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Corresponding Author: Prof. Ola Flaaten,

Corresponding Author's Institution: University of Tromso

First Author: John R Isaksen

Order of Authors: John R Isaksen; Øystein Hermansen; Ola Flaaten

Abstract: In the context of the abolition of traditional subsidies, this paper discusses the persistence of the major remaining subsidy scheme in Norwegian fisheries: exemption from fuel taxes. This reimbursement scheme stems from the late 1980s, and has persisted since then under different governments. This paper gives the background to this support against theoretical predictions of the subsidy's effects on fishing behaviour and profitability. For 2011, the estimated exempted fuel taxes for the fishing fleet was NOK 999.0 million, amounting to 6.3 per cent of the landed value, against NOK 772.7 million (6.4 per cent of landed value) in 2007. The Norwegian scheme is also discussed in relation to similar arrangements in other countries. The national fishing fleet is heterogeneous with respect to oil consumption in transport and fishing operations. Hence, the effect of the fuel subsidy is different for different fleet components. The implications of abolishing this subsidy for the fishing fleet in general and for different vessel groups, as well as its policy implications, are discussed.

Cover Letter

Norwegian College of Fishery Science
UNIVERSITY OF TROMSØ

BREIVIKA, N-9037 TROMSØ, NORWAY
Phone: +47 7764 6000
Fax: +47 7764 6020
Internet: http://www.nfh.uit.no

Ola Flaaten
Professor, DPhil
Phone: +47 7764 5544
e-mail: olaf@nfh.uit.no

Tromsø 12th August 2014

Marine Policy
The Editor-in-Chief
Prof. H.D. Smith

Dear Editor,

Please find attached our paper *Stubborn fuel tax concessions: the case of fisheries in Norway.*

The paper was spell checked by a UK editing service.

Yours sincerely

Ola Flaaten

*Title Page (WITH Author Details)

STUBBORN FUEL TAX CONCESSIONS: THE CASE OF FISHERIES IN NORWAY

John R. Isaksen, Nofima, john.isaksen@nofima.no
Øystein Hermansen, Nofima, oystein.hermansen@nofima.no
Ola Flaaten, NCFS, University of Tromsø, ola.flaaten@uit.no

STUBBORN FUEL TAX CONCESSIONS: THE CASE OF FISHERIES IN NORWAY

ABSTRACT

In the context of the abolition of traditional subsidies, this paper discusses the persistence of the major remaining subsidy scheme in Norwegian fisheries: exemption from fuel taxes. This reimbursement scheme stems from the late 1980s, and has persisted since then under different governments. This paper gives the background to this support against theoretical predictions of the subsidy's effects on fishing behaviour and profitability. For 2011, the estimated exempted fuel taxes for the fishing fleet was NOK 999.0 million, amounting to 6.3 per cent of the landed value, against NOK 772.7 million (6.4 per cent of landed value) in 2007. The Norwegian scheme is also discussed in relation to similar arrangements in other countries. The national fishing fleet is heterogeneous with respect to oil consumption in transport and fishing operations. Hence, the effect of the fuel subsidy is different for different fleet components. The implications of abolishing this subsidy for the fishing fleet in general and for different vessel groups, as well as its policy implications, are discussed.

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1 INTRODUCTION

Subsidies for the world's fishing industry have been under scholarly scrutiny for decades. The reason is obvious: with more effort being directed towards capture activities, there is widespread evidence and understanding that fish resources are limited and even threatened with extinction. In many cases, subsidies have added to overcapacity and overfishing. The magnitude of subsidies within fisheries has been mapped and analysed at a global [1,2], regional [3] and national level, including in Norway [4,5,6,7]. Also, the effects of fisheries subsidies on fishing pressure, fish resources and trade have been under scrutiny [8,9], while other studies have focused on the definition of fishery subsidies and categorization of subsidy types [8,10,11]. OECD [12] includes a chapter on recent fisheries fuel tax concessions in member countries.

Open access common pool fisheries will usually lead to economic overcapacity and even to biological over-exploitation of fish resources. Revenue enhancing and cost reducing support contribute even further to this waste [10,13[1],14]. However, the biological effects of subsidies are different when property rights and good management systems are in place, which is mainly the case in the Norwegian fisheries. Globally, several nations control their fisheries, but there are still many that are open access. Sumaila et al. [2] estimated that worldwide fisheries subsidies in 2003 to be in the range of USD 25–29 billion, with fuel subsidies composing about 15–30 per cent of this.

In the WTO framework on subsidies and countervailing measures [15], financial contributions not only include the direct transfer of funds, but also revenue forgone by the authorities, provision of goods or services and the purchase of goods. According to the WTO, subsidies are further divided into two categories: prohibited and actionable. Export subsidies and subsidies favouring local content are prohibited.

This research focuses on the Norwegian fuel subsidies scheme for the exemption of fuel taxes for fishing vessels, which has been in effect since 1988. The research problem is fourfold; first, to describe briefly the development of the Norwegian mineral oil tax and reimbursement scheme, particular in relation to fisheries subsidies; second, to portray the support for this particular industry with respect to the industry's development; third, to analyse the economic effects of a possible annulment of this support; and finally, to discuss the findings and reach conclusions about the impacts on the industry and policy implications.

The paper is organized as follows. The next section provides some background information for the analysis, including a brief review of the Norwegian fisheries subsidy history and the environmental taxation scheme and its development. Then, the data used in this study is described, followed by an account of the estimated value of the exempted mineral oil taxes and the economic effects for the major fleet segments. The methods and findings are then discussed; finally, the paper concludes with findings concerning the implications for the industry and policy makers.

2 Background

2.1 Fishing industry subsidies

Norway has a long history of providing assistance to the fishing industry, as well as to some other industries. Since 1964, the government has annually negotiated an assistance package with the Norwegian Fishermen's Association on behalf of the whole industry, with the overall objective of raising the average fisherman's income to the level of manufacturing workers. Total transfers to the Norwegian fishing industry added up to a considerable share of the catch value, peaking in 1981 at more than 30 per cent. However, from the mid-1980s fisheries subsidies were to a large degree phased out, and fell from a 20 per cent share of the catch value to less than five per cent over a four-year period [4].

