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The effects of reducing the mineral oil tax reimbursement scheme for the Norwegian short-sea shipping and fisheries sectors

- Conflicting goals, dubious results

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Abstract

This thesis conducts an analysis of the effects of reducing the mineral oil tax reimbursement scheme for the Norwegian short-sea shipping and fisheries sectors. An important contribution of this study is to review this measure in a wide context based on the Norwegian governments' principles and goals relating to climate, environment and its goals for the short-sea shipping and fisheries sectors. Based on the dynamics of supply- and demand elasticities for the sectors, the likely tax-incidence determined. The tax incidence is in turn used to discuss and contrast the different outcomes of the tax increase for the sectors.

Costs are expected to rise by at least 2.2 % for the short-sea shipping sector and 0.9 % for the fisheries sector. This increase will fall on the vessel- and ship-owners based on the tax incidence. In terms of the principles and goals for environmental taxes the effort is found to be a step in the right direction, but falling short of estimates of the social cost of carbon.

The tax is found to be better for the fishing industry than the short-sea sector. Short-sea has environmental benefits over its closest competitors and the tax increase may shift volume to other modes of transport. Thus the measure may result in increased emissions from transport. Both effects undermine the goals for the short-sea sector. For fisheries sector some goals may be achieved with regards to profitability, reduced overcapacity/redundancy and investment in new technology. This may reduce emissions in the long run, but not in the short run because of perfectly inelastic supply due to fishing quotas.

Going forward the reimbursement scheme should be held constant for the short-sea shipping sector at least until other sector goals are achieved. For the fisheries sector however, the reduction of the reimbursement should continue.

Acknowledgements

This thesis was written as a part of the master profile Energy, Natural Resources and Environment at the Norwegian School of Economics (NHH) and represents the end of my studies at NHH.

The thesis explores the effects of reducing the mineral oil tax reimbursement scheme for the Norwegian short-sea shipping and fisheries sectors and can be seen as a part of the renewed focus on shipping at NHH in later years. Throughout my studies I have had an interest in climate economics and economic policy, combining these interests in this thesis has been especially rewarding.

Writing this thesis has been a great experience and I hope to use the skills and knowledge I have gained in my future career. I also hope that others interested in this topic will find reading it exciting and informative.

I would especially like to thank my supervisor, Stein Ivar Steinshamn, for his great advice and feedback throughout the writing process.

Norwegian School of Economics

Bergen, June 18th, 2014

John-Erik Rørheim

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1. Introduction

1.1 Motivation

The effects of climate change, both potential and occurring, are at the forefront of public discussion in Norway. As traditionally a shipping and fisheries nation, the contributions of these sectors are important parts of the Norwegian climate policy discussion. The sectors have until recently been exempt from paying any mineral oil tax. This is rapidly changing; the prior government initiated an implementation of new taxes and the current government also seems determined increase the tax. The measure is in some circles believed to have the potential to reduce Norway's greenhouse gas emissions.

The sectors are important parts of Norwegian domestic policy and the effort to maintain settlements in remote coastal areas. Regulating these industries have interesting connotations from both an economical and political view. In the public discussion issues regarding fisheries are largely discussed in domestic terms. This is puzzling bearing in mind that the industry is one of our largest export industries. Norwegian registered vessels also compete with vessels from other nations who may be subject to different regulations. This may have implications for the effect of a Norwegian tax increase if this is not followed by other nations. For short-sea shipping the discussion is somewhat reversed. There we mainly discuss our role in international shipping, while ignoring the potential of the short-sea segment to improve transport and emissions domestically.

In recent times there have been calls for more research on shipping topics and the government has developed strategies for the short-sea sector (Ministry of Transport, 2013). This thesis aims to complement and contribute to this effort.

1.2 Purpose of thesis and statement of problem

The purpose of this thesis is to outline the effects of reducing, and ultimately ending the mineral oil tax reimbursement scheme for the Norwegian fishing fleet and domestic short-sea shipping. This effort will be evaluated in terms of the rationale behind the scheme, the costs and the implications for the sectors and in light of the governments stated goals for the sectors. The issue raises questions from an economic perspective as well as a political and environmental nature. Because the sectors have the potential to shift the cost of emissions to the customers it is not necessarily the case that the effective tax/fee will reduce national emissions.

To address these issues, enforcement schemes, the size of fees and market dynamics as they relate to costs for the sectors and competitive environment will have to be addressed, and reviewed in light of the Norwegian governments stated principles and goals relating to climate, environment and its goals for the short-sea shipping and fisheries sectors.

To do this the following questions will be explored:

1. How will the reduction of the mineral oil tax reimbursement scheme affect the Norwegian short-sea shipping and fisheries sectors?
2. Will the reduction help the government in reaching its "climate goals" and sector specific goals?
3. Are there potentials for "double dividends" in terms of tax revenue, goal achievement and reduced emissions?
4. Could anything be done differently?
5. Based on the findings; what are the recommended course of action/polices going forward?

In light of these questions and the climate/environment being a common good a natural limitation in this thesis is to view the issue at hand from the regulators side.

1.3 Structure of thesis

Chapter 1 gives an insight in my motivation for writing this thesis, its purpose and a statement of the problem that is to be addressed. *Chapter 2* provides context by outlining the Norwegian governments emission reduction goals that are some of the motivation behind the removal of the tax exemptions which are the topic of this thesis and giving short introductions to the short-sea shipping and fisheries sectors. *Chapter 3* provides a thorough review of relevant theory concerning climate change, the concept of negative externalities and remedies to this problem in the shape of taxes, quotas and fees. This theory section informs the analysis discussion and recommendations in the following chapters. *Chapter 4* constitutes the formal analysis and outlines the current reimbursement scheme, the governments goals for the sectors and climate. The section also determines the cost of the measure to the sectors and shows who is likely to end up bearing the cost of the tax increase. *Chapter 5* discusses the findings in the analysis comprehensively in light of the questions given in the purpose of the thesis and statement of problem; the effect on the sectors and goal fulfillment. *Chapter 6* Briefly discusses some alternatives that to the current scheme that should be considered. *Chapter 7* provides recommendations based on the findings of this study, while *Chapter 8* concludes and sums it all up. *Chapter 9* is a list of references used.

2. Background

The Norwegian fisheries sector, the domestic short sea shipping and the domestic air traffic are some of the major contributors to the country's release of CO_2 and other GHGs. According to Statistics Norway (SSB) (2014) the fisheries sector, the domestic short sea shipping contributed a combined 3,5 and the domestic air traffic contributed 1,3 million tons of CO_2 out of a total of 44,1 million tons in total for Norway in 2013. Or roughly 8 percent for shipping and fisheries combined and roughly 3 percent for domestic air traffic. The total release of greenhouse gasses for Norway was 52,7 million tons of CO_2-equvalents.

It is a stated goal from policy makers that this amount should be reduced, and the parliament voted in favor of the so-called "Klimaforliket" in 2008 determining reduction goals (NOU 2009:16, 2009; SSB, 2014). This national goal is that domestic emissions should not exceed 45-47 million tons of CO_2-equivalents in 2020. In 2013 the emissions exceeded the target by 6-8 million tons. In other words, there is a long way to go.

Norway has been awarded with quotas from the UN amounting to 50,1 million tons of CO_2-equivalents per year (Ministry of Climate and Environment, 2012). Thus current emissions exceed the awarded quotas. Norway can however still meet its obligations by the three mechanisms Joint Implementation, the clean development mechanism and buying quotas. According to the Kyoto-protocol Norway may also deduct some 1,5 million tons due to the uptake in Norwegian forests. But in the aforementioned "Klimaforliket", the government decided that country will not use this opportunity to fulfill its commitments.

These reduction goals are some of the motivation behind the removal of the tax exemptions which are the topic of this thesis. The specifics of the taxes will be given in the analysis section after the theory and principles that inform their determination have been introduced. But first, and before the theory section, a short introduction to the short-sea shipping and fisheries sectors will be provided.

2.1 The short-sea sector

The term "short-sea shipping" means transport services conducted between either domestic harbours or harbours in neighbouring courtiers. This description is distinct from deep-sea shipping, which means intercontinental shipping (Stopford, 2009).

Short-sea shipping accounts for 37 percent of all intra-European transport measured in tons/kilometres (Amerini, 2008). According to the Norwegian "Sjøtransportalliansen", an interagency group representing harbour-operators, the Norwegian Shipowners' Association and Maritimt Forum, short-sea shipping accounts for over 42 percent of all domestic transport in 2012 (Sjøtransportalliansen, 2012).

