Hence, the cost is independent of whether they use the arrangement (α). According to (3), the marginal increase in costs when D increases by one unit is represented by β_1. Alternative cost specifications could be used, but since the case in point requires the same incurred costs for each added commuter taking part in the scheme, it is reasonable to assume constant marginal costs.

Welfare effects

For a priority arrangement to gain welfare effects, it is required that the commuter must replace a non-commuter. Hence, there must be at least as many non-commuters as commuters at a given departure. This is a reasonable assumption because the priority scheme is in effect only during peak hours, i.e. in the morning and afternoon when commuters travel to and from work.

Although benefits and costs both increase with the number of users, they do not develop similarly. This is illustrated in Figure 1 based on equations (2) and (3). According to (2), there are no benefits when the number of users is zero $(D = 0)$. In this particular case, benefits (curve B) are zero, while costs (curve C) has the value β_0. For the scheme to have the potential to gain positive welfare effects, it is a necessary condition that $(T_C - T_N)H_1\alpha + T_C H_2 \alpha + \gamma > \beta_1$. This means that the increasing slope with respect to the number of users of the arrangement is steeper for benefits than for costs. This is a reasonable assumption. Moreover, the difference between the two slopes will increase if the positive elements of the benefit, such as commuters' valuation of time relative to non-commuters, increases and if costs related to each user are reduced. Consequently, the welfare effect will always improve with the number of commuters but will be restricted by the capacity of the ferry, D_C. At the extreme, it could be an optimal result from the model that all vehicles on departures included in the priority arrangement are commuters.

Consequently, if the arrangement has few users, the costs will dominate the benefits, and the welfare effect will become negative. As the number of users increases, the distance between the curves diminishes until they intersect at D_1 and produce a zero change in welfare. For usage above D_1, the arrangement is profitable from a welfare perspective. Finally, Figure 1 demonstrates the positive welfare effect of introducing the priority scheme by the distance between the two curves when the number of users reaches D_2.

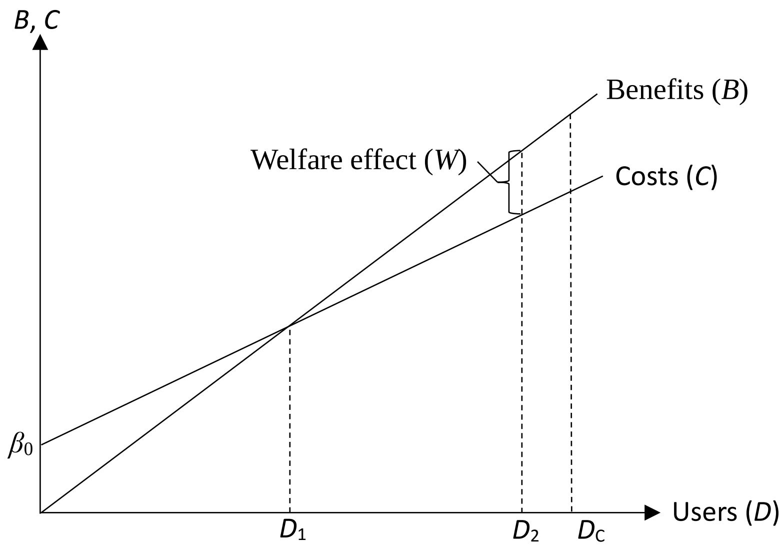

FIGURE 1 Illustration of how benefits and costs develop with respect to the number of users.

By inserting equations (2) and (3) into (1), we arrive at (4), which enables us to study how the welfare effects of introducing a priority scheme depends on the different factors included in the model.

$$W = ((T_C - T_N) \times H_1 \times \alpha \times D) + (T_C \times H_2 \times \alpha \times D) + (\gamma \times D) - \beta_0 - \beta_1 D \qquad (4)$$

The condition for a project being profitable from a welfare perspective is that W is positive. A rephrasing of (4) into (5) expresses the condition for $W > 0$ with respect to the number of users, D.

$$W > 0 => D > \frac{\beta_0}{(T_C - T_N) H_1 \alpha + T_C H_2 \alpha + \gamma - \beta_1} \qquad (5)$$