In 2004 the Government put an end to the annual financial support negotiations with the Fishermen's Association. Since then, support to the fishing industry has been modest. Figure 1 shows the peak in fisheries subsidies, as defined by the authorities, in the early 1980s, and the rapid decline since then. The fall in subsidies coincides with a rapid increase in catch per fisherman, as both the number of fishermen and fishing vessels were drastically reduced. However, Figure 1 does not include the subsidy element of interest to this paper (energy tax exemptions and the fuel tax reimbursement scheme), since the Norwegian authorities apply a more cautious definition of subsidies than the WTO's "Subsidies and Countervailing Measures" agreement. Both the nominal and the real value (2012 prices) peak are found in 1980, with NOK 1.4 and 4.6 billion, respectively. After that, the subsidies have dwindled and since 2002 have been in the range of NOK 50–70 million.

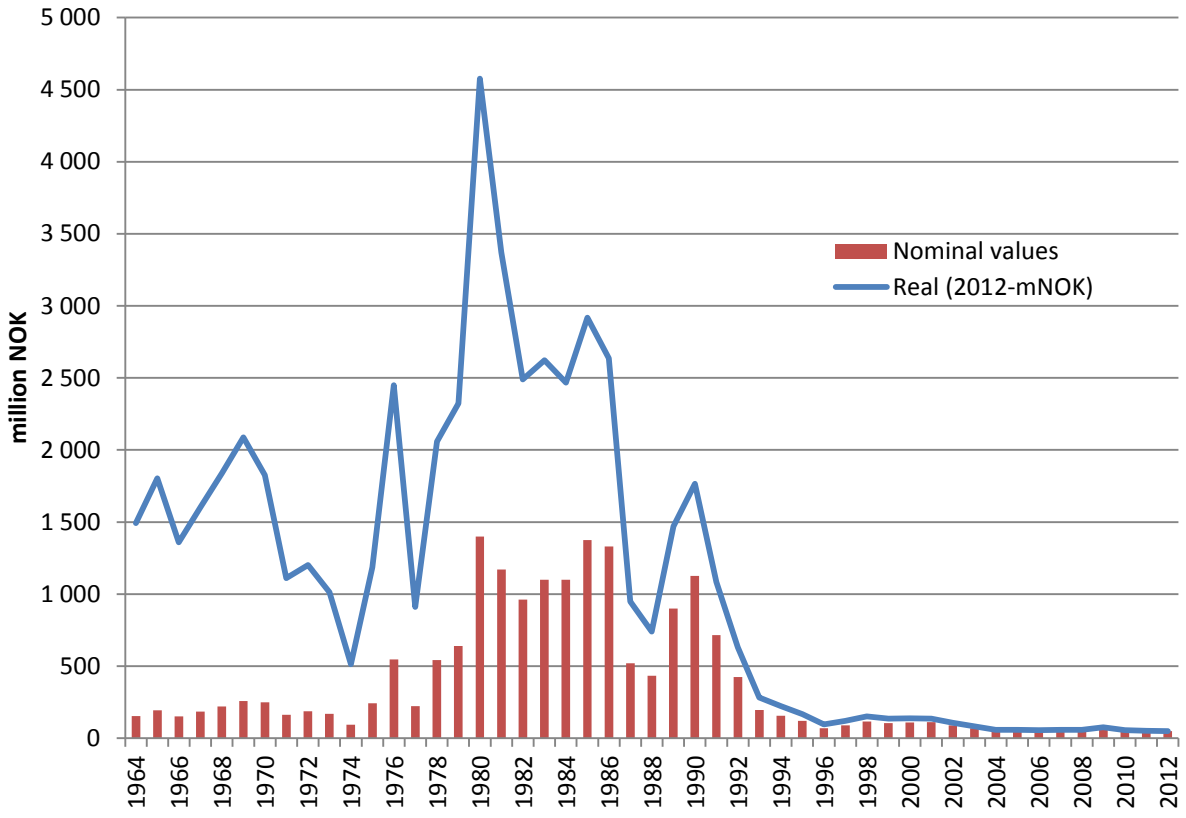

Figure 1. Government financial transfers to the Norwegian fishing industry 1964–2012. Includes monetary transfers under the General agreement (1964–2004) and the Government Budget (2005–2012). Deflated by the national Consumer price index (CPI).

Sources: Ministry of Fisheries and Coastal Affairs and Statistics Norway.

The definition of subsidies varies between researchers and organizations [2,3,15]. Using the WTO definition of subsidies, the Norwegian fishing industry in 2008 was directly supported by NOK 72 million, while the indirect support measures like general services and tax exemptions added up to NOK 2.21 billion. The main *direct support* items are transportation support (49 per cent) and support for the seal harvest (16 per cent). Of the *indirect support* items, the coastguard's fisheries-related activities (22 per cent), income tax deduction and CO_2-tax exemption (both 16 per cent), and research support (14 per cent) take the lion's share. The next section takes a closer look at the fuel tax exemption scheme; but first, a brief review of the general environmental taxation scheme is warranted.

2.2 Environmental taxes

Norway has long experience with environmental taxation. Taxation had an environmental impact long before taxes were established as an instrument of environmental policy. Already, in 1931 Norway introduced a petrol tax. The first tax with an explicit environmental purpose was the SO_2 tax on mineral oil in 1971. A widespread use of environmental taxes has been seen since the late 1980s and early 1990s. Taxes on lubricant oil and some other types of oil were introduced in 1988, and a CO_2 tax on petrol, auto diesel oil, mineral oil and the offshore petroleum sector was introduced in 1991, but these taxes excluded fisheries and some other industries. Since the early 1990s, tax instruments have played an important role in providing incentives for cleaner production and consumption patterns, even though regulation has remained the main policy instrument to abate environmental damage.