Short-sea shipping can further be divided into several distinct groups depending on type of cargo and ships that are used. There are several ways to do this distinction but an often cited one is Paixão and Marlow (2002) who uses four categories:

1. Traditional single-deck carriers which can carry neo-bulk cargo such as timber, steel and other large objects.
2. Container feeder vessels, which are smaller purpose-built container vessels that carry high-value cargo and provides a link from the deep-sea container vessels to smaller ports.
3. Tankers and bulk carriers whose dimensions are less than 3000 deadweight tons (dwt) engaged in pure and conventional dry and liquid bulk trades such as mineral oil products, chemicals, LPG, coal, iron ore and grains.
4. The last category is the fleet of different ferries engaged in short-sea shipping to varying degrees. There is however a debate to whether this category should be viewed as an extension of road transport rather than a short-sea shipping category.

This thesis will not make distinctions between these categories in the general discussion.

According to reports by Ministry of Fisheries and Coastal Affairs (2013c) and Sjøtransportalliansen (2012) the Norwegian short-sea fleet consists of about 1000 ships that sail both in Norwegian and European waters. There are about 550 registered companies in different segments of the short-sea sector with a combined income of NOK 9 billion each year. The different short-sea shipping companies employ roughly 10,000 seafarers (Sjøtransportalliansen, 2012).

The short-sea segments of shipping are mired by low margins and operate in a highly competitive market. Norwegian companies compete both with other European actors and with road and rail transport (Hovi & Grønland, 2011). Short-sea shipping has consistently lost market-share over the last 50 years, having had a share of over 70 percent in 1960 and a share of 42 percent today (Ministry of Fisheries and Coastal Affairs, 2013c; Sjøtransportalliansen, 2012). This in a period which has seen a large growth in transport work conducted. Especially in the container goods segment market share has been lost. In that segment for low volumes and where time is an issue road transport has a competitive edge. Bulk and tank are more persistent (Douet & Cappuccilli, 2011; Paixão & Marlow, 2002; Paixão Casaca & Marlow, 2005).

Compared to other modes of transport the advantage of short-sea shipping is that it can transport large volumes over long distances at a low price with comparatively low emissions. In addition there are few capacity limits and investing in infrastructure is relatively cheap compared to rail and road (Evensen, 2000; Ministry of Fisheries and Coastal Affairs, 2013c; Sjøtransportalliansen, 2012).

Most prognosis show that the demand for transport is likely to increase substantially in the years to come(European Commission, 2011; Ministry of Transport, 2013) both domestically and within Europe. If current trends persist it is likely that the majority of this increase will come in the form of road transport. This is not desirable according to both the Norwegian Government and the European Commission (European Commission, 2011; Ministry of Transport, 2013), and several policies have been implemented to try and shift this trend. The success of these policies are limited however (Douet & Cappuccilli, 2011; Paixão & Marlow, 2002; Paixão Casaca & Marlow, 2005; Riksrevisjonen, 2014). If the potential for a modal shift in favor of short-sea is to occur, a lot has to be done.

An integral part of this problem pointed out by several of these researchers and the industry itself, is that the short-sea industry is almost entirely self-financed both when it comes to infrastructure and equipment, whereas infrastructure projects in road and rail transport is largely publicly funded. Another issue is that short-sea shipping is heavily regulated compared to its competition.

The message in these reports and studies is that if short-sea is to capture a larger market share in the years to come, the government needs to "put its money where its mouth is" and invest in better infrastructure for shipping and regulate road transport more heavily than it is today. Strategies to this effect is outlined in the government documents "Stø Kurs" (Ministry of trade and industry, 2013) and "Nasjonal Transportplan 2014-2023" (National transport plan) (Ministry of Transport, 2013) which will be discussed later.

2.2 The fisheries sector

Capture fisheries have been an important part of the Norwegian economy ever since records began, and continues to be an important export article (Merete Gisvold Sandberg, Kristian Henriksen, Stian Aspaas, Heidi Bull-Berg, & Ulf Johansen, 2014). Capture fisheries comprises many different species and vessels. Fish species and fishing methods can be categorized depending on where they are located in the water column, feeding and migration habits. According to Grafton (2004) the three main categories are:

1. *Pelagic* species, which include sardines and herring. These species travel large distances and are normally captured near the surface in schools. The equipment used is longlines or purse seines.
2. *Anadromous* species are often grouped together with pelagics, but have different characteristics in that they spawn in streams and rivers. These species include Salmon. Equipment used is the same as pelagic in addition to traps and gillnets that entangle the fish.
3. The last category is *Demersal* species such as cod, plaice, haddock and whiting. These species are often caught mid-water or close to the bottom, with trawls being the most commonly used equipment.

According to the Norwegian fisheries directorates' "Registry of fisheries vessels" there were 6,133 registered fishing vessels in Norway by 02/27-2014 (Directorate of Fisheries, 2014). 255 of these are vessels larger than 28 meters, which is the common separation between the ocean going vessels and the coastal vessels. There are huge variations within this figure, with vessels spanning from small open vessels fishing close to their home port to large trawlers covering vast areas of the ocean. All sizes have seen a decrease since the 60's except the vessels in the 10-11 meter range which have seen a small increase in the recent years, now totalling 1,503 vessels. Figure 1 below shows the development of the fishing fleet over the years. As we can see there has been a steady decline since the 60's.

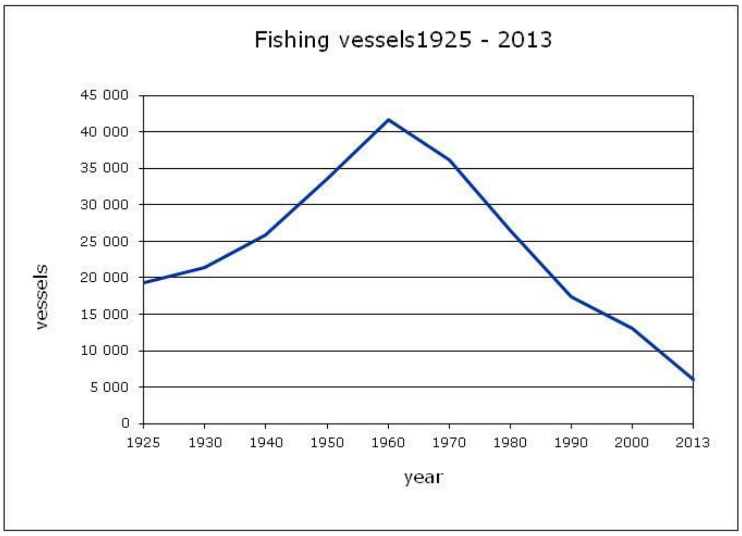

Figure 1: Number of fishing vessels registered in Norway (1925-2013)

There are many reasons for the decline in the fleet. A major reason is that capture fisheries globally and locally has been mired by all the possible problems of common resources as proposed by the classic "tragedy of the commons"-problem, which according to Grafton (2004) denotes "the overexploitation or overuse (in an economic sense) of common-pool resources due to the absence of property rights" (p. 488). The resource has in many cases been treated as more or less unlimited with corresponding lack of regulation. Consequences have in some cases been dire, including the near extinction of certain species of whales and the collapse of the Northern Cod fisheries in Canada and following moratorium in 1992 (Grafton, 2004) and the collapse of the Atlantic herring stock in the late 60's and 70's. When such collapses occur stocks require a long time to bounce back, if they ever do (Hutchings, 2000). Compared to these horrific examples of overexploitation, the agreements on fishing quotas between Russia, Iceland, Norway, the Faroe Islands and the EU may be considered rather successful (Ministry of Fisheries and Coastal affairs, 2013a).

Such evident mismanagement however led to an effort to regulate the industry to prevent these things from happening again. Thus the decrease in the number off vessels is due to a combination of more regulation, increased efficiency in the fleet and limited quotas.

An additional reason is that the fishing fleet can be said to have been artificially large due to large government subsidies over the years. These subsidies (including tax breaks for workers, price controls, direct transfers and refunds of fees paid on fuel) resulted in dangerous overexploitation of the common resource capture fisheries are. As the dangers of overexploitation became more evident quotas and regulations were implemented in combination with decreased subsidies (Isaksen & Hermansen, 2009). The combined trend towards less subsidies and more regulation has persisted ever since, and the number of vessels have been in steady decline. A thorough outline and assessment of the different regulations and fees faced by the industry can be found in Steinshamn (2008). There is still overcapacity in the fleet both internationally and in Norway (Ministry of Fisheries and Coastal affairs, 2007). Several studies, among them Pauly et al. (2002) point to a continued reduction of all kinds of subsidies to the industry as an integral part of reducing overexploitation.

