USING STANDARDIZED REVENUE- AND COST NORM ANALYSES TO REVEAL SUBSIDY FRAUD IN CONTRACTED PUBLIC TRANSPORT SERVICES[1]

Finn Jørgensen[2] and Terje Andreas Mathisen
Bodø Graduate School of Business
NO-8049 Bodø, Norway

E-mail: finn.jorgensen@nord.no
terje.a.mathisen@nord.no

Post print version of:
Jørgensen, F. and Mathisen, T. A. (2010) 'Using Standardized Revenue and Cost Norm Analyses to Reveal Subsidy Fraud in Contracted Public Transport Services', Transport Reviews, 30: 3, 299 — 313. DOI: 10.1080/01441640902986866.

ABSTRACT

In 2004 one of the biggest ferry operators in Norway was found guilty of having intentionally attempted to defraud the state of about NOK 113 million in subsidies by underreporting revenues and overstating costs during the period 1992-2002. The company and five of the top managers were convicted and the case was regarded as one of the most serious subsidy offences ever committed in Norway. The aim of this article is to show that standardized revenue– and cost norms models from the state can deter operators from committing such offences and when relevant detect the fraud attempts at an early stage. Our model suggests that the operator in question overstated costs by about 19 per cent and that the actual subsidy fraud attempt was about three times higher than concluded by the Court.

Keywords: Cost models, ferry transport, revenue models, subsidy fraud

1. INTRODUCTION

In Norway, as in many other countries, the public transport authorities' pecuniary compensation to the operators for running scheduled transport on non-profit routes is based on expected total operating costs (gross contracts) and expected subsidy needs (net contracts). The subsidies given to each operator are determined either through negotiations or competitive tendering. According to Bekken et al. (2006) net contracts constituted 90 per cent of all bus services procured on a negotiated basis in Norway in 2005 whilst tendering usually implies gross contracts. Even though competitive tendering has gradually become more popular for the provision of transport services in Norway (Mathisen and Solvoll, 2008), negotiations still play a major role. The negotiations between the operators and the authorities are partly based on every operator's reported revenues and costs, and partly on standardized revenue- and cost models (SRC-models) developed by the authorities. As far as the local bus and fast craft services are concerned, net contracts have been used and the operators have received their subsidies from the county councils. To our knowledge neither county has developed SRC-models for fast craft transport, but such models became increasingly more important for bus transport during the 1980's.[3] In 1991, for example, 10 of the 19 county authorities in Norway actively used SRC-models during negotiation processes with bus operators (Jørgensen et al., 1995).

Net contracts have been used in the Norwegian ferry industry since 1990, but, in contrast to bus and fast craft operations, the majority of ferry operators receive their subsidies from the Directorate of Roads (DR). DR does not use SRC-models at all when negotiating with a ferry operator, but instead uses the operators' reported accounting figures as basis for the negotiations. This means that DR (the regulator) possesses far less knowledge than the ferry operators (agents) about how different factors influence subsidy needs. Due to this asymmetric information, DR probably stands out as the weak part in the negotiation process, because a fair distribution of subsidies presupposes honest operators.

The direct relationship between the subsidy level on the one hand and reported operating costs and revenue on the other hand, encourages the operators to overstate costs and to understate revenues with the aim of increasing the subsidy grant. The less the operators perceive that DR knows about their true costs and revenues, the less they perceive the probability of being detected if giving incorrect information and, consequently, the more tempting they find it to swindle DR. When the ferry operators, on the other hand, know that the authorities possess accurate knowledge about the industry's revenue- and cost structure through SRC-models, they are less likely to report inaccurate values because they perceive the probability of detection as being high. Consequently, the use of SRC-models does have a deterrent effect. [4] It is also worth noting that SRC-models are useful for the authorities under a tendering regime; the models enable them to weed out unrealistic tenders and thus reduce the problem of the "winners curse". The models will, thus, encourage transport operators to submit thoroughly prepared tenders.

Even though many ferry services in Norway have been replaced with bridges and tunnels in the last two decades, the ferries still play an important function in the transport infrastructure in coastal areas. In 2007, there were 130 ferry services in Norway operated by 18 shipping companies which have in total about 180 ferries at their disposal. These ferries carried the same year nearly 20 million vehicles and over 21 million passengers (excluding car drivers). 74 of the 130 ferry services are connecting islands to the mainland whilst 56 are crossing fjords. About 20 per cent of the services imply that the ferries have to pass unsheltered stretches of open sea. The costs of operating the ferry services were in 2004 about 2900 Norwegian kroner (NOK) [5] and the revenue from passengers and vehicles was about 1300 million NOK. This resulted in subsidy requirement of 1600 million NOK (Jørgensen et al., 2005). For a more thorough review of the cost structure of the Norwegian ferries, we refer to Jørgensen et al. (2004) and Mathisen (2008).

The importance of the ferry sector in the Norwegian transport system combined with high subsidy transfers to the sector, resulted in great media publicity when it was disclosed in November 2002 that one of the largest ferry companies in Norway, Ofoten og Vesteraalens Dampskibsselskab ASA (OVDS), had intentionally manipulated its accounting figures and in this way defrauded DR of several million NOK during the period 1994-2002. The aim of this article is to use the OVDS case to demonstrate how the use of simple SRC-models could have disclosed significant deviations from expected revenues and costs so that the subsidy fraud could have been revealed and hindered.