The derivatives of D in (5) with respect to β_0, β_1 and T_N are positive, whereas the derivative with respect to all other variables are negative. This implies that the number of users that is required to make the priority arrangement preferable from a welfare perspective increases when:

- the user independent costs increases (the value of β_0)
- the user dependent costs increases (the value of β_1)
- the time value per hour for commuters decreases (the value of T_C)
- the time value per hour for non-commuters increases (the value of T_N)
- the time consumption is reduced (the values of H_1 and H_2)
- the proportion of users exercising the priority right is reduced (the value of α)
- the option value is reduced (the value of γ)

Consequently, from (5), it is possible to provide an ex ante assessment of whether a priority arrangement will render positive welfare effects. Evidently, the assumptions of CBA will influence the assessment of welfare. If the discount rate increases, we put less weight on future benefits relative to the investment cost at start-up. Hence, the required number of commuters to make the project profitable from a welfare perspective increases. Conversely, if we extend the time period, the benefits will increase, and the required number of commuters will be reduced.

MODEL RESULTS OBSERVED IN LIGHT OF NORWEGIAN CAR FERRY INDUSTRY

In 2005, the Norwegian Ministry of Transport and Communication initiated a trial arrangement. This provided commuters priority to board before other travellers at the ferry crossing between the ports at Eidsdal and Linge. The ferry crossing is a link between two of the most visited tourist destinations on the Norwegian west coast: Geiranger and Trollstigen.

The ferry connection has a particularly high volume of traffic in the summer months. In July 2005 and July 2006, the number of vehicles remaining at the port when the ferry departed attained a total of 16 216 and 11 201, respectively. In addition, more than 40% of all vehicles were required to wait at least one departure before they were able to board the ferry in July 2005. In July 2006, the proportion was, at approximately 28%, moderately lower. Summer traffic (June, July and August), typically comprises approximately 55% of the total annual traffic on this particular ferry crossing.

During the most problematic time of year, certain commuters reported having waited as much as two hours per day before being able to board the ferry. This wait was considered a serious problem for commuters, particularly those who needed to meet at work or pick up their children at kindergarten at a given time. Consequently, the Norwegian Ministry of Transport and Communication decided to initiate a trial arrangement where commuters were provided priority to board the ferry before other travellers on this ferry crossing. Commuters able to document that they work and live on different sides of ferry connection were given the opportunity to apply for priority status. In Norway, information on place of settlement and work is available for the authorities granting the priority status. However, the necessary data for assessing the truthfulness of the information provided by the applicant might not be available in other countries making such arrangements more difficult to implement.

The trial lasted three years and was evaluated by Hanssen and Solvoll [*17*]. Hanssen and Solvoll [*17*] collected cost data from Norwegian Public Roads Administration (NPRA) regulating the ferry crossing and from Møre and Romsdal county, where the priority arrangement was organized. The information from NPRA formed the basis for estimating $\beta_{0,}$ whereas data from the county related to β_1.

Hanssen and Solvoll [*17*] obtained the travellers valuation of the waiting time by the use of a questionnaire. The average willingness-to-pay (WTP) for acquiring a priority card was NOK 79. This WTP is unrealistically low, indicating that the respondents have chosen to answer tactically on this question fearing that their WTP might be used to price the priority card. Hence, a decision was made to base the valuation on the reduced waiting time for commuters on the officially recommended time values [*18*].

The cost and benefit of giving commuters priority

According to Equation (5), the minimum number of commuters for making the welfare effect of providing commuters priority to board first on a particular route depends on the corresponding costs and benefits. In the following, we will first address the user independent cost of the arrangement, then we look into the user dependent costs. Finally, we address the net user benefit of providing commuters on the ferry service the privilege to board the ferry before other travellers.

User independent cost
The Norwegian Public Roads Administration had the following user independent cost of granting commuters priority to board the ferry traveling between the ports of Eidsdal and Linge [*17*]:

- Preparing the project: 1 man-day.
- Meet officials from the local municipalities: 2 man-days.
- Information activities: 1 man-day.
- Preparing information to commuters: 3 man-days.
- Road signs at the two ports: 29 000 NOK.

The average cost of labour is 560 NOK per hour (incl. social cost), and each man-day is comprised of 7.5 hours. Consequently, the labour cost total 29 400 NOK. In addition, considering the cost of 29 000 NOK for the signs, we find a total user independent cost of nearly 58 500 NOK. All prices are in Norwegian kroner (NOK), year 2015 values.

