An Evaluation of Competitive Tendering in the Ferry Sector in Norway[1]

by

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Abstract: Fjord crossings by car ferries constitute a vital part of the Norwegian trunk road system. The current subsidy scheme is considered to provide insufficient incentives for cost efficiency however. As a consequence, tender competitions have recently been introduced, so far on a few selected ferry links in order to gain experience with tendering on this area. Although subsidies have increased somewhat, there have been major improvements in the quality of services such as increased capacity, new ferries, increased frequencies and extended opening hours. A rough estimate of the additional production costs associated with these major improvements in the quality of services indicates that the tender competitions have produced significant cost savings. In addition, such improvements add benefits to the users, albeit not being estimated. Further, it has been a "winners curse" game providing a yardstick for the remaining ferry sector not being exposed to tender competition so far. In addition to an in-depth studies of the ferry links having been exposed to tender competition, Data Envelopment Analysis (DEA) has been applied in order to measure the relative improvements in efficiency for tendered and non-tendered ferry links. The

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results from the DEA study resembles the findings of in-depth study, indicating that tendering has improved efficiency somewhat, although less than reported by the companies ex ante, indicating that the companies have been too optimistic when submitting their bids.

1 Introduction

Norway has a long coastline with a large number of fjords and islands. As a consequence, combined car and passenger ferries are vital in the Norwegian trunk road system. Although bridges and undersea tunnels have replaced a significant number of crossings during the last decades, the number of remaining crossings is still quite substantial.

As the ferry links are considered to constitute a part of the Norwegian trunk road system, the National Public Roads Administration is responsible for supplying ferry services, regulating both prices and vital service parameters such as operating hours, frequencies etc.[2] The actual production of the ferry services is performed by ferry companies, each operating a monopoly franchise on a bundle of ferry links. As revenue is insufficient to cover operating costs, the ferry companies are awarded quite substantial subsidies in order to make the ferry services economically viable.

Until 1990, subsidies were awarded ex post on a cost-plus basis. The incentive for cost efficiency was thus weak. In order to encourage cost efficiency, subsidies were awarded ex ante on and after 1990. In order to induce further cost efficiency and thus allow for further cuts in the subsidies, the transport act was amended in 1991 so as to allow for tendering to a limited extent from 1994 onwards. The National Public Roads Administration made us of this opportunity and during the years that have followed, six ferry links have been exposed to tender competition of which the operations of the first four started during 1997. This paper describes and evaluates these tender competitions. In addition to an in-depth studies of the ferry links having been exposed to tender competition, Data Envelopment Analysis (DEA) has been applied in order to measure the relative improvements in efficiency for tendered and non-tendered ferry links.

The paper is organised as follows: In section 2, tender competitions are discussed in a theoretical perspective. Section 3 elaborates the tender competitions in the Norwegian ferry sector. A short introduction to Data Envelopment Analysis (DEA) follows in

[2] Establishing operating hours and service frequencies is to a large degree delegated to local road administrations in the counties.

section 4. In section 5 we look into the production of ferry services with special emphasis on the choice of inputs and outputs for the DEA study. Section 6 gives a brief description of the data applied in the DEA study, while section 7 presents the results form the study. Section 8 concludes.

2 Tender Competitions: Theory

It has been recognised for a long time that monopoly provides weak incentives for efficiency. Although economists have tended to emphasise the deadweight loss associated with monopoly pricing, Hicks (1935, p.8) suggested that "the best of all monopoly profits is a quiet life", presumably leading to internal or X-inefficiency (Leibenstein, 1966). At the same time, economies of scope or scale may call for a monopoly in order to avoid excessive costs. Thus, there seems to be a trade off between the exploitation of economies of scale and scope on the one hand and ensuring proper incentives for efficiency on the other hand.

Several second best solutions have been suggested to induce efficiency while at the same time ensuring the exploitation of economies of scale and scope. The theory of optimal regulation (eg. Laffont & Tirole, 1993) suggests introducing incentive mechanisms in order to induce a monopoly to enhance efficiency. The theory of contestable market (Baumol et al, 1982) holds that provided that a monopoly is faced with the threat of competition and there are no sunk costs present, it will behave as if it is faced with actual competition in the market. An alternative and classical solution due to Demsetz (1968) is to refuse competition in the market, but rather allow for competition for the market through tender competitions. Both the theory of contestable market and Demsetz (1968) holds that by allowing for competition, one may exploit economies of scale and scope while at the same time provide proper incentives for efficiency.

Competitive tendering is in effect an auction where a public agency awards a monopoly franchise to the company that offers to supply the product on best terms.[3] Demsetz (1968) suggested that the company that can meet the demand at the lowest

[3] On auctions, see McAfee & McMillan (1987).

possible price should be appointed the winner of the tender competition. According to Demsetz (1968), this should induce both internal and (second best) allocative efficiency. In practice however, tender competitions have usually been limited to induce internal efficiency only. In that case, the company that can produce a pre-specified output at lowest possible cost is appointed the winner of the tender competition. It is this latter kind of limited tender competition that has been introduced recently in the Norwegian ferry sector.