The structure of the article is as follows. In section 2 we briefly review the OVDS-case. Section 3 presents our data sources and develops simple revenue- and cost models to illustrate how use of them could have revealed the fraud. In section 4 we briefly compare our results with the court's verdict. Finally, in section 5 we offer some concluding remarks.

2. THE OVDS CASE AND TRIAL

In July 2002 a former managing director in OVDS hinted to DR that he and other top managers in OVDS had swindled them for years by manipulating the company's accounting figures. In practice, the company operated with two sets of accounts, making it difficult to reveal the fraud both for the auditor and the transport authorities. This resulted in DR in November 2002 made a formal complaint to the Norwegian National Authority for Investigation and Prosecution of Economic and Environmental Crime (ØKOKRIM) putting the case that OVDS had manipulated its accounting figures for over a decade. ØKOKRIM continued the investigation and decided to charge OVDS for subsidy fraud. The offence was soon characterized as the worse subsidy fraud ever committed in Norway, and the case received, as mentioned earlier, extensive media publicity. For a more thorough description of the verdict, we refer to Salten District Court (2004).

When the Court passed judgement in August 2004, the company was found guilty of having reported too low revenues and too high costs, in total amounting to 8.6 million NOK and 104.4 million NOK, respectively, during the period 1992-2001. The company, thus, had the intention of defrauding DR for subsidies amounting to about 113 million NOK (139 million NOK in 2006 prices) in which overstatement of costs amounted to approximately 92 per cent. Measured in 2006 prices, the Court found the overestimation of subsidy needs to vary from about 7.7 million NOK in 1998 to about 21 million NOK in 1995. In comparison, OVDS's total yearly costs and ticket revenues of running all its ferry services amounted to about 200 million NOK and 90 million NOK, respectively, in 2006 prices. The Court estimated the amount of swindle attempts for every year by comparing the reported revenue, cost and traffic figures to DR for year t with the company's public financial statement for year t. The latter figures are approved by an external auditor.

One important question which the Court needed to address was to what extent the incorrect reported accounting figures had influenced the negotiations, and thereby the subsidy given to OVDS. The counsel of the defence for the ferry company put forward the argument that if the incorrect reported figures did have a great impact on the negotiation results, DR must have had poor management control systems - since they were not able to reveal and hinder the fraud at an earlier stage. In fact, if a former top director had not informed of the fraud, it is uncertain whether the offence would ever have been discovered. The defenders continued the company's defence by arguing that clearly, the absence of use of SRC-norms and/or incomplete such norms, did not enable DR to check for and react on significant deviations in reported revenue- and cost figures. Consequently, the more influence OVDS's manipulated accounting figures had on the outcome of the negotiations, the poorer was DR's control system. DR could, thus, not at the same time argue that the misreported figures had a great impact on the subsidy given, and that they did indeed have a proper management control system.

The Court finally decided that yearly increase in subsidies given to OVDS due to incorrect reported accountant figures amounted to about 70 per cent of the overstated subsidy needs.[6] The judgement cost OVDS in total about 72 million NOK, of which 6.3 million NOK were fine and legal costs and 65.7 million NOK was compensation to the state. All five members of the top management were indicted for having participated in the fraud. They admitted that their actions had led to incorrect reported revenue- and cost figures, but only two of them said that they had done this intentionally. Despite this, all were found guilty of subsidy fraud and imprisoned for periods ranging from 9 months to 42 months, with the unconditional imprisonment period varying from 3 months to 16 months.

The enforcement authorities preferred, thus, to penalize both the company (shareholders) and the top managers. To our knowledge, this was the first time in Norway that members of a company's top management have been imprisoned, even though the court could not prove that they had directly benefited personally. The verdict was therefore of great interest among the lawyers, in that it might offer precedence for similar cases in the future. Whether the enforcement authorities' best strategy is to penalize the company rather than the employees in order to prevent corporate crime is an important issue in the theoretical literature on the economics of crime, see for example Alexander (2004).

3. THE REVENUE- AND COST MODELS

3.1 The Revenue Models

Let the annual fare revenues obtained from passenger and vehicle transport from ferry service i (R_{ip} and R_{iv} respectively) be specified by the following linear functions:

(1) $$R_{ip} = a_{0p} + a_{1p}P_i + a_{2p}(P_i X_{i2}) + a_{3p}D_{i1} + q_i\,,\ (i = 1,..,N)\ \text{and}$$

(2) $$R_{iv} = a_{0v} + a_{1v}X_{i1} + a_{2v}(X_{i1}X_{i2}) + a_{3v}D_{i1} + u_i$$

in which N is the number of services. X_{i1} and P_i represents the number of passenger car equivalents (PCE) and the number of passengers transported over service i, respectively. PCE is a compound measure using one passenger car shorter than 6 meters as numeraire.[7] X_{i2} is the length of service i. Consequently, $(X_{i1}X_{i2})$ and (P_iX_{i2}) denote the number of PCE-km and passenger-km travelling on service i, respectively. D_{i1} describes whether service i is run by OVDS (D_{i1} = 1) or not (D_{i1} = 0). Finally q_i and u_i are random error terms which are assumed to have traditional properties; expected value of zero and normally and independently distributed.