User dependent cost
The user dependent cost is related to the production and distributing of the signs each commuter must have attached to his or her vehicle to obtain priority at the port. This commuter status is reconsidered annually. The cost of producing each sign and mailing it to the commuter is 15 NOK. In addition, the NPRA used 2 man-days to produce and ship the signs. Using the relevant cost of labour, a project lifetime of 40-year and a discount rate of 4%, the present value of the user dependent cost totalled 4 255 NOK per commuter.

Net user benefit
The net user benefit of providing commuters priority to board the ferry prior to other travellers is according to Equation (2) composed of three components. The first relates to reduced waiting time at the port. The second relates to reduced travel time from port to destination by being able to disembark first. The third is an option value related to having the right to priority boarding.

The priority to board the ferry first provided each commuter an average reduction in waiting time at the port of 13 hours and 12 minutes per year. Because the reduction in waiting time for commuters is accompanied by a similar increase in waiting time for non-commuters, we derive net user benefit from reduced waiting time by subtracting the time cost per hour for non-commuters ($T_N = 95$ NOK/hour) from the time cost of commuters ($T_C = 113$ NOK/hour). The difference in time-cost ($T_C - T_N$) amounts to 18 NOK/hour. This equation derives a net annual benefit per commuter who exercise their priority right, $(T_C - T_N)H_1$, of 238 NOK. However, the proportion of commuters exercising their priority rights were 50% (i.e. α=0.5) [see *17*]. Hence, the average net user benefit from being able to board the ferry first is 119 NOK for each priority card holder (D).

Priority card holders might also benefit, as is evident from Equation (2), from being able to disembark the ferry first when the on-board portion of the trip is completed. We lack input data to estimate correctly benefit. However, the speed limit is 80 km/h, but road standard is low so drivers unfamiliar with the area or users of large vehicles will not be able to attain this speed. Let us assume that the speed reduction for the latter group amounts to 25%. After about 10 km there is an improvement in road standard enabling private cars to overtake slower vehicles. Consequently, drivers will be able to hold an average speed of 80 km/hour instead of 60 km/hour when they disembark first. During the 10 km of low standard road after disembarking the ferry, drivers will save 2 min and 30 seconds of driving time due to priority disembarking. According to [*17*] each commuter, on average, disembark the ferry first 28.4 times due to holding a priority card. Hence, the total saving time is 1 hour and 11 min being valued to 134 NOK ($T_C H_2$). Evidently, the valuation of time is a question for debate. It is for example argued by Halse and Killi [19] that time values for waiting should be elevated above that of driving the car. As previously mentioned, the proportion of commuters exercising their priority rights were 50% (i.e. α=0.5). Hence, on average for each priority card holder (D), the annual net user benefit from being able to board the ferry first is 67 NOK.

The third, and final, element of net user benefit included in Equation (2) relates to the priority card holders valuation of having the option of using the card (γ). In the questionnaire, the priority card holders stated that they, on average, were willing to pay 79 NOK to keep their priority card for another year. This willingness to pay translates, for the purpose of this article, to the option value.

Summing up, travellers net benefit from reduced waiting at the terminal, from being able to disembark the ferry first and from the option value translates to a net user benefit per commuter of 265 NOK. The discounted value of the net user benefit amounts to 5 238 NOK per commuter (D).

The welfare effects of giving commuters at Eidsdal-Linge priority to board the ferry first
The parameter values needed to calculate the welfare effects of giving commuters priority to first board the ferry between Eidsdal and Linge is presented in Table 1.

TABLE 1 Benefits and costs of providing commuters priority on the ferry crossing between Eidsdal and Linge

	Description	**Value (NOK)**
β_0	User independent start-up costs	58 450
β_1	Net present value of user dependent costs	4 255
$(T_C - T_N)H_1\alpha$ $+T_C H_2\alpha + \gamma$	Net present value of user benefits	5 238

When inserting the parameter values from Table 1 into Equation (5), we find that the minimum number of commuters required for the project to have a positive welfare effect is 59. Because 40 commuters on Eidsdal-Linge were provided priority, this particular project had a negative effect on welfare. By inserting the parameter values from Table 1 into Equation (4), we find that the negative welfare effect from providing commuters on this particular ferry crossing priority to board first totalled 19 100 NOK. Moreover, by solving Equation (5) with respect to β_1 and inserting the values for β_0 and $(T_C - T_N)H_1$, we find that the user dependent costs per commuter must be reduced by 11% to 3 777 NOK for the project to have a positive effect on welfare when the number of commuters (D) equals 40. Another approach is to hold costs fixed and assume that the authorities initiate the project if it is profitable, and use their valuation of benefits.