All these examples are sources to the dire rent dissipation that has plagued fisheries for decades. Rent dissipation in a fishery context was first described in Gordon (1954). Economic rent is understood as returns that exceed those required to ensure the supply of a factor of production (Grafton, 2004). When speaking of natural resources the same concept is called "resource rent". Maximum resource rent is obtained by optimising effort and harvest as well as stock size. Without regulation, the common property nature of most fishery resources and the associated free entry of factor inputs lead to the dissipation of resource rent. In cases with dissipation of the resource rent, meaning the suboptimal rent generation from a resource, the dissipation is due to mismanagement of the resource (Bjørndal, Gordon, & Bezabih, 2013). An article by Willman, Kelleher, Arnason, and Franz (2009), aptly named "The sunken Billions", finds a potential maximum resource rent of $ 50 billion globally from fisheries given optimal management, compared to their estimate of zero aggregate rents.

Even though most fish stocks relevant to Norwegian actors are sustainable in terms of stock sizes (Ministry of Fisheries and Coastal affairs, 2007) rent dissipation is still a problem. In the case of fisheries where the stock is sustainable there are normally three different sources of dissipation related to inputs, these are; input substitution, fleet redundancy and fleet composition (Dupont, 1990). Where input substitution occurs when fishermen attempt to increase their catches by using more unrestricted inputs in the place of restricted inputs, usually vessel size (this is also called capital stuffing in some sources). Fleet redundancy (or overcapacity) may be a source of rent dissipation even in cases where access is restricted and may occur if the regulator allows more vessels to participate than the optimal number. The last source is fleet composition meaning a "suboptimal mix of heterogeneous vessels" where government determined catch allocations for each type of vessel allow less efficient vessels to continue to fish. The last problem is especially relevant in a Norwegian context where many fisheries are regulated with individual quotas that are not transferable (Bjørndal et al., 2013). These three factors are all contributors to the dissipation of resource rent in fisheries relevant Norway. This goes to show that even in cases with sustainable fish stocks, profitability may be low, or indeed zero due to other sources of mismanagement.

The situation of for the Norwegian fishing fleet is not as dire as these descriptions may lead one to believe however, reflecting that Norway has come a long way. According to a recent SINTEF report "Verdskapning og sysselsetting i norsk sjømatnæring" (2014) the Norwegian seafood industry contributed 46,5 billion NOK to GDP. Where GDP is understood as the contribution to GDP understood as the net product value after all costs associated with use and services in its production (NOU 2012:16, 2012). This is the reasoning behind the difference in estimated total production value and net contribution to GDP.

The entire sector, including aquaculture, handling and processing, employed over 47.000 people in 2012 and had a total production value of approx. 156 billion NOK. Capture fisheries, including processing and trade/export employed over 24,700 workers. According to both Merete Gisvold Sandberg et al. (2014) and Ministry of Fisheries and Coastal Affairs (2013b) the industry is able to generate profits in most segments. Also, the industry is very important for communities along the coast and therefore still has some subsides in effect, ranging from grants from "Innovasjon Norge" (Innovation Norway) to reduced income tax for seafarers and indeed the mineral oil tax refund which is discussed here.

3. Theory

We start with an introduction to the climate debate. Here I will present an historical view on climate change, give an outline of the mechanisms at play and relationship between the release of greenhouse gasses (GHGs) and climate change.

After these technical sides to the climate debate have been dealt with, I will introduce some economic models that are often used to assess the negative externalities that the release of GHGs represents. I will also present views on the effects of climate change for current and future generations.

Then I will present a model showing that, by using quotas and fees, authorities can design theoretically optimal emissions restrictions. This model has a deterministic form, and shows that fees and quotas can give the same economic benefits, but that differing uncertainties and information may make different schemes more viable than others given for instance differing industry parameters. A model showing how producers and consumers adapt to the scheme the authorities implement will also be provided.

This theory section will inform the analysis and discussion in the following chapters.

3.1 Emissions, climate change and why there is a price on emissions

The climate has always been changing. The debate we have today should therefore be seen through the context of prior changes and variations in the climate. Our planet has over its approximately 4,7 years in existence had several major "ice-ages". Between these periods the earth's temperature has at some stages been well above the temperatures we see today. Scientists have gone so far as to declare that in some periods the earth has been virtually snow free (NOU 2006:18, 2006). The current period started about 2,6 million years ago, during which the planet has gone through several smaller ice-ages.

Research from geological surveys, ice-core studies and other biological, chemical and physical measures show major changes over the earth's lifespan. Humans as a factor in this equation have only been present for about the last 12.000 years however, and we represent a possible game changer. Temperatures today are relatively high in a historic perspective, and the impacts of even higher temperatures are unknown but come with dire projections. The current pace of temperature change has not been seen before, and the scientific consensus is largely that humans are to blame.

3.1.1 Greenhouse Gases and the Greenhouse effect

According to the Intergovernmental Panel on Climate Change (IPCC), greenhouse gases (GHGs) are gases that are present in the atmosphere, both natural and anthropogenic which absorb thermal infrared radiation, emitted by the Earth's surface, by the atmosphere itself due to the same gases, and by clouds (IPCC, 2013).

Carbon dioxide (CO_2), methane (CH_4), water vapor (H_2O), nitrous oxide (N_2O), and ozone (O_3) are the most prominent GHGs in the atmosphere. In addition, there are a number of entirely man-made ones, such halocarbons and other chlorine and bromine containing substances. These substances are largely dealt with in the Montreal Protocol of 1987.

The Kyoto Protocol of 1997 in addition to dealing with CO_2, N2O and CH4, deals with the GHGs sulfur hexafluoride (SF_6), hydro-fluorocarbons (HFCs) and per-fluorocarbons (PFCs).

An important distinction between the emissions of greenhouse gases and other forms of emissions is that GHGs have a global effect on the environment, whereas other pollutants have a mainly local impact. The main focus of this thesis is on GHGs, specifically CO_2.

Because of this distinction, this thesis will be careful not to use the term "pollutants" as a description of GHG emissions. Also, from here on, whenever the terms CO_2 or GHGs are used in the thesis, it is meant as a synonym for CO_2 equivalents (CO_2e).

3.1.2 "Normal" and "enhanced" greenhouse effect

There is a distinction between the "normal" and the "enhanced" greenhouse effect. Even though there is consensus among leading scientists that both forms are present, and that the concern is off course the latter form, namely the "enhanced" form. Some of the so-called climate skeptics seem ignorant of the distinction. The distinction is between the naturally occurring, and ever present, "normal" form of greenhouse effect, which is essential to life on earth, and the enhanced form, which is the add-on temperature increase caused by mankind's industrious efforts to increase production to sustain our ever growing and prospering population.

The technical reason behind this difference is that the thermal infrared radiation in the troposphere is strongly related to the temperature of the atmosphere at the altitude at which it is emitted (IPCC, 2013). In short, and sufficient for the scope of this thesis, the explanation is that Infrared radiation emitted to space originates from an altitude with a temperature of, on average, –19°C, in balance with the net incoming solar radiation, whereas the Earth's surface is kept at a much higher temperature of, on average, +14°C. This is the naturally occurring, ever present, and vital effect described above.

The enhanced, manmade version is generated by the extra release of GHGs from human-activities. This activity causes increases concentration of greenhouse gases in the atmosphere leads to an increased infrared opacity, and therefore to an effective radiation into space from a higher altitude at a lower temperature. This causes a "radiative forcing" that leads to an enhancement of the greenhouse effect (IPCC, 2013). In other words this manifests itself as temperatures rising at a rate that is not natural, or in colloquial terms; in "Global warming".

According to Le Treut et. al (2007) in their contribution to the fourth IPCC assessment report: Climate Change (2007) the earth's temperature would be about -18 °C, compared to the average we see today of approximately +14°C, where it not for the greenhouse effect, both enhanced and naturally occurring.

3.1.3 Global warming potential (GWP)

Furthermore, the IPCC has ranked the six most common GHGs in terms of their global warming potential (GWP), my short form of this table is given in table 1 below:

Global Warming Potential (GWP) of GHGs	**(Without climate-carbon feedback)**
Greenhouse gas	GWP over 100 years
Carbon dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous Oxide (N_2O)	265
Hydro-fluorocarbons (HFCs)	140-11700
Per-fluorocarbons (PFCs)	6500-9200

Sulfur Hexafluoride (SF_6)	23900

Table 1: Source: IPCC, 2013

The table should be understood as being indexed to the GWP of one metric ton of CO_2, it follows that one metric ton of Methane has a 28 times higher GWP than one metric ton of CO_2. This is due to methane having a higher absorption of outgoing radiation.