According to the Norwegian ferry fare system for passengers and cars decided by DR and described in Jørgensen et al. (2004), fares are strictly regulated according to a nationwide scheme and cross-subsidy between services or vehicle categories is not allowed. It is, thus, reasonable to assume a positive linear relationship between revenues on the one hand and the above production measures on the other hand where a_{0p}, $a_{0v} \approx 0$ and a_{1p}, a_{2p}, a_{1v}, $a_{2v} > 0$. Even though the fare schemes imply a close relationship between revenues and the productions measures in (1) and (2), there are some stochastic effects arising from inaccurate revenue reports from the ferry companies and from the fact that the proportion of discounted fares may vary across ferry services. Moreover, according to the court's conclusions, OVDS understated revenues during the period 1992-2001 except for the years 1996, 1999 and 2000. This indicates that $a_{3p} = a_{3v} = 0$ for these three years and $(a_{3p} + a_{3v}) < 0$ for the other years.[8] After the point in time that OVDS became suspected of subsidy fraud, it is reasonable to assume that the company stopped committing such offences implying that $a_{3p} = a_{3v} = 0$ after 2002.

3.2 The cost model

In accordance with Jørgensen et al. (2004), we assume that the cost structure of the ferry industry can be specified by the following modified translog cost function:[9]

$$\begin{aligned}(3)\qquad \ln C_i &= b_0 + b_1(\ln X_{i1} - \mu_1) + b_2(\ln(X_{i1}X_{i2}) - \mu_2) \\ &+ b_3(\ln X_{i1} - \mu_1)^2 + b_4(\ln(X_{i1}X_{i2}) - \mu_2)^2 + b_5 D_{i1} + b_6 D_{i2} + v_i\end{aligned}, \ (i = 1,...,N)$$

in which N represents the number of services and C_i represents the annual total costs reported from the ferry operators to DR for running service i. Since our estimation of the cost function is based on the ferry companies' reported costs, we also introduce the dummy variable D_{i1} in the model in order to take into account whether the costs data relates to OVDS (D_{i1} = 1) or not (D_{i1} = 0). Because all services are operated on contracts given by DR according to the ferry standard, there is no reason to believe that other factors such as differences in quality or safety should distinguish the ferry companies. Also, there are no indications that costs of input factors such as salary and fuel are unevenly distributed throughout the country. D_{i2} is a dummy variable where D_{i2} = 0 if the service i is located in sheltered waters, whereas D_{i2} = 1 if the service runs in unsheltered stretches of open sea. μ_1 and μ_2 are the averages of the natural logarithms of PCE-units and PCE-km, respectively, and are defined as follows:

$$\mu_1 = \frac{1}{N}\sum_{i=1}^{N} \ln X_{i1}\ , \ \mu_2 = \frac{1}{N}\sum_{i=1}^{N} \ln(X_{i1}X_{i2})$$

Finally v_i is a random error term assumed to possess the same standard properties as q_i and u_i in (1) and (2).

It is worth noting that $100b_5$ and $100b_6$ denote the percentage changes in costs when D_{i1} and D_{i2} increase from 0 to 1, respectively, see for example Sydsæter and Hammond (1995). If the

authorities' accusations made against OVDS were correct, $b_5 > 0$ before 2002, whereas $b_5 \approx 0$ after the fraud was detected, providing that OVDS operates approximately as effectively as the other ferry companies. Since technical and safety demands for ferries operating in unsheltered stretches of open sea are considerably higher than for those only sailing in sheltered waters, it is reasonable to assume that $b_6 > 0$.

Furthermore, it can be deduced from (3) that if the marginal costs for the ferry operators of carrying one PCE are positive and increase with trip length ($\partial C_i / \partial X_{i1}$, $\partial^2 C_i / \partial X_{i1} \partial X_{i2} > 0$), it follows that b_2, $(b_1 + b_2) > 0$. It remains, however, difficult to produce unambiguous statements regarding the signs of b_0, b_1, b_3 and b_4, see Jørgensen et al. (2004) for a more thorough discussion.

3.3 Data sources

Our analysis is based on reported accounting and output data from ferry services operated by 21 ferry companies from 1996 to 2000, and from 2003 to 2005. The data set, thus, includes observations for 5 years before and for three years after OVDS's fraud was disclosed.[10] Except for one service in which two of the ports of call are situated near each other and far away from the third port, we have omitted the services with more than two ports of call. The reason for doing this is that the reported value of average trip length per PCE (X_{i2}) is rather inaccurate for such services. Moreover, we have omitted services in year t which were discontinued during year t. This implies that our data set contains about half of the total number of ferry services in Norway.

(Insert Table 1 about here)

Table 1 shows that the yearly number of services included in the data set has fallen from 67 in 1996 to 51 in 2005. This is mainly caused by a reduction in the number of ferry services in

Norway during this period. Revenues from passenger transport stand for about 28 per cent of total revenues. The average length of the ferry services has remained fairly constant at about 8 km during the 9 year period. During the same time period the average values of costs and PCE have increased steadily, indicating greater transport activity on the services over time. It is also worth noting that OVDS runs 12 ferry services in total and that the data set contains the same 6 OVDS services for all years. The proportion of OVDS services varies, thus, from 9 per cent in 1996 to 12 per cent in 2005. Furthermore, Table 1 shows that the proportion of services whose ferries operate in unsheltered stretches of open sea varies from 18 per cent to 23 per cent.