Tender competitions should improve internal efficiency for two reasons. First, each company will presumably strive for the most efficient or least costly way of producing the prespecified ferry service as this will both maximise each company's probability of winning the tender competition and also maximise the company's profits if being picked as the winner. Second, the incumbent companies may be replaced by more efficient companies. Thus, tender competition may induce proper incentives for cutting costs and also provide a favourable selection of the most cost efficient company or companies. Several studies have proved that tender competitions can bring about substantial cost savings.[4]

Prior to competitive tendering, the public agency must specify the various aspects of the service to be provided, the method by which the supplying company will be remunerated, the time period for which the supplying company will be awarded the exclusive right to supply the service, the yardstick to which the competitors will be evaluated and finally any penalties for not providing the specified service. Once a winner is appointed, this is specified in a contract entered by the agency and the appointed winner.

Concerning the method by which the supplying company will be remunerated, there are two main methods. One option is to let the operating company retain the farebox revenue. If the farebox revenue is insufficient to cover the cost of production (which is the rule rather than exception in the Norwegian ferry sector), the public agency pays a subsidy in order to cover the deficit. Alternatively, the public agency retains the

[4] In some cases a substantial share of the cost savings is due to reduced wages rather than more efficient operations, however. While the latter is a gain for the society, the former is merely redistribution.

farebox revenue and awards the operating company a subsidy in order to cover its costs of production. The former method is called the net-subsidy method, while the latter is called the full- or gross-cost method.

As the operating company retains the farebox revenue when operating on net-subsidy terms, it is encouraged to promote demand by providing a satisfactory level of service quality. On the other hand, the operating company confers a high risk as it takes the rap for both cost overruns and declining revenue. If the company operates on gross-cost terms however, it is only responsible for cost overruns and thus incurs less risk. However, as farebox revenue accrues to the public agency, the operating company has no incentive to promote demand when operating on gross-cost terms.

Concerning the specification of the service to be provided, the public agency must specify for each ferry link the operating hours, service frequency, carrying capacity etc. Such requirements may be absolute or constitute minimal requirements. Also, if the company is to operate on net-subsidy terms, the public agency must specify the fare or fares. Further, the agency must specify whether capital equipment or assets (in our case; ferries) will be provided by the agency or not. If provided by the agency, we refer to this as an operating franchise. Otherwise, it is called an ordinary franchise.

In case of an ordinary franchise, the capital assets owned by the incumbent company may constitute sunk costs, possibly deterring new entrants from making bids. As a consequence, competition will suffer. Also, an operating company being uncertain about the prospects for renewal of the contract or the market value of the capital in case of non-renewal, will be reluctant to undertake investments in capital. As a consequence, investments may be sub-optimal. This calls for choosing operating franchises. On the other hand, by not being the owners of the capital equipment, the companies incentives for maintenance of the equipment are poor. Further, as the operating companies do not incur the capital costs under operating franchises, but may reap any positive consequences (in terms of reduced operating costs), they have an incentive to persuade the public agency to invest excessively.

Concerning the time period for which the supplying company will be awarded the exclusive right to supply the service, Posner (1972) have argued that as demand and cost conditions may change rather rapidly, one should opt for short periods. However, this neglects any administration costs associated with tender competitions. Also, it neglects the fact that as long as operating companies must undertake investments that are not easily transferable or at least to a substantial cost, their possibility to reap the gains from these investments are quite limited when contract periods are short. As a consequence, investments suffer. To prevent this, Williamson (1976) suggests that monopoly franchises should be awarded for rather long periods of time while Laffont & Tirole (1993) suggests that at the renewal stage, incumbent companies should to a certain extent be favoured to entrants.

Concerning the selection of the winner, the general rule is to select the company that offers to supply the specified service at best terms. Concerning the choice of the terms or the yardstick to which the competitors should be evaluated, this depends on the aim of the tender competition. If the aim is to safeguard internal efficiency, the company offering to supply the specified service to least subsidy should be appointed the winner. If the aim is to promote allocative efficiency as well, Demsetz (1968) has suggested that the company that can meet the demand at the lowest possible price or fare should be appointed the winner of the tender competition.

The selection of a winner is not without its problems however. For instance, suppose that the public agency has specified minimum requirements for the service, but allows for bids offering a higher quality of service. How should a choice be made between a bid involving low subsidies but also low quality and a bid involving larger subsidies but also higher quality? Alternatively, suppose that the fare level is used as yardstick. How should a choice be made between two bids where one of the bids outperforms the other for some market segments but falls short in other segments?