3.1.4 Current outlook

According to the World Energy Outlook 2013 published by the International Energy Agency (IEA) the energy-related CO_2 emissions is set to rise by 20 percent by 2035, even when they take into account all the measures that governments around the world has committed to. This leaves the world on a trajectory that will lead to a long-term average temperature increase of 3.6 C, which is far above the internationally agreed 2°C target (International Energy Agency, 2013).

3.1.5 The social cost of carbon

The social cost of carbon (SCC) is a way to put an economic value to the damages caused by a small increase in CO_2 emissions, usually one metric ton, in a given year. This number is used by governments and international bodies such as the IPCC to estimate the benefits associated with reducing emissions, or the damage incurred by its release. Thus this monetary value represents the value of damages avoided by reducing CO_2 emissions.

According to the IPCC fourth assessment report (2007) The SCC is meant to be a comprehensive estimate of climate change damages and includes, but is not limited to, changes in net agricultural productivity, human health, and property damages from increased flood risk. The SCC estimates are derived using integrated assessment models. These models cannot comprise all of the possible impacts of climate change discussed in the literature due to lack of information or unreliable estimates and therefore incorporate high degrees of uncertainty. According to K. Arrow et al. (2013) an integrated assessment model can be stylized as shown in the figure below:

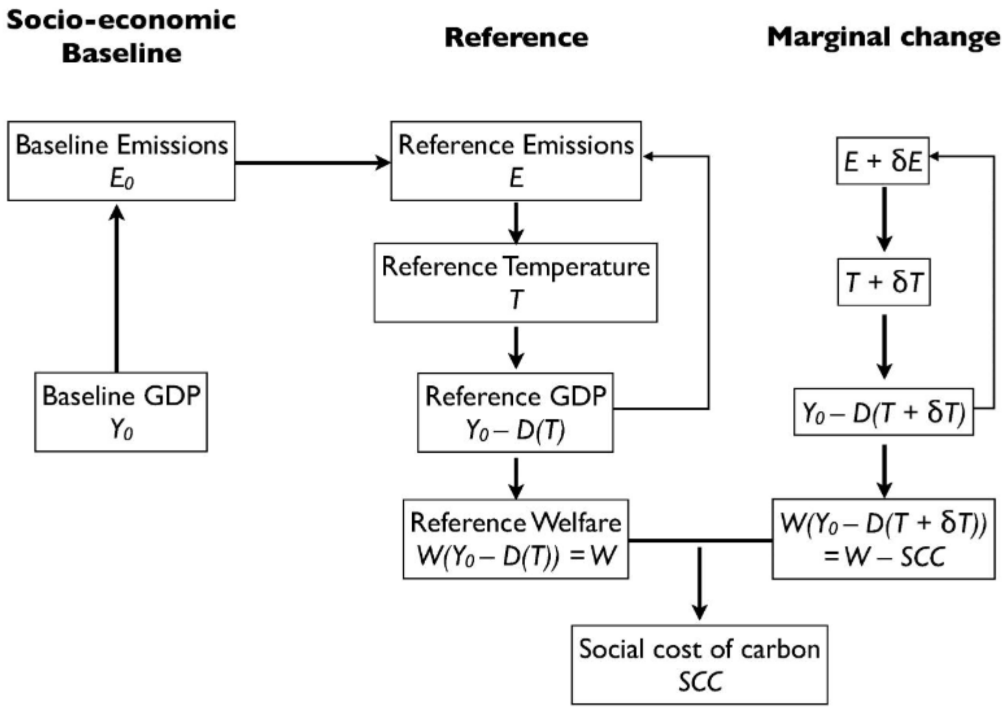

Figure 2: contents of an integrated assessment model (K. Arrow et al., 2013)

As figure 2 above shows in an integrated assessment model an estimate of the *SCC* is determined by first transforming projections of economic growth (Y_0) into projections of greenhouse gas emissions (E_0). Then temperature change (T) due to the increase of emissions is estimated and this further informs an estimate of associated economic losses $D(T)$ caused by those emissions (indirectly due to temperature increase). The feedback effect of reduced emissions (E-E_0) due to the economic loss is taken into account in some models. According to K. Arrow et al. (2013) the *SCC* is then mathematically defined as the marginal loss of social welfare δW caused by an additional ton of carbon dioxide emitted δE, normalized to the marginal loss of social welfare caused by one dollar lost in terms of consumption ε.

It stands to reason that such a comprehensive estimate is subject to large uncertainties and thus a topic of discussion. Also as noted by the Interagency Working Group on Social Cost of Carbon (2013) appointed by President Obama these models naturally lag behind the most recent research. Some argue that the figures provided are too high and others that they are too low. The IPCC notes in their report that it is very likely that the social cost of carbon underestimates the damages. The graph below shows some of the difference between the different models:

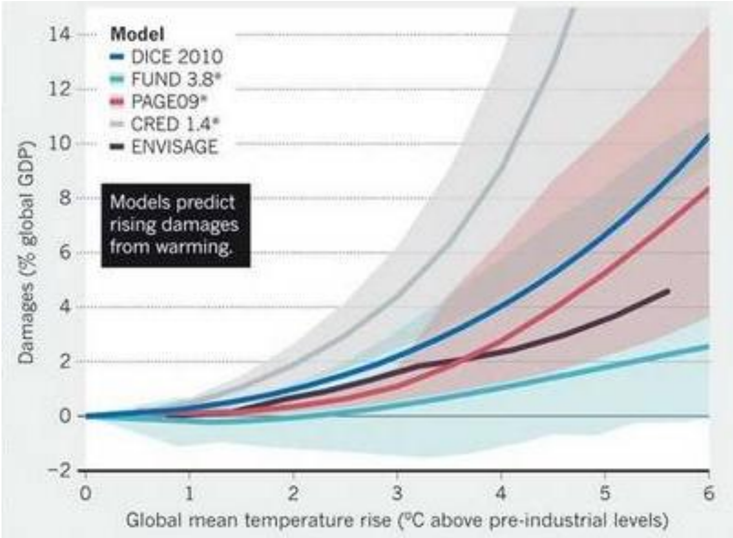

Figure 3: Projected damages as share of global GDP from different models (Richard L. Revesz et al., 2014)

These considerable differences in projected damages in turn influences the estimated monetary value set to the SCC. Table 2 shows some of the more recent estimates of SCC and the models they are based on.

Source	Modell	SCC ($/metric ton)		Base year
Arrow et. al (2014)	Summary	$	43	2020
US government (2013)	FUND, DICE, PAGE	$	37	2015
US government (2010)	FUND, DICE, PAGE	$	24	2015
Nordhaus (2010)	RICE	$	30	2020
Bastianin mfl. (2010)	WITCH	$	22	2020
Tol (2009)	FUND	$	55	2020
Paltsev mfl. (2009)	EPPA	$	75	2020
Bosetti mfl. (2009)	WITCH	$	38	2020

Table 2: Different estimates of the social cost of carbon (K. Arrow et al., 2013; NOU 2012:16, 2012; Richard L. Revesz et al., 2014)

The key takeaway here is that even though each model has a different approach and there is a wide range of uncertainties, all the models predict huge economic damages from GHG emissions for warming beyond 2 °C above pre-industrial levels. According to Richard L. Revesz et al. (2014) two newer models "ENVISAGE" and "CRED", published after the US analysis was structured in 2010, give about the same projections. The authors further sum up by saying that across all the models they have reviewed, depending on assumptions about how future damages are valued in today’s money, "the expected global cost of one tone of carbon dioxide emitted in 2020 is between $ 12 and $ 64, with $ 43 as the central value". Also, Richard Tol gives an average value of $ 50 from his meta-study from 2005 (Richard S.

J. Tol, 2005). Interestingly, he points out that peer-reviewed articles often provide lower estimates of the social cost of carbon than do governmental studies and numbers provided by advocacy groups.

3.1.6 Uncertain damage estimates

The costs associated with climate change could be even higher than the social costs and discussion given above indicate. There are several reasons for this; the first being that societies and economies may be more vulnerable to climate change than the models are able to predict. According to Richard L. Revesz et al. (2014) the models factor in average weather changes but not increasing variations in weather. Severe draughts or floods and the impacts these may have is therefore not represented. Also, some crops are less resistant to weather conditions than others. Some crops may decline rapidly over a certain temperature. If a country or region is highly dependent on this crop there may be extreme economic effects due to famines, diseases and war that the models do not encompass. Hsiang, Burke, and Miguel (2013) take an even more somber view, mentioning the risks of governments being overthrown, wars, economic crises and societal collapse as a result of changing climate.