3.4 Estimation results

3.4.1 The revenue models

Estimating the linear revenues models (1) and (2) using OLS produced residual plots and standard tests which did not meet the desired standard properties fully; their expected values are zero but some heteroskedasticity does occur. Trying standard remedies to moderate this problem by deflating the equations by one of the explanatory variables (see for example Maddala (1992)) did not help much. Despite this, F-values and adjusted R^2 values above 400 and 0.95 respectively for all years indicate that the models do capture well the variations in revenues from passenger and vehicle transport among the ferry services, see Table 2 and Table 3. A further examination of the results shows that a_{0p} and a_{0v} are not different from zero at a 10 per cent significance level, whilst a_{1p}, a_{2p}, a_{1v} and a_{2v} are all highly significantly positive for all years. The findings do thus support our a priori assumptions.

As far as the OVDS verdict is concerned, the estimated values of a_{3p} and a_{3v} are not significantly different from zero for any years. More importantly, neither a_{3p} nor a_{3v} are significantly negative in 1997 and 1998; that is for the two years in our data set for which OVDS was accused for revenue underreporting. This means that our results do not indicate that OVDS has understated revenues during the period in question on the six services in our

data set. Since the Court did not take into consideration whether OVDS underreported revenues to a larger extent on some services than others, one reasonable conclusion is, then, that our estimations are in accordance with the Court's conclusions for the years 1996, 1999 and 2000, but in conflict with the verdict for the years 1997 and 1998. It is, however, worth noting that according to the accusation brought against OVDS, the magnitudes of the revenue manipulation were small; they stand for only 4.6 per cent of the overstating of subsidy needs for these two years.

(Insert Table 2 about here)

Besides the standard properties with error terms not being fully met, let us finally mention another possible weakness with our revenue model: We have not accounted for the proportion of discounted fares on different services. This proportion is likely to vary significantly between ferry services, being highest on services with many regular travellers. If, for example, OVDS has a relatively high proportion of full fare payers, this pulls in the direction of high revenues in OVDS. This implies that our model can underestimate OVDS's true revenues, and thus is unable to reveal understated revenues. One important fact making the occurring of this reasoning less likely is, however, that the estimated values of a_{3p} and a_{3v} are not significantly positive for the years 2003, 2004 and 2005; that is after OVDS's fraud was detected. If OVDS reported correct revenues after incurring suspicion and had a higher proportion of full fare payers on their services than other operators, a_{3p} and/or a_{3v} should have been significantly positive for these years.

(Insert Table 3 about here)

3.4.2 The cost model

Estimating the translog cost function in (3) using OLS showed that b_3 did not significantly deviate from zero for any year. We therefore removed the squared explanatory variable

accompanying b_3 and re-estimated the model without this variable. A thorough analysis of the residuals, $u_1 \ldots u_N$, shows that they have the desired statistical properties. This, in combination with the high values of F and adjusted R^2 shown in Table 4, indicates that the model has a good fit and is well suited to explain the variations in costs amongst ferry services. The model coefficients are positive and generally significant. It is worth noting that our presumptions that b_2, $(b_1+b_2) > 0$ are verified at a 1 per cent significance level for all years. Also the coefficient related to the types of waters in which ferries operate (b_6) is significantly different from zero at a 10 per cent level or better except for the year 1996. Simulations show that the estimated b-values imply that marginal costs increase slightly concavely according to trip length ($\partial(\frac{\partial C_i}{\partial X_{i1}})/\partial X_{i2} > 0, \partial^2(\frac{\partial C_i}{\partial X_{i1}})/\partial X_{i2}^2 < 0$) and that marginal cost per distance transported is decreasing in distance ($\partial(\frac{\partial \mathrm{C_i}}{\partial \mathrm{X_{i1}}} / X_{i2})\partial X_{i2} < 0$) . The latter is due to the distance independent costs elements related to turn – arounds being distributed on more km. Similar results are found in Jørgensen et al. (2004).

(Insert Table 4 about here)

Most interesting is, however, that the estimated value of the parameter which indicates whether OVDS has reported too high costs to the authorities or not (b_5), generally supports our a priori assumptions; its estimated value is positive for all years between 1996 and 2000 and significant at a 10 per cent level or better.[11] The value of b_5 varies from 0.13 in 1998 to 0.25 in 1997 with an average of 0.19 between 1996 and 2000. This means that the reported costs for these six services run by OVDS were on average about 19 per cent higher ($100b_5$ denotes percentage difference) compared to the reported costs for comparable services run by other operators. After the fraud was detected, that is for the years 2003, 2004 and 2005; Table 4 shows that $b_5 \approx 0$ implying that the reported costs for the OVDS services corresponded to the reported costs for similar services run by other companies.

It is expected that $b_5 > 0$ before 2001 since OVDS officially admitted having conducted fraud. One central question is, of course, whether all OVDS' higher reported costs related to the b_5 parameters for the period 1996-2000 are purely fraud-connected. The higher reported costs in this period could also be due to the company working under harder external conditions or being run less efficiently than other Norwegian ferry companies.