Over the years some taxes have been increased substantially, but at the same time exemptions and reduced rates for some industries have been introduced. In Norway, 7.1 per cent of central government tax revenue is derived from environmental and energy taxes[2], which is equivalent to 3.6 per cent of GDP (estimates based on the 2010 budget). The level of green (environmental) taxation is one of the highest in the OECD area. Environmental taxes refer to taxes with an explicitly environmental purpose (e.g. CO_2 and SO_2 taxes). By the end of the 1980s the Government's opinion of the use of environmental taxation had become markedly more positive. Several governments have envisaged that increased revenue from environmental taxation could be used for reducing other taxes. In the early 1990s a government-appointed commission noticed that 40 per cent of CO_2 emissions and 60 per cent of SO_2 emissions were exempt from taxation. It also criticized the weak correspondence between the CO_2 tax rate and the carbon content of different fuels. The CO_2 tax should in principle be applied at the same rate for emissions from all fossil fuels and uses. However, the costs of restructuring in industries and of adaptation in local communities should be considered when introducing and increasing CO_2 taxation.

Cost efficiency should be a fundamental principle in the formulation of environmental and climate policy. In the case of CO_2 emissions, this means that all products/uses of fossil fuels should in principle bear the same tax per unit of emission, not just in Norway, but in all countries. Another commission admitted that it would be difficult in the short run to ensure an optimal policy structure across countries. Norwegian CO_2 taxes should therefore be considered as an element of the fulfillment of Norway's role as an instigator in the area of climate policy. This complicates the task of formulating a cost efficient structure of CO_2 taxes in Norway. The level of taxation must therefore be determined on a more pragmatic basis, against the costs of Norway for being a pioneer in this area. The majority on the Commission proposed a low CO_2 tax rate for fuels and sectors that were exempt, while a minority opposed any expansion of the CO_2 tax.

In 1998 the *Storting* (Parliament) approved a general expansion of the SO_2 tax. The CO_2 tax was extended to air transport (later withdrawn due to international air transport agreements), the domestic sea transport of goods and the supply fleet in the North Sea, leaving CO_2 emissions from most processing industries and fisheries untaxed as before. The base tax on mineral oil was introduced in 2000, in principle for all uses and industries, but there are still several exceptions. As an adjustment towards the more rigid state aid rules determined by the EFTA Surveillance Authority (ESA), from 2003 the CO_2 tax only covers the use of petrol, auto diesel and mineral oil (except fisheries), and CO_2 emissions from offshore petroleum activities. During autumn

2005 the Government also proposed a trading system with allowances for CO_2 gas emissions. The system is similar to the European Union's system, but emissions covered by the CO2 tax are exempt. Together with the greenhouse tax, these mechanisms will cover about 70 per cent of Norway's total greenhouse gases.

The general CO_2 tax rates were NOK 0.570 and 0.610 per litre of oil for 2010 and 2013, respectively, and the base tax rates on mineral oil were NOK 0.886 and 1.018 per litre of oil in 2010 and 2013, respectively. However, as noted above there are several amendments and exemptions to these. Distant water fishing is fully exempted from the CO_2 tax, and coastal fishing pays a reduced rate, which in 2013 was NOK 0.130 per litre.

3 Data

Fisheries are still mainly exempt from environmental fuel taxes. In terms of the CO_2 tax, all fisheries are exempt, while only distant water fisheries (defined as further than 250 nautical miles from the coast) are exempted from the SO_2 tax[3]. In practice, vessels buy taxed fuel and the CO_2 tax is reimbursed by a government agency. When heading for distant water fishing, vessels purchase untaxed fuel directly. The most complicated regime is that for the NO_X tax. Fishing vessels with less than 750 kW engine power are totally exempt. An agreement on the reduction of emissions was signed by the authorities and several industry organizations. Instead of paying the full tax rate, vessels (both fishing vessels and others) that have entered into this agreement pay a reduced rate of NOK 4.0 kg NO_X. Tax revenues go to a fund that financially supports investment in emissions-reducing measures aboard vessels.

The listed prices of marine gas oil (MGO), including taxes – but excluding VAT – and the tax refund per litre for 1988–2012, are shown in Figure 2. These data are used in the analysis below. Even if adjusted for the general price increase over the period, there has been an increase in the MGO price paid by the vessels. However, further investigation has proved that the biggest vessels were actually rebated and paid less than the listed price. In addition, these vessels are to some degree able to refuel tax-free (abroad or domestically), and the support from the reimbursement/exemption constitutes a greater share of their fuel price than is the case for smaller vessels paying higher prices.