Finally, as there is conflict of interest between the public agency and the operating company, a contract should specify penalties for not providing the contractual terms. For instance, a company operating on gross-cost terms has an incentive to reduce service quality in order to save on its cost of production. In order to prevent this, the contract may specify penalties for cancelled or late departures.

3 Tender competitions in the Norwegian ferry sector

Following an amendment of the transport act in 1991, tender competition was legalised to a limited extent for ferry services in Norway from 1994 onwards. The National Public Roads Administration made use of this opportunity and during the years that have followed, six ferry links have been exposed to tender competition. The deadlines for submitting bids on the first four links to be exposed to tender competition were fixed at the beginning of 1996, operations determined to start during 1997. The remaining two links were exposed to tender competition during 1997, operations starting only recently.

The responsibility for developing competitive tendering was left to the local road agencies. They had no prior experience in this field except for auctioning processes in the road building sector. Three of the six cases were organised on gross-cost terms while the remaining three where on net-subsidy terms. The experience was that gross-cost term contracts had somewhat higher transaction costs and lack of incentives for the companies in order to enhance demand and thus revenue. In addition to these perspectives, the risk-premiums in the market for net-subsidy contracts were not higher than for gross-cost contracts. Since public sector is not able to diversify this kind of systematic risk, there is no reason to stick to gross-cost contracts.

In order to attain a thorough understanding of the figures and the process, all the local road agencies and ferry companies have been subject to in-depth interviews. The in-depth analysis has been explored in Hervik, Sunde, Bryn and Hauge (2000) and has been important both to public agencies and companies for the learning process to organise and take part in competitive tendering in the future. The interviews have revealed that each case is complex and unique. We will concentrate on the main findings and the general lessons to be learned from the six cases.

The benefits for the public sector are not easy to estimate since simultaneously to exposing the links to tender competitions, the services have been subject to major improvements along many dimensions such as new ferries instead of old ones, increased capacity, increased frequencies and extended opening hours (eg. services during night hours). The total subsidies have increased somewhat, but only modestly by NOK 17 mill. This has occurred despite the fact that operating (or variable) costs have decreased (by NOK 19 mill). This is due to the fact that a total of eight new ferries were required. The value of these eight new ferries has been estimated to NOK 740 mill. The value of the above mentioned qualitative improvements have been estimated to NOK 44 mill. Based on these figures, we have estimated that these improvements in quality would have added to a total subsidy requirement of NOK 80 mill if the ferry links had not been exposed to tender competitions. Compared to the modestly increases in subsidies (NOK 17 mill), we conclude that tendering competition has led to substantial cost savings.

In the political process to get accept from the local level to take part in competitive tendering, the service quality in these six links has been somewhat higher than what is customary in the Norwegian ferry sector. These incentives could be interpreted as a cost for introducing competitive tendering in the Norwegian ferry system. So far we have not performed a complete cost-benefit analysis, but rather a pure cost approach, estimating the costs associated with the improvements in service quality if the ferry links had not been exposed to tender competitions. In a cost- benefit approach one should include the willingness to pay for these quality improvements.

From the in-depth studies we have also revealed that one seems to have ended up with a "winners curse" game for all the competitively tendered ferry links. Uncertainties have been high due to uncertainties concerning manning requirements, wages and (in case of net subsidy terms) traffic-prognosis. The number of submitted bids varied between 6 and 9 in the 6 cases, the bids exhibiting large variations. In most cases, the winning bids involved significantly lower subsidies than would have the second-best bids. In some cases, subsidies would have doubled if the second-best bids had been accepted. In five of the six cases the incumbent companies won the tender competitions, probably in order to prove their capability to compete within this new competitive environment. The workforce was also highly motivated to win. So far opportunistic behaviour has not caused any problems. For instance, no company seems to have lowered the quality of service in order to cut costs. Further, in cases where improvements of the services have been required ex post, none of the companies seems to have exploited their strategic position in order to claim large additional subsidies in order to earn supranormal surpluses. The incentives to run these ferry links efficiently seems to have been very strong, and this gives an extra benefit to the public agencies to use this information in yardstick competition for the whole ferry system.

The duration of the contracts have varied between 5 and 8 years depending on the need for asset specific investments. The problems with long term contracts are the lack of flexibility. The new ferries cannot bee relocated in order to optimise the total ferry system, but are stuck in the links according to the contracts. The contracts do not contain any incentives to improve efficiency through innovations during the contract periods lasting for up to 8 years. The companies have no incentives to increase their market and adopt to changes in the market especially in the gross-term contracts. New incentive contracts can be developed to increase flexibility.