When it comes to external working conditions, it should be noted that the Norwegian ferry industry is strictly regulated by the authorities with respect to safety and service on different ferries. There are also national standards regarding the necessary number of crewmen onboard. Moreover, there are no indications that prices of input factors are unevenly distributed throughout the country; the prices of important inputs such as salary and fuel are, for example, the same all over the country. This indicates limited variations in salaries and fuel in total amounting to about 60 per cent of total ferry costs (depreciation included). Summing up, neither of these factors point in the direction of higher reported costs in OVDS due to the company running under different working conditions than other Norwegian ferry operators.

Several factors also indicate that the internal efficiency of OVDS is not substantially different from other ferry operators. Firstly, national staff qualification requirements ensure that the crewmen are equally skilled in all companies. Secondly, available figures from 1995 and 2003 indicate that the development in the ferries' load factor, defined as the number of PCE-km ($X_{i1}X_{i2}$) over the number of sailed PCE-km, has been approximately the same for OVDS as for other ferry companies. Consequently, the development in ferry capacity utilization when sailing, should not cause any significant improvement in OVDS's efficiency compared to other ferry operators. Finally, as commented on later, the dummy variable (b_5) does not show any significant time pattern from 1996 to 2000. Hence, if the change in b_5 from the period 1996-2000 to the period 2003-2005 was due to improved internal efficiency, the

company must have achieved productivity improvements of about 19 per cent compared to other ferry operators during the period 2000 - 2003. The reported costs of running OVDS's services after 2002 correlated namely well with the costs of running comparable services in other companies ($b_5 \approx 0$). Such a productivity improvement in OVDS seems very unlikely. In fact the negative media focus and attention related to the lawsuit created a lot of anxiety amongst company employees. This would be more likely to demoralise them than boost their efficiency considerably.

Summing up, even though this cannot be unambiguously concluded, the arguments support the interpretation that the higher costs indicated by the OVDS dummy variable manifest fraud (overstated costs) during the time period 1996-2000. This means that the estimated values of $100b_{5t}$ (t = 1996 – 2000) show OVDS's actual overstating of costs in year t, measured in per cent. Some variation in b5 does show between 1996 and 2000, but the estimated value of b_5 only deviates in the year 1998 from the mean for all years using a significance level of 10 per cent or better. Hence, we cannot conclude at a reasonable level of significance that OVDS's overstating of costs is different for the years 1996, 1997, 1999 and 2000.

Based on the above reasoning, the magnitudes of the overstated costs in year t for all the 6 OVDS services included in our data set (OC_t) can be estimated using the following formula:

$$(4) \qquad OC_t = \frac{C_t \cdot b_{5t}}{1 + b_{5t}}$$

in which C_t represents total reported ferry costs for the 6 services from OVDS to the authorities.[12] As Table 5 shows, the total overstatement of costs from OVDS for these 6 services in question, measured in 2006 prices, varies from 14.6 million NOK in 1998 to 25.4 NOK million in 1997. Over this five year period (1996-2000) total overstatement, thus, amounts to over 103 million NOK, measured in 2006 prices. Additionally, using the estimated

standard deviations of b_5 and the relationship between OC_t and b_5 in (4), 90 per cent confidence intervals of b_5 and OC_t are given in Table 5. The lowest values of the confidence intervals of b_5 and OC_t are positive for all years except 1998 where the significance of b_5 is low. As an approximation, the confidence interval of OC_t derives a 90 per cent probability that the annual overstatement of costs lies between 4 million NOK and 35 million NOK for the years 1996, 1997, 1999 and 2000.

(Insert Table 5 about here)

4. COMPARING THE MODEL RESULTS WITH THE COURT'S VERDICT

Since the revenue models did not provide significant values of the parameter indicating whether or not OVDS has understated revenues (a_{3p} and a_{3v}) for any year, we have disregarded their estimated values in Table 6.

As previously emphasized, the verdict provides no information about whether OVDS's defraud attempt was linked to particular services or not. In the following calculations, we therefore assume that OVDS overstated the costs for the other ferry services with the same percentage as for those included in our data set. Furthermore, the total reported costs of running all the 12 OVDS's services are estimated to be about 60 per cent higher for every year than for those services included in the data set.[13] It follows then that OVDS's total overstatement of costs, TOC_t, for every year t in Table 6 can be found by multiplying the figures in Table 5 by 1.60.

Table 6 shows, that our model estimations indicate far higher figures of overstated costs for all years than the Court did. Except for the year 1998, we can conclude that the Court's verdict gives too low subsidy fraud amounts at 7 per cent significant level or better. The overstatement of costs during the period 1995-2000 amounts to 165 million NOK. These

estimations are over 3 times as high as the Court's estimates. A closer look at the figures in Table 6 shows that the annual correlation between the magnitudes of the Court's and the model's estimates of cost overstatement are low; relatively speaking the differences in these estimates are highest for the years 1996 and 1997.

(Insert Table 6 about here)

The critical question is, of course, whether OVDS overstated the costs for the other ferry services with about the same percentage as for those included in our data set. We find no reason to believe that OVDS's reporting procedures have differed to any great extent for these two groups of ferry services. If so, the Court has greatly underestimated the magnitudes of OVDS's cost manipulations. In this respect, it is worth noting that, according to accepted juridical and accounting principles, the defendant can only be found guilty for amounts which the Court can prove without doubt. This suggests lower estimates than we have found.