Also, the models largely exclude the damages related to climate change when it comes to labor productivity, productivity growth, and to the value of the capital stock. The models are static, if a decreasing annual growth rate was introduced due to climate change; the damages could have larger effects on the global economy than the models currently take into account. This compounding "lost growth" may represent a substantial decline in welfare (Fankhauser & S.J. Tol, 2005; Richard S.J. Tol, 2011).

Richard S.J. Tol (2011) and Sterner and Persson (2008) mention that as resources become more scarce their value increases. This is also a shortfall related to the models being static. Because the benefit the resources yields is likely to decline as warming degrades them, the costs of future damage from climate change will rise faster than the models predict (K. Arrow et al., 2013).

Last, several prominent researchers, perhaps most notably Weitzman and the Stern review, have noted that the models use constant discount rates to give an estimate of present value of the damages. They argue that for impacts that are both highly uncertain and occurring in the distant future a declining discount rate should be used. They reason in different ways, Weitzman viewing the issue as a form of "insurance", while Stern emphasizes the uncertainty aspect but arrive at roughly the same conclusion: the discount rate should decline. This would give a much higher present value long-term damages and therefore a higher value for the social cost of carbon (Stern, 2007; Martin L. Weitzman, 1998; Martin L Weitzman, 2007). Nordhaus (2007) disagrees with this and promotes high discount rates based on the current markets ability to handle the high social cost of carbon, and also cites the fact that we have poor people now that need help. If future generations are to be richer anyway, he sees no reason for them to benefit even more by reducing emissions now.

To Nordhous' credit, it is true those future generations may be richer and that technological improvements might equip them to cope with climate change. But according to K. Arrow et al. (2013) the bulk of the literature and arguments indicate that social-cost models are under-estimating climate-change harms.

The type of cost/benefit analysis that the discussion about discount rates implies that known benefits and costs of a project should be converted to consumption units and discounted to the present at the consumption rate of interest, i.e. the rate at which society would trade consumption in a future year *t* for consumption now. From the Ramsey–Cass–Koopmans model one can under certain assumptions (social planner who wishes to maximize social welfare of society etc.), which simplifies the picture substantially, derive the "Ramsey condition", where the discount rate applied to net benefits at time *t*, ρ_t, equals the sum of the utility rate of discount (δ) and the rate of growth in consumption between *t* and the present (g_t), weighted by (minus) the elasticity of marginal utility of consumption (η) (Fankhauser & S.J. Tol, 2005):

$$\rho = \eta g + \delta$$

Most climate scientists agree that this is a useful conceptual framework for examining intergenerational discounting, but they disagree on how to determine the parameters (δ) and (η) (Stern, 2007).

One further speaks of a prescriptive and descriptive approach. The prescriptive approach is to view the parameters (δ) and (η) as representing policy choices whereas the descriptive approach is to base the estimates of (δ) and (η) on market rates of return.

Those who favor the prescriptive approach argue that the parameters could be based on ethical principles, public policy decisions or social preferences. Stern (2006), for example, argues that it is ethically indefensible to discount the utility of future generations, except possibly to take account of the fact that these generations may not exist. This implies that δ=0, or a number that reflects the probability that future generations will not be alive. Stern assumes that the hazard rate of extinction is 0.1% per year.

The parameter η determines how fast the marginal utility of consumption declines as consumption increases. According to Dasgupta (2008) it can be understood as a measure of intertemporal inequality aversion. This means that it reflects the maximum sacrifice one generation should make to transfer income to the next generation. Those who favor the descriptive approach (Nordhouse (2007) among them) suggest that η (or ρ itself) could be inferred from the financial markets. Although they recognize that, even for longer term assets such as 30-year bonds, behavior in financial markets is likely to reflect intragenerational than intergenerational preferences.

Positive effects

While most researchers hold the view that, when all effects are added up, the result will be a net negative, there are also some positive effects that may materialize. Among these positive effects are the opening of the northern passages, the Northern Sea Route and the Northwest Passage which can decrease shipping distances substantially and therefore also the costs and emissions associated with international shipping. Also, there might be benefits to global food production as land farther north becomes arable. These areas may have the potential to supply more food than is done today (Parry, Rosenzweig, Iglesias, Livermore, & Fischer, 2004). Richard Tol (R. S. Tol, 2002a, 2002b) states that an increase of 1°C in the average global surface temperature will have, on balance a positive effect for the OECD, China and the Middle East (and a negative effect for other countries). In that case the problem becomes more an issue of how the benefits of climate change are distributed. It should be noted that Tol still puts a price to emissions (Richard S. J. Tol, 2005).

3.1.7 Disclaimer

This thesis will not discuss differing opinions on the effects of GHGs building up in the atmosphere. In these matters it will side with the stance of the IPCC, saying that the enhanced greenhouse effect caused by human activities is to be viewed as a force with potentially dire consequences.

3.2 Optimal emissions restrictions

To reach economic efficiency in production, Diamond and Mirrlees (1971a, 1971b) showed that inputs should not be taxed. They maintain that it will not be efficient to implement taxes that would cause different sectors and producers to face differing factor prices. Or, perhaps even more politically controversial implementing taxes that distort the price relationship between imported and domestically produced goods.

Diamond and Mirrlees maintained however, that taxes should be implemented to correct for the externalities of production. The environmental taxes strive to be in this category. These taxes may ideally be seen as furthering efficiency because they see to that consumer’s factor in all costs that society has to bear because of the production and consumption of a product. According to the writers of NOU2009:16 (NOU 2009:16, 2009) Diamond and Mirrlees builds on very strict assumptions. But the group still holds the view that it is difficult to see any economically founded reasons for taxes being used to shift the factor intensity between producers and sectors, if this is not on the basis of correcting externalities.

Another classical example is Ramsey (1927) which states that to reach economic efficiency in consumption, taxes should be levied in markets where the allocation will be least affected. This is called the Ramsey principle for optimal taxation (Norman & Orvedal, 2010). It states that the efficiency loss is least when a tax is implemented on goods where a change in price leads to small changes in demand, or in other words in markets where the demand and supply elasticities are low and the sum of cross price effects are low (NOU 2009:16, 2009).

These examples are however not set in stone. NOU2009:16 uses the example of diapers for children to illustrate this point. It is unlikely that parents of small children will consume fewer diapers even if prices increase. According to the Ramsey principle this should then be a relevant item for taxation. But, we also know that parents with small children, in many cases, are relatively poor. So, implementation of such a tax may not be politically, or indeed morally, acceptable.

When it comes to the regulation of GHG emissions there are both the costs of measures and the benefits of avoided damage to consider. The relationships between these two are illustrated in figure 5. Here we see the quantity of pollution on the x-axis and the benefits or "value" represented on the y-axis. An efficient level of pollution is here defined by using the concept of Pareto efficiency, which is defined as an outcome being efficient if it is not possible to make someone better off without making someone else worse off (Grafton, 2004). This efficiency term does of course not imply that pollution is in any way desirable.

The efficient level of the pollutant shown in figure 5 is found at the intersect of the marginal cost of abatement curve and the marginal benefit of abatement cost curve. This is where the marginal cost of reducing or abating pollution exactly equals the marginal benefit of abatement. The marginal benefit further represents the reduction in the *MEC* associated with the pollution.

To give the standard example of this concept provided in both Grafton (2004) and Pindyck and Rubinfeld (2005) one can think of a factory that pollutes a river, affecting (imposing costs on) the users of the water downstream. The cost imposed on the downstream users is a negative externality that the factory upstream is oblivious to. The fact that the factory does not factor in this cost negatively affects the utility or production function of other actors in the market. Reductions in the pollution from the factory, that will reduce the cost incurred by the downstream actors, represents the benefits associated with abatement. The cost of abatements represents the expense to the factory associated with implementing measures to reduce pollution. Factoring in these aspects one can derive the efficient level of pollution indicated in the figure below:

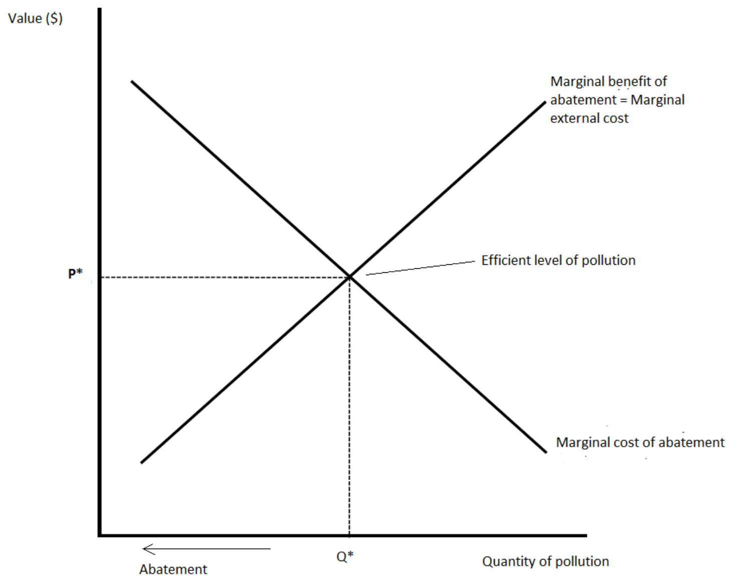

Figure 4: Efficient level of pollution adapted from (Grafton, 2004)

The key takeaway here is that just as the level of pollution can be too high, the level of pollution abatement can also be too high if the benefits of reducing the pollution is less than the cost of taking such measures. It follows that for many, perhaps even most, pollutants the efficient level will be positive.