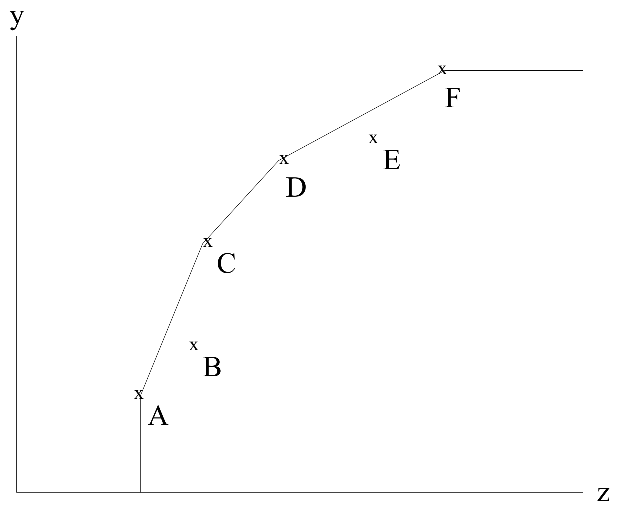
4 Measuring efficiency by means of DEA

Tendering has been suggested as a means to enhance efficiency. Efficiency is not an unambiguous concept however. A major distinction is between allocative efficiency and internal efficiency. Roughly speaking, allocative efficiency refers to whether outputs are produced and consumed in optimal quantities while internal efficiency refers to whether the quantity of output is produced at least possible costs. In other words, the former refers to 'doing the right things' while the latter refers to 'doing things right'. As tendering concerns the fulfilment of a given timetable to least cost, internal efficiency is the relevant concept when comparing tendered and non-tendered ferry links.[5]

If a production unit is to be internally efficient, it must be impossible to increase any output and/or decrease any input without simultaneously reducing at least one other output and/or increasing at least one other input (Koopmans, 1951). In order to determine whether a production unit is efficient or not, we need to know the frontier of the production possibility set representing the efficient combinations of inputs and outputs. Such information is rarely available however. A solution is to construct a so-

[5] One may attempt to infer the significance of tender competition by comparing the costs prior to the tender competition to the costs after the tender competition for each tendered link. However, as there has been major improvements in the service quality however, this complicates such comparisons.

called best practice frontier based on the production units found to be the most efficient in practice. Farrell (1957) suggested that such a frontier could be constructed by enveloping the input-output data by means of a piecewise linear frontier. Such a frontier is depicted for a single input – single output case in figure 1 where z measures the quantity of the input, y measures the quantity of the output and A, B, C etc. are input-output combinations of production units that are to be evaluated.



As can be seen, A, C, D and F are all located on the frontier. Such production units are termed best practice efficient. B and E are located off the frontier however, producing less output or by means of more input than is possible. Such production units are termed inefficient. In order to measure the degree of inefficiency, Farrell (1957), building on Debreu (1951), suggested that efficiency may be measured in terms of a simple index being equal to one minus the maximum proportional reduction in all inputs consistent with continued production of existing outputs. Alternatively, efficiency may be measured in terms of a simple index being equal to one plus the maximum proportional increase in all outputs consistent with continued use of existing inputs. The former is termed an input-saving measure of efficiency, while the latter is termed an output-increasing measure of efficiency. To illustrate, consider production unit B in figure 1. The input-saving and the output-increasing measure of efficiency suggested by Farrell (1957) is given by $z_B^*/z_B \equiv E_1$ and $y_B^*/y_B \equiv E_2$ respectively. As $0 < z_B^* \leq z_B$, it follows that $0 < E_1 \leq 1$. A production unit is best practice efficient if $E_1 = 1$, otherwise (that is; $0 < E_1 < 1$) it is inefficient. The lower the value of E_1, the less efficient is the production unit considered. As $y_k^* \geq y_k$, it follows that $E_2 \geq 1$. A production unit is efficient if $E_2 = 1$, otherwise (that is; $E_2 > 1$) it is inefficient. The higher the value of E_2, the less efficient is the production unit considered.

Although pioneered by Farrell (1957), the piecewise linear frontier did not gain ground until Charnes et al (1978) ingeniously applied linear programming techniques in order to jointly calculate the efficiency measures and the relevant part of the frontier for each production unit in turn. This method has come to be known as Data Envelopment Analysis or DEA for short. Although their study was restricted to constant returns to scale, the methodology has been generalised by Bankers et al (1984) to handle variable returns to scale as is the case illustrated in figure 1. As the latter is more flexible than the former, we concentrate on the variable returns to scale model. A thorough introduction to the various DEA models can be found in Cooper, Seiford and Tone (2000).

It should be admitted that there exist several alternative methods to DEA.[6] However, DEA is widely acclaimed for being a quite flexible tool for efficiency measurement, letting the data to a large extent reveal the possibly complex relationships between inputs and outputs. Further, the method handles multiple inputs and multiple outputs straightforwardly. As a consequence, recent years have seen a great variety of applications of DEA. Of particular interest is the previous DEA studies of Norwegian ferries and ferry links by Førsund & Hærnes (1994) and Minken et al (2000) respectively.[7]

[6] DEA is a so-called non-parametric method as it does not assume that the production possibility set can be represented by a parametric production function. On parametric production frontiers, see Greene (1993).