5. CONCLUDING REMARKS

The aim of this article is to demonstrate how the use of standardized revenue- and cost norm models based on the transport operators' reported accountant figures to the authorities can be used to reveal inaccurate information from the transport operators. The article uses the accusation against one of the biggest Norwegian ferry company (OVDS) as a starting point. OVDS was accused of intentionally having understated revenues and exaggerated costs during the period 1992-2001, in this way attempting to swindle the state for 113 million NOK or 139 million NOK in 2006 prices. The Court concluded that OVDS's overstatement of subsidy needs has probably resulted in granting the company about 63 million NOK too much in subsidies (about 75 million NOK in 2006 prices) up to 2002. When the Court

proceedings finished in 2004, the verdict concluded that OVDS should pay back 72 million NOK and five of the top managers were in addition given prison sentences.

Our analysis shows no indications that OVDS had understated revenues for any year between 1996 and 2000, whilst the Court concluded that such offences had also taken place for the years 1997 and 1998. Hence, as far as manipulation of revenue figures is concerned, our results conflict with the Court's verdict for these two years. The planned introduction of electronic tickets (AUTOPASS) on the Norwegian ferries will report the traffic figures automatically and can be a means to meet possible fraudulent accounting of revenues.

According to our model, OVDS's reported costs during the period 1996 – 2000 were between 13 per cent and 25 per cent higher than for comparable services in other ferry companies. After the company was suspected for subsidy fraud in 2002, its reported costs were, however, the same as for other ferry companies. Higher reported costs during 1996 – 2000 could be due to overstatement of costs, harder working conditions or company specific inefficiency. Even though there is strong evidence to support the arguments that both external working conditions and internal efficiency have been similar for OVDS and other ferry companies, it is impossible to conclude unambiguously that all costs indicated by the OVDS dummy variable from 1996 to 2000 are due to fraud. Taking all the arguments above into account, our analysis supports the verdict reached that such offences have indeed taken place during the period 1996-2000.

If we accept that OVDS's higher reported costs are due to fraud and that OVDS also used the same reporting procedures for the services not included in our data set, the company attempted to swindle the state for about 165 million NOK in 2006 prices during the five year period from 1996 to 2000. Even though our model acquits OVDS for revenue understatement, the magnitude of the swindle attempt in our model is over 3 times higher than the conclusions given in the court verdict.

It is also important to note that we only compare the court's conclusions with revenue- and cost models for the five year period 1996 – 2000. According to the verdict, the subsidy fraud attempted in this period accounts for only about 38 per cent of the total fraud attempt. Bearing this and the results in Table 6 in mind, this indicates that the subsidy amount actually received illegally by OVDS far exceeded the sum of 63 million NOK estimated by the Court.

Summing up, if the authorities had used a similar cost model presented in this article when negotiating with the ferry companies, the partners would have had less asymmetric information about the cost structure in the ferry industry, and the authorities would most likely have been able to reveal OVDS's fraud attempt at an earlier stage. Moreover, when the ferry operators know that their negotiators use such models, they are less likely to manipulate the accounts. In this way, such models have a significant deterrent effect.

ACKNOWLEDGEMENTS

We would like to thank the Editor and anonymous referees of this journal for their valuable comments.

NOTES

1. This article is a revised version of a paper presented at the European Transport Conference 2007.

2. Author for correspondence: Tel. +47 75 51 76 84, Email: finn.jorgensen@nord.no.

3. Before 1981 the county authorities balanced the bus- and fast craft operators' accounts and before 1990 DR balanced the ferry operators' accounts. Such payment procedures gave the operators few incentives to run their business efficiently.

4. Suppose P, F and EF = P·F denote the probability of being detected, the level of fine and expected fine, respectively. For a risk neutral operator the deterrent effect can be measured

by the expected penalty alone, see for example Polinsky and Shavell (2007). It follows that $(\partial EF / \partial P) = F > 0$ and $(\partial EF / \partial F) = P > 0$. P and F are thus complementary deterrent means; the higher the value of one of them, the more deterrent effect has a change in the other one.

5. 1€ ≈ 9 NOK

6. The verdict does not specify the details behind the calculation of 69.6 per cent, but argues that it is a well founded approximation of the misreported accounting figures influence on subsidies because it is based on extensive studies of costs and revenues in combination with statements from witnesses.

7. A detailed description of the PCE production measure is given in Solvoll (1997).

8. The Court did not specify whether OVDS underreported revenues from passenger transport or from vehicle transport.

9. For discussions of cost functions in transport, see for example Braeutigam (1999), Pels and Rietveld (2000) and Hensher and Brewer (2001).

10. We possess no available data before 1996 and for the years 2001 and 2002.

11. Note that the significance for b_5 is given according to the assumption in section 3.2 using a one-sided test for the years 1996-2000 and a two-sided test for the years 2003-2005.

12. Let C_t^* be the true costs for OVDS in year t. This implies that $C_t = (1 + b_{5t})C_t^*$ such that

$$OC_t = (C_t - C_t^*) = \frac{C_t b_{5t}}{(1 + b_{5t})}.$$

13. This means that the reported costs of running the 6 ferry services included in our data set account for about 60 per cent of OVDS's total reported ferry costs.