Another possibility, not illustrated here, is when the marginal external cost is greater than any marginal cost of abatement. If this is the case, the marginal external cost curve will be greater than the marginal cost of abatement for all pollution levels, leading to an efficient level of pollution equal to zero.

3.2.1 Stock and flow pollutants

The example above is of a flow pollutant, where an efficient level of pollution can be derived when the marginal benefits of pollution control equals the marginal cost of abating, and is defined as some fixed level of emissions per unit of time. The efficient level of a stock pollutant on the other hand, is not generally fixed but rather a function whose value will change over time (Grafton, 2004). The definitions of stock and flow pollutants, respectively, from Grafton (2004) are:

- Stock pollutant: Pollutants whose effects accumulate over time and dissipate slowly
- Flow Pollutant: Pollutants whose effects are only felt at the time of discharge and can be readily assimilated by the environment.

Because this thesis concerns CO_2, which is a stock pollutant the explanation above may seem irrelevant, but I feel it serves as a good explanation of the general concepts involved in emissions reduction.

3.2.2 Externalities and market failures

Markets, in spite of all their benefits, sometimes need to be regulated or controlled. Authorities and policy makers largely aim to provide regulations that are fair and efficient to correct market failures when they arise.

Negative externalities associated with emissions are a typical example of a market failure. Even though there seem to be potential benefits to all parties involved in reducing emissions, research has shown that these cost-efficient measures often gets blocked by different market barriers. Chiefly among them is perhaps a lack of reliable information in addition to technical and market failures. Where, lack of information makes investment decisions in new technology uncertain as standards and regulations are unclear. Technical barriers happen when for instance ship-owners do not have confidence in a solutions ability to provide the cost reduction promised. Market failures can typically arise from divergent incentives, for instance if the party that pays for an efficiency measure does not get the benefits of the associated fuel savings or, if private capital to invest in low-carbon technologies cannot be obtained. Ways to overcome market barriers could drive the adoption of cost effective measures without compromising profitability (Grafton, 2004; Pindyck & Rubinfeld, 2005).

The authorities and policy makers typically have the following major options and measures to correct these failures and barriers; taxes; fees; penalties; prohibitions; quotas; regulating consumption, production or the use of certain resources; giving direct or indirect subsidies to production, employment, investments etc.; customs; and export subsidies in addition to several other more subtle ways of trying to facilitate efficient markets.

The following section will present the concept of externalities and economic theories concerning the correction of market failures.

3.2.3 Externalities

According Grafton (2004) externalities can be defined as: "*The result of an activity that causes incidental benefits or damages to others with no corresponding compensation provided to or paid by those who generate the externality"*. This compensation is usually understood as a price mechanism. These externalities can further be positive or negative, determined by whether the action of one party results on benefits for other parties or imposes costs on other parties (Pindyck & Rubinfeld, 2005).

As these externalities are not compensated for, and as such is not reflected in market prices they are often viewed as sources of economic inefficiency, where a state of economic efficiency is defined as when: Maximum output is produced for the inputs used, and inputs are allocated to minimize costs for any output level (Grafton, 2004). The source of inefficiency in this thesis would be that the price of inputs in the efficiency maxim is wrong because it does not factor in the damage of emissions, and thus the allocation of inputs is wrong and the ideal of economic efficiency cannot hold. The following chart shows the costs of externalities.

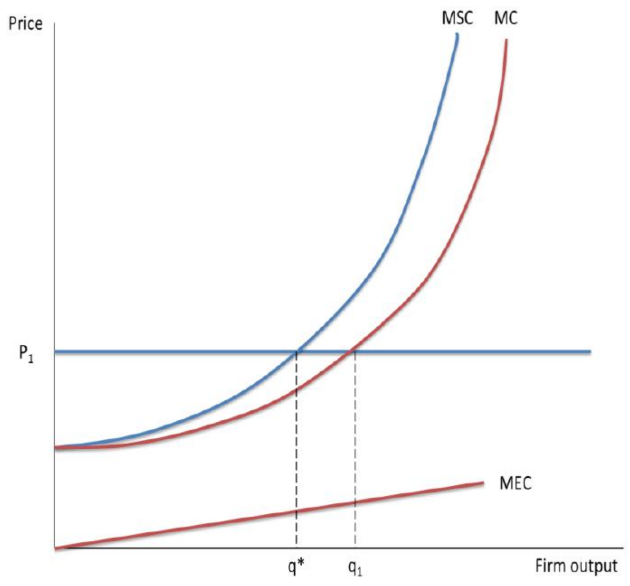

Figure 5: the concept of negative externalities from Pindyck and Rubinfeld (2005)

As figure 5 illustrates; in cases where negative externalities are present, the marginal cost curve for a firm does not reflect the actual cost of production, denoted *marginal social cost* (*MSC*). This leads to the *MSC* of production being higher than the marginal cost (*MC*) of production currently faced by the representative firm.

The difference between the curves is the marginal external cost (*MEC*). This cost is not felt by the producer, and thus the profit-maximizing firm will disregard this cost (the externality) and therefore produces more (q_1) than the efficient output (q^*).

To correct this imbalance either price of inputs and the corresponding market price has to change to reflect the social cost of production (factoring in the externality), which will lead to a smaller quantity demanded or, the quantity produced must be curtailed by other measures.

The following section will present the simplest theoretic solution (several assumptions have to hold) to resolving externality problems; introducing a Pigouvian tax.

3.2.4 Taxes and economic theory

To avoid the resulting ineffective equilibrium and corresponding excessive pollution from market failures, a Pigouvian tax can be introduced. These taxes are named after the economist A. C. Pigou who first argued for their use in the 1920's (Grafton, 2004). Pigou was the first to suggest the theoretical possibility of correcting negative externalities by taxing the activities that cause these externalities directly. Because these taxes are set equal to the *MEC* they do not lead to economic inefficiency and loss such as other taxes do. According to Norman and Orvedal (2010) taxes normally lead to ineffective shifts in allocation of resources. Instead, by correcting market failures, Pigouvian taxes lead to gains.

Pigouvian taxes works by adding a tax *t** per unit of emissions, where *t** is equal to the *MEC* for the individual firm. The result is that the allocation of resources and prices in the market is brought closer to the optimal market solution. Indeed given a perfectly competitive market and under the assumption that authorities have perfect information one can reach the theoretically efficient market solution. Thus levying the correct tax directly on the source can lead to an optimal equilibrium. This is shown in figure 7 below.

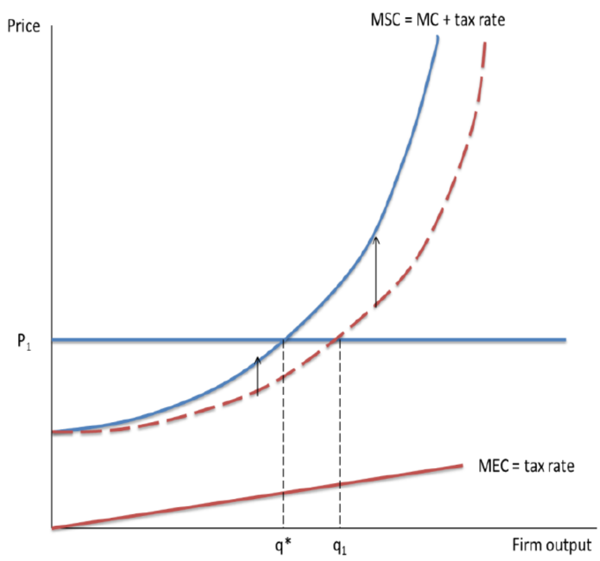

Figure 6: Illustration of a Pigouvian tax from Pindyck and Rubinfeld (2005)

Figure 6 shows the tax set equal to the *MEC*. This leads to the firms' marginal cost curve (*MC*) shifting upward. The resulting *MSC* curve is equal to the firms marginal cost plus the tax. To reach the new equilibrium dictated by the intersect of the fixed price curve and the firms' *MSC*, the firm has to adjust its output. The firm reduces its output from q_1 to q^* units, which reflects the optimal market solution in this case.