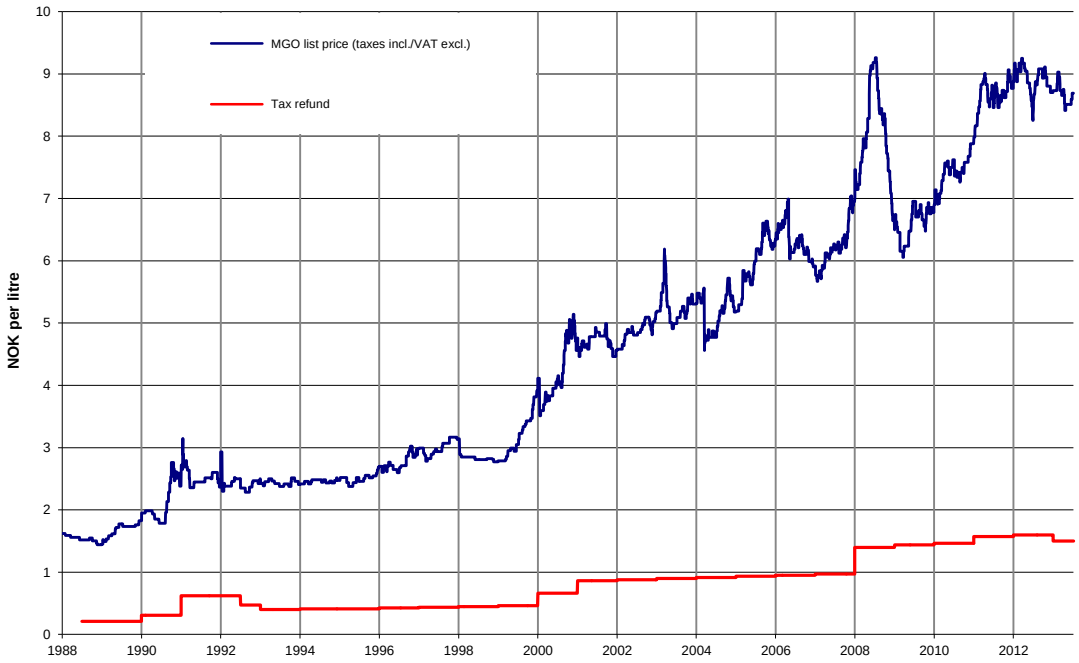

Figure 2. The mineral gas oil list price and the per litre fuel tax refund, 1988 to July 2013. Sources: Statoil Fuel and Retail ASA [18] and the Guarantee Fund for Fishermen.

Detailed data for individual vessels were obtained from The Guarantee Fund for Fishermen (GFF), which has administered the reimbursement scheme since its introduction. This special dataset gives information for every vessel that has been granted fuel tax reimbursement in the period 2000–2011, from which aggregated annual figures for reimbursed volume and value could be estimated. In addition, this project was granted access to the data of the annual profitability study of the fishing fleet by the Directorate of Fisheries [19] From there, cost and income data, together with technical characteristics, catch and operational data, could be obtained for individual vessels, as well as average values for vessel groups. This source, however, represents only a sample of vessels and not the whole population as the selection criterion is mainly related to a vessel's importance with respect to first hand sales value. From a total of 1,525 vessels entering the profitability study, data from 328 vessels were collected and compared (22 per cent). For some vessel groups, with a rather low catch value, the sample size's share of the population is rather small. For example, for the most numerous vessel group (coastal vessels of less than 11 metres, targeting demersal species) the sample of 55 vessels constitutes only 9 per cent of the population. For larger vessels this share is usually in the range of 60–80 per cent. It should be noted that the profitability study for the fishing fleet throughout the period 2000–2011 has undergone significant methodical alterations, which makes comparisons between years challenging.

In 2011 more than 3800 fishing vessels had the mineral oil tax (CO_2 and base tax) reimbursed. Figure 3 demonstrates that 253 large vessels (6.6 per cent of the total number of vessels) received 73 per cent of the total reimbursement, which amounted to NOK 354 million. On average one vessel above 28 metres by implication received the same amount of reimbursed fuel

as 145 vessels under 11 metres. In 2007, vessels of less than 28 metres received 29 per cent of the fuel tax reimbursement; in 2011 this was reduced to 27 per cent.

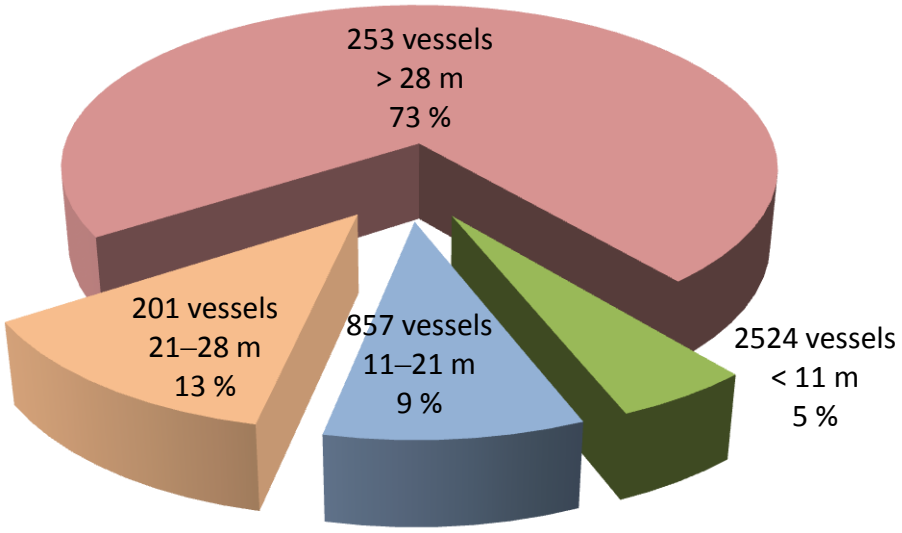

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Figure 3. Distribution of fuel tax reimbursement by vessel size, 2011.

Source: The Guarantee Fund for Fishermen.

4 RESULTS

In estimating the value of the total mineral oil tax exemption for the fishing fleet in 2007 and 2011 (shown in Table 1), we have employed a static model; thus, we have not taken into account substitution effects and other adaptations the fishing fleet could have introduced as responses to higher taxes. Official Norwegian statistics on fuel use across industries have not been reliable since 2005 [20]. However, by using the annual profitability survey of Norwegian fishing vessels (Directorate of Fisheries, 2008 and other years) and average fuel costs and fuel prices, we estimated the actual fuel consumption of the Norwegian fishing fleet in 2007 at 407 million litres. Of this, 244 million litres (about 60%) were included in the reimbursement scheme at a value of NOK 236 million, while the remaining 163 million litres is the estimated consumption of Norwegian vessels operating in distant waters – from "tax-free bunkering" in Norway at sea in international waters and abroad. For 2011, a similar estimation shows that the reimbursement scheme for 225 million litres paid back NOK 354 million, covering about 56 per cent of the fishing fleet's fuel consumption. The estimate of the total fuel consumption of the fishing fleet for 2011 amounts to nearly 400 million litres. The difference of 173 million litres is the fuel consumption in distant waters. A monetary estimate of the foregone static tax revenue is obtained by multiplying the aggregate consumption with the tax rate.