[7] In addition, Førsund (1993) has measured productivity growth in the Norwegian ferry sector by means of the Malmquist productivity index.

5 The production of ferry services

A ferry service consists of transporting motor vehicles and passengers according to fixed timetables. We may distinguish at least three activities associated with the production of a ferry service. First, there are the crossings per se. Second, each ferry must be loaded with cars and passengers prior to each crossing and correspondingly unloaded after each crossing. Third, the timetable may entail that a ferry lies idle between scheduled crossings. All these activities occupy a ferry of course. In addition, a ferry must be manned by a crew in the operating hours of the day (except for any possible breaks of sufficiently long duration). Finally, during a crossing and to some degree during loading and unloading, a ferry consumes fuel.

These activities entail costs as ferries entail capital costs and costs associated with maintenance and repairs, fuel must be paid for and the crew must be paid wages. Capital costs depends on several factors, amongst others the construction cost of the ferry which in turn increases (less than proportionally) with the size of the ferry being measured in terms of its capacity in private car equivalent units (CEU). Fuel cost is the product of the price of fuel and fuel consumption, the latter depending on several factors such as size and type of ferry (eg. designed for long or short distance), operating conditions (eg. sheltered or unsheltered water), the load factor and of course the distance travelled. Crew cost is the product of crew wages and man hours, the latter depending on operating hours and the manning requirements for the ferry, the latter being positively correlated with the size of the ferry.

Although this applies to all ferry links, the costs may vary considerable. This is due to the fact that ferry links vary in several respects. Amongst the major determinants of costs is the capacity of the ferry or ferries required in order to supply adequate capacity as capital, fuel and manning costs do all increase with the size of the ferry. In addition, fuel and manning costs depends on the use of the ferries. Fuel consumption and thus fuel costs depends mainly on distance travelled and the size of the ferries. Manning costs on the other hand, depends mainly on the operating hours and the size of the ferries. Thus, the size of the ferry or ferries, the distance travelled and the operating hours are all major determinants of the costs of a specific ferry link. In order to take this into account, we make use of two outputs being the product of the carrying capacity of the ferries (CEUs) and the distance travelled (O1) and operating hours (O2) respectively:

O1: Carrying capacity times distance travelled (CEU-kilometers)
O2: Carrying capacity times operating hours (CEU-hours)

Although these two outputs are considered to be major determinants of costs, they are not entirely adequate. For instance, as the ferries consume fuel not only during crossings, but also during loading and unloading, we should take into account how large a share of the operating hours the ferries spends in berth as opposed to crossing. Also, as fuel consumption increases with the load factor, we should take into account the load factor as well. As such data are not readily available, we abstain from including these and possibly others measures of output.

It should be noted that outputs O1 and O2 are both associated with the fulfilment of a timetable with a given capacity per unit of time rather than the number of vehichles and passengers transported. Thus, outputs are supply-related and not demand-related. Whether one should opt for supply-related or demand-related outputs is a highly controversial issue within the literature dealing with the measurement of relative efficiency in transit; see De Borger & Keerstens (2000). In our case where output is specified by the authorities and not left to the discretion of the companies and further, the cost associated with producing a ferry service is barely dependent on the use of that service, one should opt for supply-dependent outputs as is done in this study.

As already noted, ferry services requires the input of ferries, fuel and crew. Concerning the former, accounting measures do not give an adequate picture of the capital costs involved; see Førsund and Hærnes (1994). As a consequence, several alternatives have been suggested. For instance, Førsund & Hærnes (1994) suggested that capital costs could be based on market value estimated from insurance premiums, although the authors admit that the procedure is not totally convincing. As an alternative measure of capital, Førsund & Hærnes (1994) suggested to use the ferries carrying capacity in terms of car equivalent units. However, this does not take into account that newbulding costs and hence capital costs increase less than proportionally with the capacity of the ferries as demonstrated by Minken et al (2000).

Therefore, Minken et al (2000) suggests that capital costs should be based on estimated newbuilding costs. For ferries constructed recently, newbuilding costs are available. For older ferries, newbuilding costs are estimated by means of a regression analysis. We are in line with Minken et al (2000) and capital costs are thus calculated according to the procedure suggested therein.

Further, repair and maintenance of a ferry is rather lumpy, varying significantly from year to year. Thus, the costs associated with repair and maintenance to be found in the accounts may partly refer to wear and tear in previous years. A solution suggested in Førsund & Hærnes (1994) is to calculate the average repair and maintenance costs based on the accounts from past years. In our case, this is not an option since several of the links tendered are making use of new ferries for which such information is not available. As a consequence, repair and maintenance costs are left out.