It should be noted that it is difficult to find the correct tax, most argue that it is only a theoretical possibility (Grafton, 2004). Also, Pigouvian taxes are very different than fees, and these two terms should not be mixed. Pigouvian taxes require perfect information and are a form of a direct regulation, taxing the source of pollution (in our case) directly. The perfect information criterion further implies that we know the outcome of the regulation, a very strong assumption. Fees on the other hand, are determined with less market information (no assumption of perfect information); the outcome of a fee is therefore more uncertain and can be subject to several moderating and subjective factors such as political interest etc. Pigouvian taxes are by their nature objective, factoring in only the unbiased marginal external cost to reflect the true cost in the market. This is why these taxes often are held as the ideal of a regulation, rather than being a practical solution.

3.2.5 Direct and indirect regulation

To correct for market failures authorities have several means at their disposal. An important distinction between these means is whether they are direct or indirect.

3.2.6.1 Direct regulation

Direct means, in the case of emissions, are largely centered on prohibitions, quotas and injunctions. These measures have in common that they specify specifically for any actors in the market either what they must do or what the consequences, or costs, of their actions will be. Examples here can be when the authorities regulate the emissions from an activity directly or specifically banns a substance, such as the ban on using chlorofluorocarbon gasses (CFC gasses) in refrigerators.

Direct measures attract popular criticism because the enforcement of them usually incurs administrative costs related to monitoring the adherence to the regulation. In addition such measures may not be effective in either cost-terms or economic terms because they force actors to behave in certain ways rather than giving the actor the opportunity to decide the most efficient solution for their needs. The fact that these are often "blanket measures" (applies to all parties equally) strengthens this inefficiency.

An extreme example of a direct measure related to this thesis would be if the Norwegian government, aiming to reach national emission targets, mandated that all ships operating in Norwegian territorial waters had to switch to liquid natural gas (LNG) as fuel. This measure would not be cost-efficient as cost-efficiency of a measure depends on whether the measure is the cheapest way to reduce national emissions or not.

As with the Pigouvian tax example above, direct measures can be made more efficient if the authorities have good information about marginal external costs, market participants and differences between segments of the market. The last point about differences between segments of a market is relevant to this thesis as it is the basis for the reasoning behind the government exempting smaller commercial fishing vessels from paying CO_2 tax on fuel.

3.2.6.1 Indirect regulation

Contrary to the direct measures described above, indirect measures aim to incentivize desirable behavior from actors in the market. It is often referred to as the "market mechanism" as it corrects failures by assigning costs to the negative externalities or benefits to positive externalities and thus, ideally, drive firms and other actors towards choosing the optimal solution (Pindyck & Rubinfeld, 2005). Among the examples of indirect measures are fees per unit of emission, subsidies, tradable emission permits or deposits incentivizing certain behavior such as the Norwegian "plastic bottle recycling scheme".

3.2.6 Fees and quotas

This section will focus on a firms' marginal cost of abatement (*MCA*) and its relation to marginal social costs (*MSC*) and how one can elicit the optimal level of emissions by either quotas or fees. Figure 7 below illustrates this relationship. Here the same logic as for the factory mentioned in earlier applies. The factory produces something, say; a car, and in the course of this effort releases some polluting substance into the river. The firm has options available to them to reduce the emissions, but there is a cost associated with it.

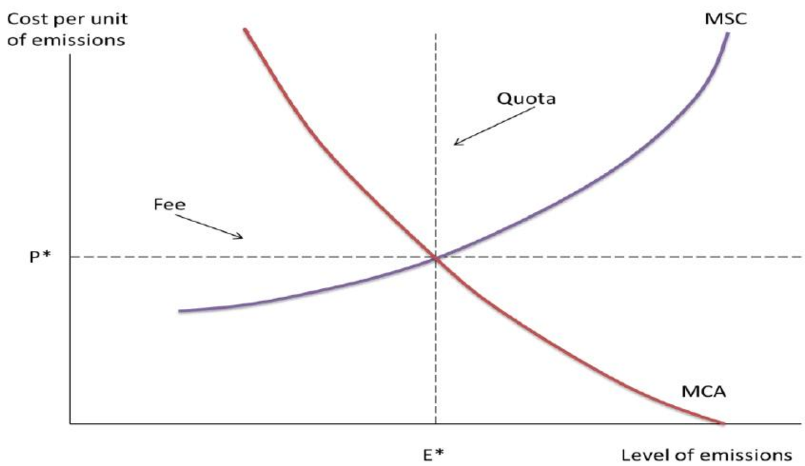

Figure 7: The relationship between fees and quotas (Pindyck & Rubinfeld, 2005)

We assume that the firm is profit-maximizing and that it therefore has chosen its preferred emission amount based on the costs and benefits it is faced with. The *MSC* curve slopes upward due to the marginal social cost of the pollution increasing as the externality is compounded. The *MCA* curve slopes downward due to the cost of reducing emissions being low when the level of emissions is high and high when emissions are low to begin with.

3.2.7 Fees

The authorities can implement a fee equal to *P** per unit emitted. If emission levels are above *E**, the *MCA* faced by the firm is less than the emission fee. The response of the profit-maximizing factory in our case would then be to minimize its costs by reducing its emissions quantity to the optimal level indicated by *E**. If the level of emissions are below *E** the *MCA* would be higher than the emission fee, the factory would then have no incentive to reduce its emissions, preferring instead to pay the fees on its current level.

Fees will generally bring certainty to the cost of abatement but leave the reduction level of emissions uncertain.

3.2.8 Quotas

A quota works by specifying the amount of emissions that our factory is allowed to release. The factory would incur great costs or penalties if it exceeds the limit. The quota would be set equal to the optimal level of emissions *E**. To meet these demands the factory has to invest in abatement measures to avoid the penalties, which would cause the average production costs of the factory to increase. This should in theory lead the factory to produce its economically efficient output as defined above. If the price the factory can get for its products in the market is higher than the average cost of production, including the abatement cost (and also providing a reasonable return on capital) the factory will stay in business. If the cost of production, including the abatement cost, is higher than the market price the factory would shut down.

3.2.9 Quotas and fees compared

Hoel and Karp (2002) state in their article that asymmetric information plays an important role in environmental regulation because the emitter usually knows more than the government about its abatement cost function. When this information asymmetry is present in the market, the first-best optimum can seldom be reached by the use of taxes or quotas. With the "first- best optimum" being the formal term for the solution "that equates the marginal abatement costs of the pollutants and the marginal environmental damage" (Hoel & Karp, 2002).

It follows that the comparative strengths of quotas versus fees depends on the authorities' access to information and the costs of controlling the emissions (Hoel & Karp, 2002; Pindyck & Rubinfeld, 2005; Martin L Weitzman, 1974). In practice fees are often considered the most viable option as it achieves the same level of emission reduction at a lower cost than the equal per-firm emissions quota (Grafton, 2004), especially policy makers seem to hold this view (Martin L Weitzman, 1974). According to Martin L Weitzman (1974) the two deciding factors for this observation is:

1. In real life quotas, for practical reasons, often have to be applied to all firms equally. In this case, not needing the same level of supervision, a fee will result in the same total reduction but at a lower cost. The fee will lower the relative production cost of firms with low *MCA* compared to firms with high *MCA*. This results in a more efficient output and allocation of resources than quotas.
2. Introducing a fee incentives investment in equipment that allows the firm to reduce its emissions. This may lead to technological progress as an added benefit. Quotas only reduce emissions by limiting production, there are no incentives to reduce emissions beyond this as the firm will not benefit.

If however we are faced with an industry where the marginal social cost curve is very steep in addition to the marginal cost of abatement curve being relatively flat, quotas may be the preferred measure. Also if, as is often the case in the real world, there is incomplete information the introduction of quotas will give more certain emissions levels. This will however make the costs of abatement uncertain (Martin L Weitzman, 1974).