Estimating the foregone SO_2 tax is more complicated, as only the coastal fisheries pay this tax, and specific data on consumption in distant water fisheries are not available. Therefore, the above estimates employed for distant water fisheries are multiplied with the SO_2 tax rate. We

also assumed that all fuel contains less than 0.25 % sulphur, since heavy fuel is rarely used in the fishing fleet.

The exempted NO_X tax is estimated using a rate of NOK 0.9 per litre of fuel; the monetary estimates of tax exemptions for all the tax schemes in both years are presented in Table 1.

Table 1. Estimated exempted mineral oil and environmental taxes in the Norwegian fishing fleet, nominal value 2007 and 2011 (million NOK)

Tax	***CO_2**	**SO_2**	**NO_X**	**Total**
2007	394.7	11.4	366.6	772.7
2011	627.1	13.1	358.8	999.0

*Including the base mineral oil tax

Sources: Own calculations based on data from the Guarantee Fund for Fishermen and Statistics Norway (2013).

The exemption from the mineral oil tax for the fishing fleet operating in coastal waters was introduced in 1988, due to the difficult economic situation in the industry. At that time the tax amounted to NOK 0.21 per litre of oil for the combined base and CO_2 tax, and it has since increased to NOK 1.599 per litre in 2012[4].

In Figure 4, the average operating margin of the Norwegian fishing fleet is presented. However, it should be noted that the average operating margin hides huge variations between different vessel groups and between single vessels. In 2010, the group averages varied from −1.5 per cent (pelagic coastal vessels under 11 metres) to 27.8 per cent (large purse seiners). As will be discussed below, the rationale for supporting the fishing industry has dwindled since the 1980s. The red dotted curve in Figure 4 demonstrates what the operating margin would have been without the actual mineral oil tax reimbursements, but not including the calculated values of NOx and SO_2 taxes as well as the value of tax free bunkering offshore. Thus, this reimbursement is just a part of the estimated exempted taxes for 2007 and 2011 in Table 1. The operating margin in Figure 4 would have been reduced from 13.8 and 21.7 per cent to approximately 7.8 and 13.5 per cent in 2007 and 2011, respectively, if the estimated oil taxes in Table 1 were fully deducted from the earnings before interests and taxes (EBIT). This is a significant reduction, but remember that it is based on the assumption of no substitution and adaptation possibilities for the fleet.

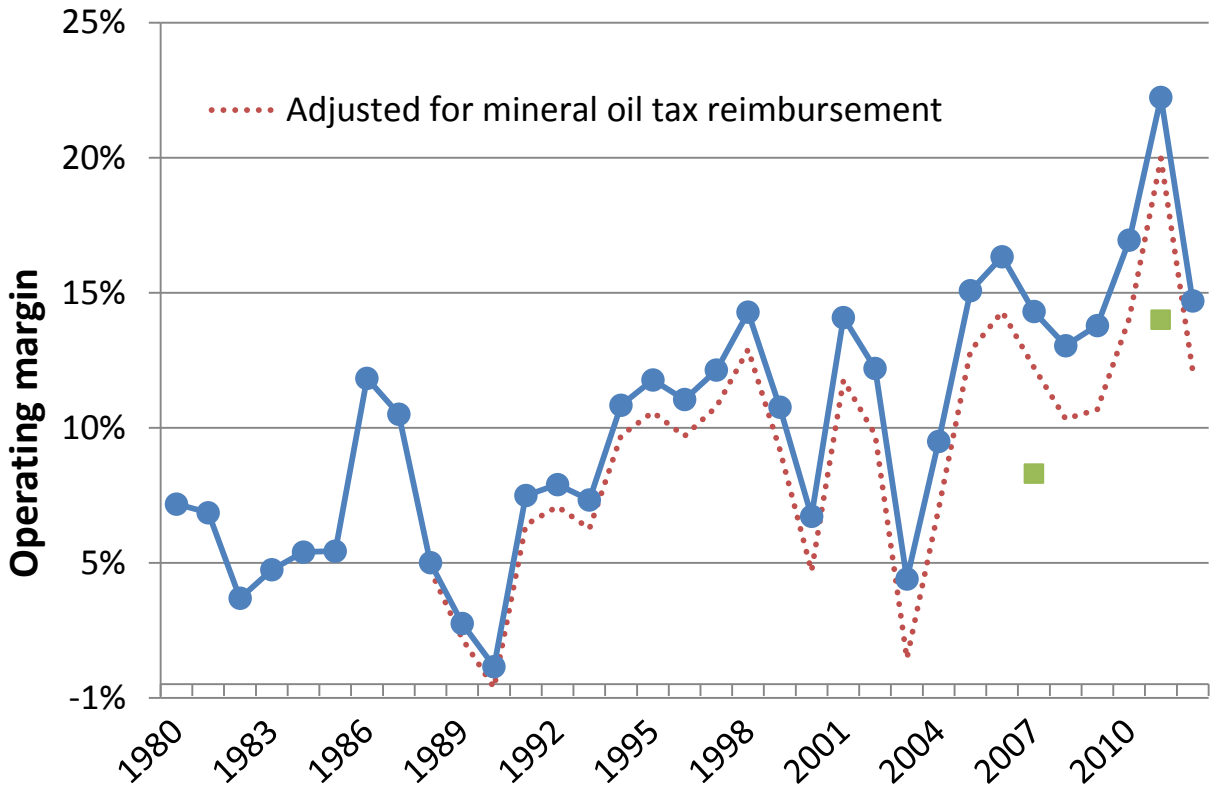

Figure 4. The average operating margin (EBIT's share of turnover) in the Norwegian fishing fleet and adjusted for the CO_2 tax reimbursements, 1980–2012. For 2007 and 2011, the green squares indicate the profit margins for these years if all fuel tax exemptions were abolished.

Source: Directorate of Fisheries and Guarantee Fund for Fishermen.