As fuel may be assumed to be a homogenous input, we prefer to measure this input in physical units rather than monetary units. Fuel consumption in litres is found by dividing fuel costs by the fuel price per litre reported by the actual ferry company. Crew on the other hand, is measured in monetary terms being total (gross) wages. This is mainly due to lack of information concerning manning hours and overtime payments. Thus, we assume the following inputs:

I1: Capital costs in NOK
I2: Fuel consumption in litres
I3: Total crew wages in NOK

This is in line with Førsund & Hærnes (1994), while Minken et al (2000) measures fuel consumption in monetary units.

6 The Data

The Norwegian Pubic Roads Administration keeps track on the ferries, their yearly costs and the links in which they are operating. This information is based on yearly accounting reports obtained from the ferry companies. In addition, the Norwegian Pubic Roads Administration keeps track on the various aspects of the supply of ferry services such as operating hours, frequencies etc. Based on this information, we have constructed a data set for a sample of ferry links for the years 1996 and 1998. This data set contains data for all the input and output variables listed in the previous section. The years 1996 and 1998 were chosen as the former is the last year prior to tendering while the latter is the first year in which the tendered links were in operation. Ferry links for which the data was suspected to be unreliable were censored from the data set. This left us with a total of 63 ferry links of which 4 were tendered during 1997.[8] The tendered ferry links were all either simple shuttle links between two ferry-berths or almost simple shuttle services. The same applies to 33 of the non-tendered links. The remaining ferry links are more complex services between multiple ferry-berths. Summary statistics for the sample of ferry links are presented in table 6.1.

Table 6.1: Summary statistics. All figures in thousands.

			1996		
	Capital (NOK)	Fuel (litres)	Wages (NOK)	CEU-km	CEU-hours
Min	703	88	1 648	158	24
Average	4 210	1 164	7 222	5 059	389
Max	16 787	6 500	26 136	44 668	1 981
SD	3 864	1 123	4 491	9 678	380
			1998		
Min	703	94	1 840	165	26
Mean	4 338	1 180	7 971	5 006	412
Max	16 787	4 142	22 818	20 798	1 611
SD	3 775	967	4 653	5 036	378

The data kept by the Norwegian Pubic Roads Administration refers to the actual figures that have accrued. However, it was required that the competitors for the tendered ferry links should report expected costs or production plans in addition to their bids. This information allows one to compare the planned and actual figures for each tendered link.

[8] In Sunde (2001) it is argued that if two categories of production units are located in separate subsets in the production possibility space, measuring the relative efficiency of the two categories are at best dubious. In order to avoid this pitfall, Sunde (2001) suggests a method to censor the data set for production units that are not comparable to any production units of the opposite category. However, in our case the method is not applicable as there are so few units in one of the categories (tendered links). In other words, there are too few ‘degrees of freedom’.

7 Empirical results

Input-saving measures of efficiency were obtained for each ferry link for the years 1996 and 1998, assuming variable returns to scale and strong disposability. Summary results for the whole sample is presented in table 7.1. For the tendered ferry links, in addition to actual figures reported by the companies, results were also obtained for the figures according to the production plans that were reported by the ferry companies when submitting their bids. These are marked 1998* in the table.

Table 7.1: Summary of efficiency scores: Sample of all types of ferry links.

	Tendered			Non-tendered	
	1996	1998	1998*	1996	1998
Min	55 %	60 %	58 %	48 %	43 %
Average	71,3 %	75,3 %	79,3 %	83,0 %	79,6 %
Max	91 %	100 %	100 %	100 %	100 %
SD	14,8 %	18,0 %	20,8 %	14,2 %	13,9 %
No. of efficient units	0	1	1	8	7
No. of units	4	4	4	59	59

If we look at actual figures, we notice that in 1998, the first business year the tendered links were in operation, the average efficiency for the tendered links was about 75 percent as compared to about 80 percent for the non-tendered ferry links. In other words, the tendered ferry links were about 5 percent less efficient than non-tendered links on average. Thus, on average, the tendered ferry links were outperformed by the non-tendered ferry links, quite contrary to expectations. The same applies to 1996 however, the last business year prior to tendering. In fact, the difference was significantly more pronounced in 1996 as in that year the average efficiency for the tendered links was about 71 percent as compared to 83 percent for the non-tendered ferry links. In other words, the tendered ferry links were about 12 percent less efficient than non-tendered links on average prior to tendering. Thus, although the tendered links have performed worse than the non-tendered links on average, the differences were more pronounced in the year prior to tendering than in the first business year posterior to tendering. This can be measured in terms of the ‘catching up’ part of the Malmquist (1953) productivity index for each production unit (i.e. ferry link). For each production unit, this consists of computing the ratio of the efficiency score obtained for the most recent period (year) to the efficiency score obtained for the least recent period (year), in our case:

$$MC = \frac{E_{1998}}{E_{1996}}$$

where E_{1998} and E_{1996} are the efficiency scores obtained in 1998 and 1996 respectively. If MC > 1, the production unit has become more efficient over time whereas if MC < 1, the production unit has become less efficient over time. If MC = 1, the production unit has become neither more nor less efficient over time. Average figures for MC are reported in table 7.2. As can be seen from the table, on average, MC = 1,06 and MC = 0,96 for tendered and non-tendered ferry links respectively. In other words, tendered links have on average increased their relative efficiency whereas non-tendered links have on average decreased their relative efficiency.