In Figure 2, the relation between the number of commuters and the benefits and cost of granting them priority is illustrated. The two lines labelled Benefit and Cost 1 are based on the parameter values in Table 1. As a basis for the Cost 2 curve, the parameter values from Table 1 were used with the exception of β_1, which has been given the value 3 777 NOK.

It can be observed from Figure 2 that the benefit of the project (line Benefit) and the cost of the project when the user dependent cost equals 3 777 NOK (line Cost 2) intersect at approximately 40 commuters. In accordance with the principal relations discussed in Figure 1, it is evident from Figure 2 how Cost 1 lie above Benefit at $D = 40$, and that these two lines intersect at $D \approx 59$. If $\alpha > 0.5$, the point of intersection would be reduced to lower values of D. For any given value of D, the distance between Benefit and the two cost curves illustrates the welfare effect of providing commuters priority. To the left of the intersections, the distance between the lines illustrate how negative the welfare effects are at the particular level of D. Conversely, the distance between Benefit and the cost lines to the right of the intersections illustrate how positive the welfare effects are. Thus, it can be observed from Figure 2 that, when for example $D = 50$, there will be a positive welfare effect of approximately 14 600 NOK when $\beta_1 = 3\ 777$ (Cost 2 line) and a negative welfare effect of approximately 9 300 NOK, when $\beta_1 = 4\ 255$ (Cost 1 line).