REFERENCES

Alexander, C. R. (2004) Corporate crime, markets and enforcement: a review, in H. Sjögren and G. Skogh (Eds.), New perspectives on economic crime, pp. 20–41. (Cheltenham: Edward Elgar Publishing Ltd.).

Bekken, J.-T., Longva, F., Fearnley, N. and Osland, O. (2006) Norwegian experiences with tendered bus services, European Transport, 33, pp. 29-40.

Braeutigam, R. R. (1999) Learning about transport costs, in J. A. Gomez-Ibanez (Ed.), Essays in transportation economics and policy: A handbook in honor of John R. Meyer, pp. 57–97. (Washington DC: Brookings Institution Press).

Hensher, D. A. and Brewer, A. (2001) Transport: an economics and management perspective. (Oxford: Oxford University Press).

Jørgensen, F., Pedersen, H. and Solvoll, G. (2004) Ramsey pricing in practice: the case of the Norwegian ferries, Transport Policy, 11(3), pp. 205–214.

Jørgensen, F., Pedersen, P. A. and Solvoll, G. (1995) The costs of bus operations in Norway, Journal of Transport Economics and Policy, 29(3), pp. 253–262.

Jørgensen, F., Solvoll, G. and Welde, M. (2005) Kystdistriktene tjener på gratis ferje. (In Norwegian), Samferdsel, 44, pp. 4-5.

Maddala, G. S. (1992) Introduction to econometrics, (2nd ed.). (New York: Macmillan).

Mathisen, T. A. (2008) Marginal Costs and Capacity Utilization: Calculating Short-Run, Medium-Term, and Long-Run Marginal Costs in the Ferry Industry, International Journal of Transport Economics, XXXV(3), pp. 373-389.

Mathisen, T. A. and Solvoll, G. (2008) Competitive tendering and structural changes: an example from the bus industry, Transport Policy, 15(1), pp. 1-11.

Pels, E. and Rietveld, P. (2000) Cost functions in transport, in K. Button and D. A. Hensher (Eds.), Handbook of transport modelling, Vol. 1, pp. 321–333. (Amsterdam: Pergamon).

Polinsky, A. M. and Shavell, S. (2007) The theory of public enforcement of law, in A. M. Polinsky and S. Shavell (Eds.), Handbook of law and economics, Vol. 1, pp. 403–454. (Amsterdam: Elsevier).

Salten District Court (2004) Judgement in case 03-1130 M and case 04-701 M. (Bodø, Norway: Salten District Court).

Solvoll, G. (1997) Takstsystemet på riksvegferjene. (Fare scheme for the Norwegian ferry industry). In Norwegian. Report no. 20/1997, (Bodø: Nordland Research Institute).

Sydsæter, K. and Hammond, P. J. (1995) Mathematics for economic analysis. (Englewood Cliffs, N.J.: Prentice Hall International).

Tables

Table 1. Descriptive statistics for all services in the data set for the years 1995-2005. Costs and revenues are reported in 2006 prices.

Year		1996	1997	1998	1999	2000	2003	2004	2005
No. Observations, N		67	67	66	61	57	57	58	51
Revenue, R_{ip}, 1 000 NOK	Mean	3 470	3 426	3 694	3 623	3 853	3 765	3 443	3 612
	Std. dev.	3 295	3 383	3 642	4 308	4 482	4 371	3 722	4 076
Revenue, R_{iv}, 1 000 NOK	Mean	11 200	11 500	12 000	11 500	11 900	13 800	14 600	14 500
	Std. dev	13 200	13 800	14 900	14 900	15 600	18 700	19 900	18 800
Costs, C_i, 1 000 NOK	Mean	18 600	18 800	19 200	18 900	21 800	25 400	26 400	29 100
	Std. dev.	14 400	14 900	14 900	15 500	18 500	22 000	22 100	25 200
PCE Transported, X_{i1} in 1 000	Mean	213	226	236	216	221	273	296	325
	Std. dev.	210	223	236	218	227	298	317	346
Passengers Transported, P_i in 1 000	Mean	204	209	209	194	204	219	231	243
	Std. dev.	201	210	202	192	203	224	233	251
Distance of service, X_{i2} in km	Mean	7.7	7.8	7.8	7.9	8.1	7.3	7.2	7.1
	Std. dev.	7.9	7.9	8	8.1	8.3	7.4	7.3	7.6
OVDS services D_{i1}=1 or not D_{i1}=0	Mean	0.09	0.09	0.09	0.10	0.11	0.11	0.10	0.12
	Std. dev.	0.29	0.29	0.29	0.30	0.31	0.31	0.31	0.33
Unsheltered stretches D_{i2}=1 or not D_{i2}=0	Mean	0.22	0.22	0.23	0.23	0.23	0.19	0.19	0.18
	Std. dev.	0.42	0.42	0.42	0.42	0.42	0.40	0.40	0.39

Table 2. Estimation results of the passenger revenue model for every year – t-values in parentheses.