Table 7.2: Average efficiency: Sample of all types of ferry links.

	Not Tendered	Tendered: Actual figures	Tendered: According to bids
E_{1996}	83,0 %	71,3 %	71,3 %
E_{1998}	79,6 %	75,3 %	79,3 %
$MC = E_{1998}/E_{1996}$	0,96	1,06	1,11

Ferry links were also ranked in descending order according to MC. Based on actual figures, the average rank for the tendered links turned out to be 26,5 whereas the average rank for non-tendered links turned out to be 32,4. Thus, tendered ferry links ranked somewhat better than non-tendered ferry links in terms of increase in efficiency over time.

Table 7.2 also reports the findings for the tendered ferry links based on the figures according to the bids submitted by the winning companies. As can be seen, average efficiency for tendered ferry links in 1998 would have exceeded 79 percent, being only slightly less than the corresponding average efficiency for non-tendered links being slightly less than 80 percent. Further, on average, MC = 1,11 for the tendered ferry links as compared to MC = 0,96 for the non-tendered ferry links. In other words, if the ferry links had performed according to the plans reported by the companies, average efficiency would have increased significantly as compared to non-tendered ferry links. This is also confirmed by ranking the links according to MC in which case we obtain an average ranking of 14,5 for the tendered links as compared to an average rank of 33,2 for the non-tendered links.

The sample above includes various types of ferry links, some being simple shuttle services between two ferry-berths while others are more complex services visiting multiple ferry-berth. As the tendered ferry links are all shuttle services or almost shuttle services, efficiency scores were also obtained for a sub-sample including shuttle services or almost shuttle services only. Summary results for this sub-sample is presented in table 7.3. As can be seen by comparing tables 7.2 and 7.3, average efficiency scores are somewhat higher for this sub-sample than for the whole sample as is expected.

Table 7.3: Summary of efficiency scores: Sub-sample of shuttle links.

	Tendered			Non-tendered	
	1996	1998	1998*	1996	1998
Min	55 %	60 %	58 %	52 %	58 %
Average	71,3 %	76,5 %	80,8 %	84,9 %	83,4 %
Max	91 %	100 %	100 %	100 %	100 %
SD	14,8 %	18,4 %	22,4 %	13,6 %	13,7 %
No. of efficient units	0	1	2	8	7
No. of units	4	4	4	33	33

Looking at the efficiency scores for 1996 and 1998 for this sub-sample, the same pattern appears as for the whole sample; cf. table 7.4. That is, on average, the non-tendered ferry links outperforms the tendered ferry links but by more in 1996 than in 1998. Further, while there is a slight decrease in average efficiency from 1996 to 1998 for the non-tendered ferry links, there is an increase in average efficiency for the tendered ferry links. More specifically, looking at the actual figures, MC = 1,07 and MC = 0,98 for tendered and non-tendered ferry links respectively. In other words, tendered links have on average increased their relative efficiency whereas non-tendered links have on average slightly decreased their relative efficiency. Looking at the figures reported in the plans from the winning companies, the difference would have been even more marked as on average, MC = 1,13 for the tendered links.

Table 7.4: Average efficiency: Sub-sample of shuttle links.

	Not Tendered	Tendered: Actual figures	Tendered: According to bids
E_{1996}	84,9 %	71,3 %	71,3 %
E_{1998}	83,4 %	76,5 %	80,8 %
$MC = E_{1998}/E_{1996}$	0,98	1,07	1,13

Ferry links were also ranked in descending order according to MC. Based on actual figures, the average rank for the tendered links was 16,5 whereas the average rank for non-tendered links was 19,3. Based on the figures reported in the plans from the winning companies, the average rank for the tendered links would have been 10,0 whereas the average rank for non-tendered links would have been 20,1. Thus, in terms of increase in efficiency over time, tendered ferry links have ranked better than non-tendered ferry links.

Our main finding is thus that although on average the tendered ferry links have performed worse than their non-tendered counterparts, the former links have increased their average performance over time as opposed to the latter links showing a slight decrease in average efficiency over time. In order to test whether this difference in performance over time is significant, non-parametric Mann-Whitney (or Wilcoxon) rank tests were applied. Based on actual figures, tendered links were not found to perform significantly better than their non-tendered counterparts over time. Based on the figures obtained from the production plans reported by the winning companies however, tendered links would have performed significantly better than their non-tendered counterparts if the plans had been fulfilled. The level of significance is 0,05 (5 %) and 0,10 (10 %) for the whole sample and the sub-sample respectively.