Fuel is utilized to different degrees by vessels. While in some fisheries it constitutes only a small part of the total costs, it is substantial in others, and it is usually gear and size dependent. Fuel costs on average amounted to 12.3 and 9.7 per cent of the vessel revenue in 2007 and 2011, respectively[5]. A more fine-grained analysis reveals that the fuel cost share of revenue varies between 5.0 and 21.2 per cent among the averages of vessel groups. Of course the variation among single vessels is significantly greater. Coastal vessel (under 28 meters) fuel costs amounted to 6.7 and 7.1 per cent of revenue in 2007 and 2011, respectively. The corresponding figures for the offshore fishing vessels were 15.1 and 10.9 per cent; thus, for the offshore vessels there was a clear reduction in the revenue share needed to cover fuel costs, whereas the coastal vessels had a small increase. Figure 5 shows the fuel cost share of revenue for 13 vessel groups for 2011 – this is a first approach to analysing the economic performance effects of a fuel price increase following an oil tax increase in fisheries. The group-wise illustrations based on average values conceal a great variation between individual vessels. For instance, among the smaller coastal vessels (CV < 11 m) fuel costs vary between 0.8 and 15.6 per cent of revenues.

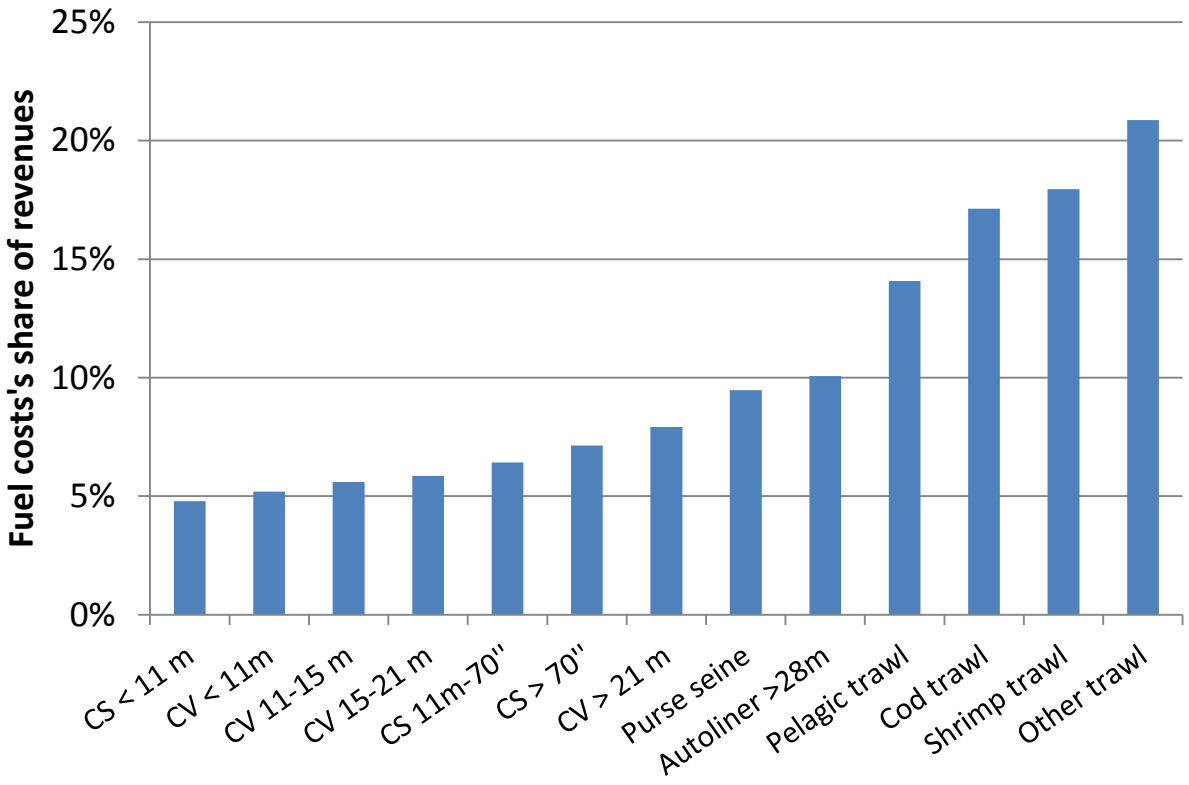

Figure 5. Average fuel cost as a percentage of average revenue for specified vessel groups, 2008-2011. Abbreviations: CS = coastal seiners, CV = coastal vessels.

Another dimension is that the actual price paid for fuel differs with the size of the vessels, and rather large rebates are conceded to larger vessels and higher consumption. According to the 2011 figures from the GFF, larger vessels (> 28 m) on average paid an oil price that was 18 per cent lower than the smallest vessels (< 8 m). On the other hand, most of the reimbursed mineral oil tax goes to the largest vessels, as demonstrated in Figure 3.

How would cancelling the fuel tax exemptions affect the economic performance of specific vessel groups in the Norwegian fishing fleet? The profitability change resulting from a fuel price increase is analysed by way of a sensitivity analysis. The basis of this was the profitability survey's cost and earnings data, and the aim was to calculate the percentage change in fuel costs (adjusting the labour cost accordingly[6]) to generate a "break even" result (EBIT = 0), assuming that there are no effects on harvest and stock dependent costs from operational and capital adjustments. Thus, this is a short run economic analysis. One indicator of the fuel dependency of vessels is the percentage fuel cost increase that renders the average vessel break even (EBIT = 0). This is shown in Figure 6 for twelve vessel groups, using averages for the four years 2008–2011 to smooth out annual shocks. There is a huge variation in the results. Trawlers, in general, are most sensitive to fuel cost increases, whereas coastal vessels and purse seiners could endure a doubling or even tripling of the fuel price. Note that these are vessel group means and that each individual vessel's performance can deviate substantially from the mean. Furthermore, being a static analysis, it has been implicitly assumed that the vessel groups will, on average, generate

the same revenues and costs in the same manner under a fuel price increase as was the case for the 2008–2011 average. This is a relatively strong assumption since vessel owners, under the influence or even expectation of fuel price increases, will act to mitigate such cost increases. Such adaptation strategies, both in the short and longer term, will be discussed in greater detail in another paper.