Year	a_{0p}	a_{1p}	a_{2p}	a_{3p}	Adj. R^2	F-value
1996	107 210 (0.76)	10.88 (16.30)	0.85 (15.98)	212 880 (0.71)	0.958	469
1997	38 807 (0.28)	11.48 (17.80)	0.80 (15.20)	20 964 (0.07)	0.960	491
1998	2 366 (0.02)	13.11 (19.37)	0.75 (14.00)	-1 500 (-0.00)	0.963	521
1999	-69 475 (-0.50)	12.06 (17.56)	0.98 (19.17)	-313 093 (-0.95)	0.979	732
2000	-89 365 (-0.47)	13.48 (15.47)	0.73 (12.05)	132 823 (0.31)	0.968	421
2003	-114 211 (1.08)	14.77 (31.47)	0.51 (15.86)	-282 262 (-1.29)	0.988	1 355
2004	31 760 (0.29)	12.67 (26.42)	0.56 (18.29)	237 247 (1.10)	0.984	1 006
2005	-21 025 (-0.17)	13.39 (26.12)	0.50 (15.90)	111 456 (0.48)	0.985	949

Table 3. Estimation results of the vehicle revenue model for every year – t-values in parentheses.

Year	a_{0v}	a_{1v}	a_{2v}	a_{3v}	Adj. R^2	F-value
1996	-29 914 (-0.08)	27.07 (17.58)	3.36 (26.56)	727 880 (0.91)	0.981	1 107
1997	-32 350 (-0.10)	26.86 (19.34)	3.31 (28.87)	1 009 811 (1.30)	0.984	1 308
1998	-187 773 (-0.51)	28.50 (19.47)	3.21 (26.75)	526 778 (0.62)	0.984	1 235
1999	-500 581 (-1.36)	34.74 (20.67)	2.73 (22.03)	-199 206 (-0.25)	0.985	1 227
2000	-284 525 (-0.64)	31.35 (15.97)	3.03 (20.68)	-309 639 (-0.33)	0.982	928
2003	-254 083 (-0.56)	31.92 (20.32)	2.60 (23.20)	50 640 (0.05)	0.986	1 266
2004	-908 040 (-1.37)	33.73 (16.25)	2.57 (16.31)	722 562 (0.48)	0.972	651
2005	-153 678 (-0.25)	29.76 (15.95)	2.60 (20.33)	505 470 (0.40)	0.978	731

Table 4. Estimation results of the cost model for every year – t-values in parentheses.[a]

Year	b_0	b_1	b_2	b_4	b_5	b_6	Adj. R^2	F-value
1996	16.389 (491.76)	0.154 (3.86)	0.354 (11.75)	0.052 (5.07)	0.177 (2.03)	0.107 (1.60)	0.893	111
1997	16.385 (484.63)	0.170 (4.17)	0.332 (10.54)	0.064 (6.18)	0.252 (2.83)	0.148 (2.15)	0.886	103
1998	16.428 (432.87)	0.192 (4.28)	0.309 (8.84)	0.060 (5.28)	0.131 (1.33)	0.153 (2.03)	0.863	83
1999	16.391 (438.04)	0.237 (5.40)	0.280 (7.83)	0.064 (5.84)	0.193 (2.14)	0.124 (1.74)	0.888	96
2000	16.485 (434.20)	0.210 (4.56)	0.320 (8.59)	0.060 (5.33)	0.186 (2.10)	0.167 (2.25)	0.904	107
2003	16.657 (399.31)	0.174 (3.39)	0.331 (8.30)	0.055 (5.05)	0.007 (0.06)	0.257 (2.90)	0.873	78
2004	16.695 (378.15	0.167 (3.06)	0.330 (7.69)	0.057 (4.80)	0.057 (0.51)	0.253 (2.67)	0.854	67
2005	16.779 (343.62)	0.116 (1.88)	0.409 (8.20)	0.034 (2.60)	-0.008 (-0.07)	0.345 (3.43)	0.890	82

[a] The second order explanatory variable $(\ln X_{i1} - \mu_1)^2$, and thereby the estimation of b_3 in (3), is omitted.

Table 5. Overstated costs from OVDS during the period 1996-2000 for the 6 services in our data set in 2006 prices. 90 per cent confidence interval.

Year	Percentage overstating of costs ($100b_5$)			Overstated costs, (1000 NOK)		
	Low	Expected	High	Low	Expected	High
1996	3.2	17.7	32.3	3 799	18 650	30 252
1997	10.3	25.2	40.2	11 814	25 449	36 182
1998	-3.3	13.1	29.6	-4 370	14 629	28 800
1999	4.2	19.3	34.4	5 296	21 089	33 339
2000	3.8	18.6	33.3	5 444	23 510	37 568
Average	3.6	18.8	33.9	4 397	20 665	33 228
Total	–	–	–	21 983	103 327	166 141

Table 6. Model results compared with the verdict for the years 1996-2000 in 2006 prices.

Year	Understated revenues, 1 000 NOK		Overstated costs, 1 000 NOK		Overstated subsidy needs, 1 000 NOK		Significant level of difference [a]
	Model results	The verdict	Model results, TOC_t	The verdict	Model results	The verdict	
1996	No indications of understated revenues	0	29 840	8 622	29 840	8 622	6 %
1997		96	40 669	8 312	40 669	8 408	1 %
1998		663	23 384	7 673	23 384	8 336	19 %
1999		0	33 731	11 999	33 731	11 999	7 %
2000		0	37 696	12 476	37 696	12 476	7 %
1996-2000	–	759	165 320	49 082	165 320	49 841	–

[a] Significant level of difference between overstated subsidy needs from the model and the verdict. 1-tailed test.