Our conclusion is thus that if the tendered links had performed according to the plans, tender competition would have had a statistical significant positive effect on internal or X-efficiency. The tendered links did not perform as well as planned however. Although the tendered links experienced an increase in efficiency whereas the remaining non-tendered links experienced a slight decrease in efficiency, the results were not statistically significant. It should be kept in mind however that the number of ferry links being exposed to tender competition is quite small.

8 Concluding remarks

Following an amendment of the transport act in 1994, six ferry links have been exposed to tender competition. Four of these were exposed to tender competition during 1996, operations starting during 1997. Operations of the remaining two links have started only recently.

Although subsidies have increased somewhat, there have been major improvements in the quality of services such as increased capacity, new ferries, increased frequencies and extended opening hours. A rough estimate of the additional production costs associated with these major improvements in the quality of services indicates that the tender competitions have produced significant cost savings. In addition, such improvements add benefits to the users, albeit not being estimated. Further, it has been a "winners curse" game providing a yardstick for the remaining ferry sector not being exposed to tender competition so far.

We have performed a DEA study of a sample of ferry links for which reliable data were obtainable. Based on efficiency scores for the year prior to tendering (1996) and the year posterior to tendering (1998), an index measuring relative improvements in efficiency over time was calculated for each individual ferry link. For the tendered ferry links being in operation in 1998, results were obtained both for the actual figures and for the figures obtained from the production plans reported by the companies ex post. It turned out that if the tendered links had performed according to the plans, tender competition would have had a statistical significant positive effect on internal or X-efficiency. The tendered links did not perform as well as planned however. Although the tendered links experienced an increase in efficiency whereas the remaining non-tendered links experienced a slight decrease in efficiency, the results were not statistically significant. Thus, the companies seems to have been too optimistic when submitting their bids. It should be kept in mind however that the number of ferry links being exposed to tender competition is quite small.

Looking ahead, a major threat for the success of future tender competitions is the possible lack of competition. While competition seems to have been present in the previous tender competitions, several of the major ferry companies are now considering merging. Such mergers into larger companies may impede competition through collusion. The Norwegian ferry sector may be expected to be particularly vulnerable to such mergers as the operations of these kinds of ferry services may be considered to be distinctively Norwegian so that the threat of competition from companies from abroad may be expected to be weak or even absent. In other words, the Norwegian ferry sector may not be contestable.

Concerning future tender competitions, a major challenge concerns the exploitation of possible economies of scale and scope in the ferry sector.[9] If present, such economies calls for tendering bundles of ferry links rather than individual links. This necessitates the composition of optimal bundles. However, the ferry companies are presumably better informed than the authorities in this respect. Rather than defining (possibly non-optimal) bundles prior to the tender competition, Brewer & Plott (1996) and Milgrom (1997) suggests that the bidders should be allowed to make bids on bundles composed by themselves. As the composition of bundles is not co-ordinated, the bundles are not necessarily compatible with each other. Brewer & Plott (1996) and Milgrom (1997) suggest multi-stage auctions in order to cope with this problem. Despite being a fascinating solution to the problem of optimal bundling, the theory has revealed that free-rider problems may arise that may preclude optimal bundling.

While tender competition has been introduced in order to enhance internal or X-efficiency ('doing things right'), there has been a growing concern for allocative efficiency ('doing the right things'). For instance, Larsen (1999) considers the design of proper regulations in order to induce public transit companies to provide optimal public transit services.[10] In a pioneering study however, Demsetz (1968) raised the provocative question 'Why regulate utilities?' and suggested that regulations should be replaced by tender competitions in order to enhance (second best) allocative efficiency (in addition to internal or X-efficiency). More specifically, Demsetz suggested that the company offering to meet the demand at the lowest possible price should be awarded the monopoly franchise. Despite being a fascinating solution, it is not straightforwardly applicable. For instance, picking a winner is not straightforward

[9] A possible source of economies is the need for spare ferries. As breakdowns in several ferries at the same time is rather unlikely, it is optimal for a bundle of ferry links to share a spare ferry.

unless efficiency calls for a uniform price. More specifically, in scheduled transport services the quality of the services (such as operating hours, frequency etc.) might be just as or even more important for allocative efficiency than are prices. Thus, one should consider tender competitions in which companies are given the discretion to specify the public transit services that are to be provided. In this respect, a major challenge is to design proper yardsticks that enhance allocative efficiency.

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[10] Such incentive schemes have recently been introduced in Norway; see Larsen (2001) and Carlquist (2001).

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