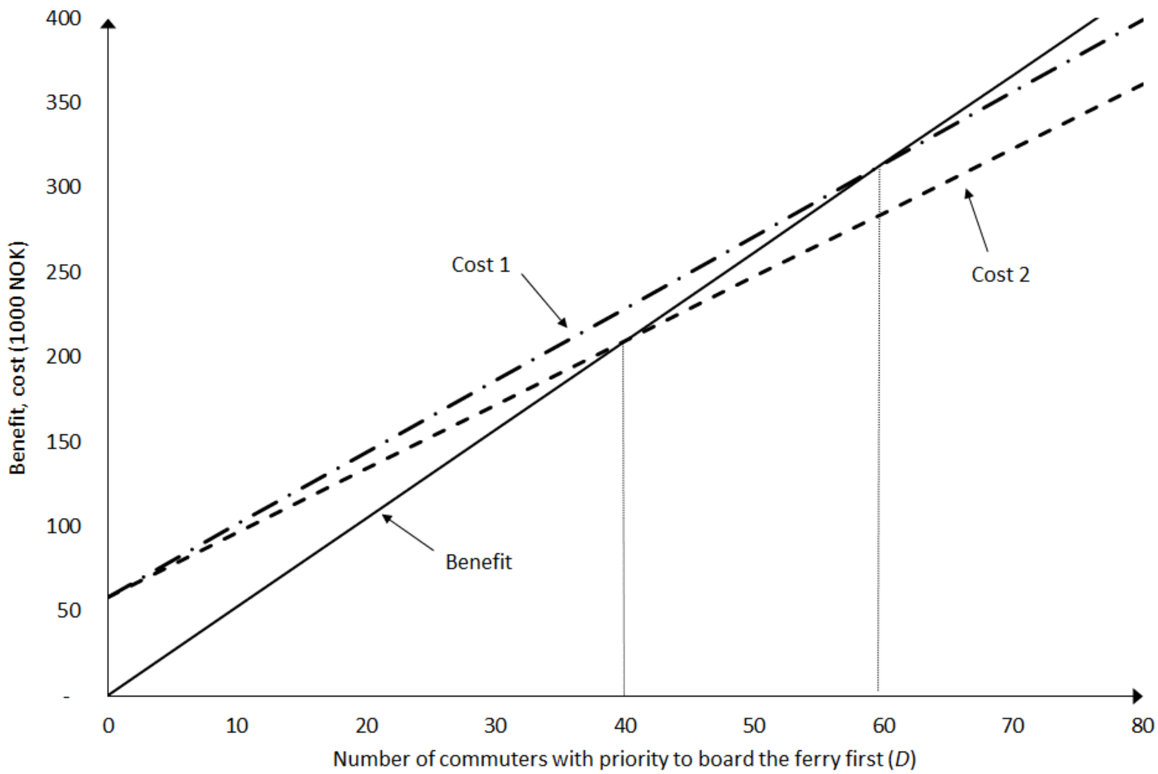

FIGURE 2 The relationship between the number of commuters, net benefits and costs.

One of the main objectives of the Norwegian transport policy is to encourage regional development [*20*]. Public subsidies to ferry services in rural areas characterized by fjords and islands are among the measures provided to achieve this objective. Hence, the allocation of resources to the ferry industry is largely caused by political objectives related to a distribution policy. Jørgensen et al. [*21*] revealed the welfare effect of all state operated ferry crossings and concluded that approximately 25% of these contributed negatively to social surplus. Because these ferry crossings remained in operation, Jørgensen et al. [*21*] suggested that the benefits for the users must implicitly be valued higher than that of other parts of the population. In accordance with this line of thought, we can conclude how much the benefits of the commuters are valued relative to the non-commuters. In the case of the crossing between Eidsdal and Linge, where the arrangement is introduced for 40 users, it can be derived that the benefits of commuters are valued approximately 23% higher than that of the non-commuters. This value follows from the assumption that all users are active (indicating that the value is excessively high) and does not include a valuation of disembarking first and does not include the option value (indicating that the value is excessively low). Provided the authorities' goal of distribution policy, it could be reasonable to use priority boarding at ferries as a means to encourage working people to live in rural areas.

CONCLUSIONS AND IMPLICATIONS

In this article, we have developed a model framework for an ex ante assessment of the welfare effects of introducing a priority arrangement on a low frequency scheduled transport mode with capacity restrictions. Such priority arrangements could be relevant when the implementation of price discrimination is not possible or desirable to deal with congestion problems. The model indicates how many users are required to make the arrangement beneficial for the society as a whole. Based on a set of assumptions, it is demonstrated that the difference between the marginal changes in benefits and costs when an additional user is included in the system is decisive.

The results from the model show that welfare problems (negative external effects) related to congestion at the port can be successfully reduced by introducing a priority scheme. Consequently, such priority schemes should be considered for scheduled transport services with capacity constrains where politicians want to discriminate certain passenger groups and when price discrimination is deemed unacceptable. The arrangement becomes more attractive if the: i) waiting time (headway) is higher, ii) difference in time value between prioritized group and the other increases, iii) marginal costs of serving additional users is low and iv) future benefits are valued higher.

The model is applied on a trial arrangement at a Norwegian ferry crossing where commuters are granted priority boarding with the objective of maintaining settlement in rural areas. Not all information on benefits were available; therefore, the estimates of benefits can be considered conservative estimates. Despite low investment costs, the welfare effect of the case in point is negative. The number of commuters participating in the arrangement was 40, whereas the required number to produce a positive welfare benefit for the project was 59. Consequently, the case in point can be viewed as a failure because it does not contribute positively to social welfare. The fact that the priority arrangement continues to be conducted shows that the benefits for commuters is valued at least 23% higher by the authorities than that of the non-commuters. Given the stated objective of Norwegian transport policy of contributing to regional development, this is not an unreasonable conclusion.

These results relate to commuters at a specific ferry crossing but the approach could as well be treated in terms that are more general. For example, other groups of travellers could be granted priority on other transport modes. Admittedly, it is a weakness that only linear relationships are applied. It should also be noted that implementing such a priority scheme could influence the behavior of both commuters and non-commuters. Hence, using average values for time cost might not reflect the actual preferences of passengers being displaced. However, as for all studies involving time costs it is uncertainty related to determining this value. Nevertheless, the conclusions are robust and provide insight into the effects of the mechanisms determining the welfare effects of such projects. Consequently, the model renders a manageable way of assessing ex ante whether a priority arrangement has positive welfare effects.

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