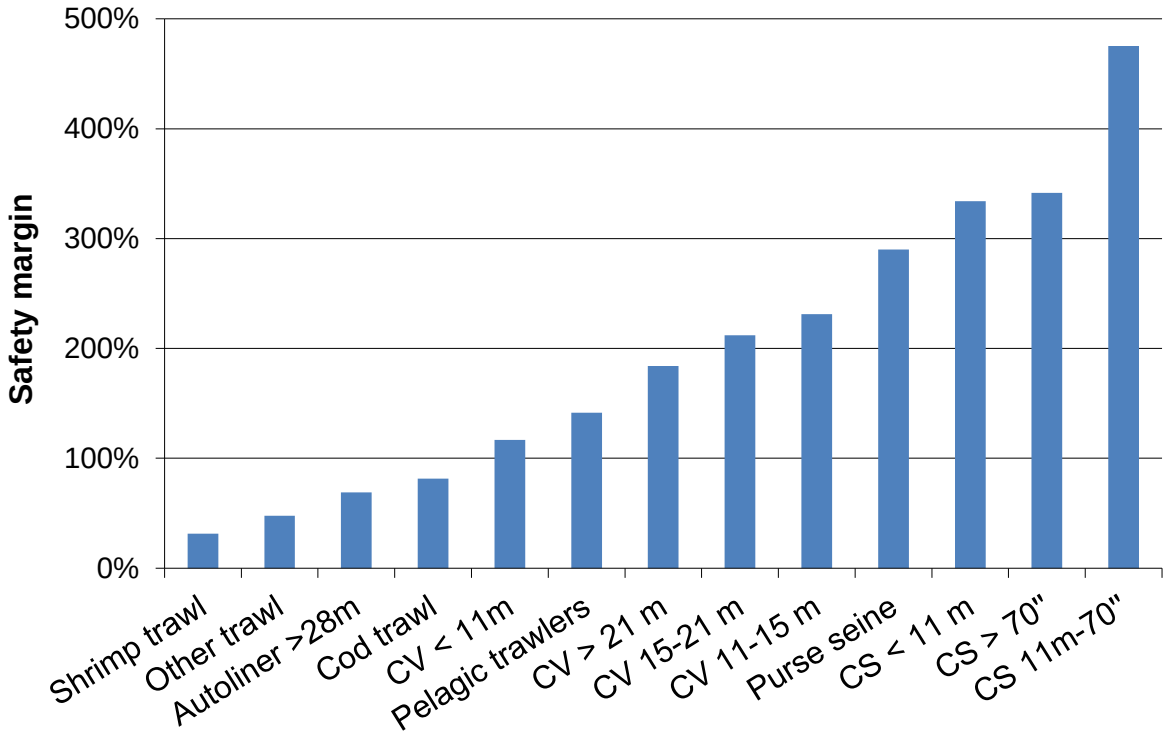

Figure 6. Fuel price increase "safety margin" for vessel groups with respect to fuel price (the increase allowed for a "break-even" result); mean for 2008–2011. Abbreviations: CS = coastal seiners, CV = coastal vessels.

4 DISCUSSION

The marginal damage from CO_2 emissions is independent of the location of the emission source, and from an economic (and environmental) point of view, the optimal emissions tax on CO_2 should be equal across countries and sectors [22]. In accordance with the "polluter pays" principle, either taxes or emission rights should be used. However, CO_2 taxes vary between

countries as well as within national economic sectors and across fuel types [22]. The same applies to SO_2, NO_x and other environmental taxes.

When considering the subsidy element of the CO_2 tax reimbursement/exemption, the contribution should be determined on the basis of market prices (see the recent ruling by WTO, 2009). In the EU quota market for CO_2 emissions, the price per ton varied between NOK 124 and 235 (EUR 13.55–29.40) in 2008 [20] and was down to EUR 6.62 per ton in 2012 at a UK auction [23]. The taxes in Norway in 2008 (NOK 1.395 per litre of oil) and 2012 (NOK 1.599 per litre of oil) correspond to a rate of NOK 528 and 605 per ton of CO_2 emissions, respectively. These tax rates were approximately two to four times higher than the 2008 EU quota market price for CO_2, and in 2012 they were about twelve times as high. Thus, the CO_2 taxes in Norway are much higher than the EU Emissions Trading Scheme (EU ETS) prices. In an almost parliament-wide compromise measure to promote more climate-friendly conduct, a proposal was agreed to consider phasing out the fishing industry's fuel tax exemptions. This was first implemented for 2013 when the coastal fishing vessels paid the reduced rate of NOK 0.130 per litre (about one fifth of the full CO_2 rate), whereas distant water fishing is fully exempted from the CO_2 tax. The Government's White Paper on the 2014 budget suggests doubling this rate.

This analysis has demonstrated that the mineral oil tax exemptions are not a prerequisite for a profitable Norwegian fishing fleet. Of the total population of 1731 and 1525 vessels for 2010 and 2011, respectively, included in the annual profitability survey, only two out of 13 vessel groups, representing about 5 per cent of the surveyed population of vessels, had deficits these years. The importance of the subsidy elements of the Norwegian tax exemptions depends to a large extent on the perspective. The fishing industry is to a great extent export oriented and in competition with fish from other countries and food sources. A survey of the fuel tax regimes in neighbouring coastal states shows that their fleets are hardly taxed on fuel at all [20,24]. Compared to this, the Norwegian regime implies no subsidies. However, in comparison with other Norwegian industries the picture gets more complicated. Some industries, like airlines, shipping and oil production, are almost totally exempt, as in most countries. Others, for example the wood and fishmeal processing industries, pay half tax on their fuel consumption. From this perspective, there is an element of subsidy in fish harvesting, but the amount is difficult to estimate due to the tax rate differences.

Another dimension of this is the ability of the upstream link in the seafood value chain to shift the burden of this tax to the consecutive downstream links, namely, the fish processors. This will partly depend on the competitive conditions in the market [25] and on the legal arrangements in Norway. Fishermen's sales organizations have considerable power in the first hand market for fish, where they are granted the legal right to fix minimum prices for fish, which could shift the burden of fuel taxes to the adjacent stages in the value chain.

5 **Conclusion**

Is there the possibility that fishing vessels could substitute away from marine gas oil?[7] In the short run the way to adapt to increased fuel prices is to alter the way of operating the vessel, by minimizing the steaming between the port and the fishing ground and by reducing the speed. Vessels may concentrate fishing activities in periods and areas where fish abundance is high, and

take a greater load before going to port. Fisheries with marginal profitability might be rendered unprofitable and phased out. In the longer run, a substantial and persistent fuel price increase would induce greater adjustment possibilities, such as more energy efficient fishing vessels and gear, and the shift of quota rights from less to more energy efficient gear, if allowed.

For the smaller coastal vessels, an annulment of the reimbursement scheme would be relatively small. Oil constitutes a relatively low cost for these vessels, and they have limited possibilities for substitution. The effects of oil price increases in this vessel group could be withdrawal from fishing for lower valued species (especially saithe, but also haddock) and from fishing from distant ports (i.e. spring cod fishery in Finnmark). Overall, however, the operational effect on this group would probably be marginal.

For purse seiners with an additional trawl licence for blue whiting, the adjustment possibilities are greater than for the smaller coastal vessels. The most likely adaptations would be to phase out fisheries with little and uncertain profitability, such as the North Sea herring, with its limited quotas, and the horse mackerel fishery. For the blue whiting fishery west of Ireland and the capelin fishery in the Icelandic zone, fishing could either be phased out or deliveries would be made in Ireland or Iceland to reduce steaming. For other vessel groups the economic effects could be more substantial, especially for those on the left-hand side of Figure 6, including the trawlers. In case of annulment of the reimbursement scheme, the landing-abroad effect would be greater and could take place for all fisheries, since vessels could then take advantage of lower fuel prices abroad. Refuelling in the open sea from foreign tanker vessels may also be an option, especially for larger fishing vessels [20].

The rationale behind environmental taxation is to reduce emissions harming the global climate and local environmental conditions. For some fisheries and vessel groups, the chosen adaptations may result in higher emissions in order to avoid taxed fuel, which clearly is counter-productive. In addition, in case of comparatively high Norwegian fuel prices in the future, some vessels would land their fish abroad, and hence reduce the supply to the Norwegian fish processing industry.

The substantiated or potential effects of taxation constitute important information for policy makers. Undoubtedly, this scheme represents a support to the industry that should be abolished, especially since the worst emitters get the highest relief from it. However, removing this support would, according to our analysis, spur incentives and responses in the fleet that could bring about unfavourable consequences, especially a shift in demand to foreign “untaxed” fuel and a shift in the supply of fish towards making landings abroad. Some distributional effects also come into place since smaller energy efficient vessels have considerably fewer opportunities to avoid the tax.

A good solution to protect the environment from the GHG emissions of the fishing fleet would be the international harmonization of fuel taxes among nations. Sumaila et al. [2] estimated worldwide fisheries subsidies in 2003 to be in the range of USD 25–29 billion, of which fuel subsidies composed about 15–30 per cent. OECD [12] estimates for 2008 for 27 member countries’ fuel support as a percentage of landed value ranges from less than one per cent to more than 40 per cent, with an unweighted average of eight per cent. This paper has

demonstrated that the situation in Norway is sound with respect to most other subsides, but fuel tax exemptions still prevail, amounting to more than six per cent of the landed value in 2011[8]. In the light of the efforts incurred to achieve international fuel tax or CO_2 quota agreements for similar industries and the recent progress for airlines and shipping, the international community may now be ready to attempt to make agreements in global fisheries.

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[1] Bjorn Brochmann, MSc was on leave from the Ministry of Fisheries to the Norwegian College of Fishery Science in 1980 when writing this article. Later, when back at the Ministry, he argued internally and externally for the abolition of the fisheries subsidies. The reaction from the industry was fierce, some demanding that the Minister should sack Director Brochmann, but without success. Gradually, the industry representatives, led by the powerful Federation of Fishermen, came to understand that the subsidies were not sustainable.

[2] According to Eurostat definitions, environmental and energy taxes amounted to NOK 69 billion in 2010, including electricity and vehicle taxes [16]. The annual average exchange rate, NOK per USD, from 2008 to 2013 was 5.64, 6.29, 6.04, 5.61, 5.82 and 5.88, respectively.

[3] The sulphur tax is only levied on those fishing in coastal/near waters, and no reimbursement is given. Steinshamn [17] pointed out that this fleet was responsible of 5 per cent of emissions, but paid about 11 per cent of the total SO_2 tax. However, he claimed sulphur emissions are responsible for local – not global – pollution damage, which makes it rational that this tax is levied on less mobile vessels and not on those operating in distant waters.

[4] In 1988 the basic tax of oil was NOK 0.21 per litre, and this was fully refunded. Also, the increased base tax has thereafter been fully refunded. In 1991 the CO_2 tax was introduced and in fish harvesting this was fully refunded up to and including 2012. For 2013, however, and in the Government's proposed budget for 2014, a minor part of the mineral oil tax (basic and CO_2) has to be paid by the fishing vessels.

[5] In a historical perspective, this is not very different from the 1974–1977 average of 10.8 per cent for the Norwegian fishing fleet [21].

[6] Labour costs in the Norwegian fisheries are normally calculated as a share of revenues minus some vessel costs. In the coastal fleet (vessel permissions less than 28 meters) crew shares are calculated from revenues *minus* fuel costs, as opposed to the larger offshore vessels where owners carry all fuel costs. Coastal vessel owners can therefore "shift" some of the fuel cost increase over to the crew. Hence, the effect of fuel price increases on profitability is smaller in the coastal fleet than in the offshore fleet.

[7] The following paragraphs are based on the conference paper [26].

[8] OECD [12] gives 3 per cent in 2008 for Norway.