3.2.10 Transferable Emissions Permits

A third and popular measure that can be used to moderate the existence of market failures is a so called "cap and trade scheme". According to Grafton (2004) a cap and trade scheme is an emission permit trading program where an overall cap or total level of emissions is set by a regulator and permits are allocated to polluters who are allowed to trade permits among themselves. One example of such a measure in practice is the European Union Emissions Trading Scheme (EU ETS) which will be outlined briefly later.

The cap and trade schemes are inspired by the Nobel Laureate in Economics Ronald Coase's contribution to understanding how property rights and transaction costs can mitigate inefficiencies associated with technological externalities (Grafton, 2004). This concept is called the Coase theorem, and states that if property rights are defined, given certain conditions then, regardless of how these property rights was initially distributed, liabilities or legal entitlements, the parties that are affected by an externality will bargain and negotiate between themselves and arrive at an efficient outcome (Norman & Orvedal, 2010).

The conditions to ensure this result is that there is zero costs attached to the negotiations and bargaining, there is no strategic behavior in the bargaining, all parties have perfect information, and that the initial distribution of rights does not affect the marginal valuation of resources or assets (Grafton, 2004).

This logic appeals to business and free market minded individuals as it is radically different than the traditional command and control approaches used by governments with all the faults associated with these approaches. Because, as is often the mantra in the US; the government is very bad at picking winners. And as we have seen above neither quotas nor fees are likely to produce efficient outcomes in situations with imperfect information. The cap and trade approach leaves this to market dynamics by decentralizing the resolution for externalities to the affected parties, as it is assumed that these have the most available information to resolve the issue efficiently (Grafton, 2004). Also Martin L Weitzman (1974) says that this may be a good solution from a theoretical point of view, especially in industries where output is more or less identical. He however cautions that the basic problem stands; is it better to fix the total amount by a quantity or using a price control option.

In practice a simple system of tradable permits can be distributed among firms equal to the maximum amount of emissions that can be generated. This efficiently creates a market for externalities (Pindyck & Rubinfeld, 2005). This approach combines the simplicity of a quota system with the cost advantages of a fee system. This works by the cap serving as an effective "quota" and the trading mechanism allows abatement to be done at the lowest cost as in the case of an optimal fee system.

As mentioned cap and trade systems mimics these features and work in practice by authorities auctioning off a fixed number of emissions permits to firms and other actors that are willing to bid. The firms also have the opportunity to trade between themselves. One permit could for instance be equal to one metric ton of CO_2, as is the case in the EU ETS. A company that manages to reduce its emissions can either sell the spare permits to other companies thus offsetting the costs of the reduction or "store" the permits for use at a later date. This flexibility, in line with the basic theory outlined above, will lead to cost-efficient emissions cuts, with abatements taking place where it is cheapest/most effective, and those who cannot reduce at a reasonable cost still have to pay for the externalities they cause as they have to buy permits for the emissions in excess of their initial "allowance".

As the authorities decide the quantity of permits that are in the market at any given time, or the "cap", they can regulate the market and reduce the amount of available permits over time to inspire further abatement. This last point has proved a problem as there are currently too many permits in the EU ETS due to high initial allocations and due to companies being able to hoard and store cheap permits. One possible amendment to this problem is expiration dates on the permits as this would force companies to either use them or sell them off within a reasonable timeframe.

The example in figure 8 outlined in Babiker, Reilly, and Viguier (2004) illustrates the benefits and allocations in a simple system of tradable permits, without distortions, between firms.

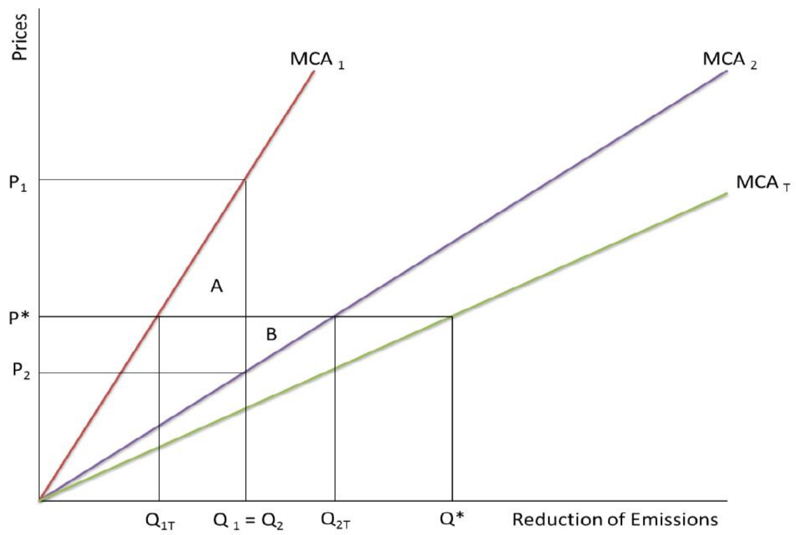

Figure 8: Tradable Permits (Babiker et al., 2004)

Figure 8 shows the marginal cost of emission reduction for firm 1 (MCA_1) and firm 2 (MCA_2). The MCA_T is the total marginal abatement cost and corresponding reduction quantity realized with the trading scheme in place. The initial situation assumes that the firms have limits on their allowed emissions, so that emissions have to be reduced without emission trading by Q, where Q is the combined reduction target for the two firms (Q_1,Q_2) such that $Q_1+Q_2=Q$, and where $Q1=Q_2$. As the figure illustrates, the marginal cost of abatement at Q is higher for firm 1 than for firm 2. This is because $P_1>P_2$, where P_1 and P_2 is the marginal abatement costs (or carbon prices) in their individual markets.

If an international emission trading regime is then implemented, marginal costs of abatement can be equalized across the two firms. The optimal reduction levels in the two firms are given by the combined quantity labeled Q^* and the corresponding marginal cost of abatement, with trade, is P^* in both markets. Now, given the ability to trade permits, it is beneficial for firm 1 to reduce its emissions by Q_{1T} and buying emission permits from firm 2, whereas firm 2 benefits from reduces emissions by Q_{2T} and selling permits to firm 1. As shown in Figure 8, the two firms are better off with emission trading compared to the situation as is was before. The net income gains are equal to area A for firm 1 and to area B for firm 2 (Babiker et al., 2004).

The EU ETS may be a possible contender for the best way to regulate emissions in shipping together with more direct and less complicated measures like a fee paid "at the pump".

3.2.8.1 A short note on Transferable Emissions Permits vs. Pigouvian taxes

The same outcome as illustrated in figure 9 can theoretically come about if a Pigouvian tax is implemented. The problem with these taxes is that given the assumption of a growing economy (or indeed an economy in recession) the tax would have to be adjusted very frequently to have optimal effect (Pindyck & Rubinfeld, 2005). This is not possible in practice, and the costs associated with trying are likely to be too high. Without these adjustments and without taking in other effects such as inflation the effects of the tax will eventually be eroded and it will lose its effect. Thus the Pigouvian tax must be said to be far less precise with regards to quantity in practice than permits. The price of permits however, will due to market mechanisms follow the general price level. Also, given a market for permits when the economy grows the price permits will increase accordingly, reflecting the relative scarcity of the rights to emit (Grafton, 2004).

3.3 Determining an environmental tax

Naturally using the criteria given above green taxes or fees can take many forms, and a more specific definition may be needed. Many taxes may be labeled "green" by the authorities, according to Sandmo (2009) the OECD defines taxes as green if they are levied on tax bases that are correlated with adverse environmental effects. This correlation can however take many forms, therefore the labeling of taxes as "green" or not is largely at the discretion of those who implement it. And, as everyone knows, correlation is not the same as causation. To illustrate these problems Sandmo (2009) uses a selection of the different taxes imposed on cars; the tax on car ownership (annual fee), petrol tax and taxes related to road use.

All these taxes have weaknesses. The tax on ownership has no effect on car use in the short run as it is fixed regardless of use, but may have long run effects leading to less cars being bought overall. The tax on petrol varies with use and may as such be a better environmental tax. It still has some limitations however as it does not discriminate between what the car is used for and when it is used (e.g. at congested times of day or not). According to Sandmo (2009) the taxes that has the closest resemblance to the Pigouvian tax is the taxes on road use. Here there is a chance to tax more congested roads higher than others, vary the charge with time of day. Another such tax is a congestion charge, like the one in London.

The key to setting such taxes is that they should reflect the difference between social and private marginal cost, as discussed above, where the difference represents the price of the damage caused by the externality. How to determine this amount is very difficult and has to be determined on empirical grounds, ideally tailored to each particular case.

3.3.1 Double dividends

According to Goulder (1995) another potential benefit of environmental taxes is that in addition to correcting negative externalities, they also generate revenue for the government without leading to the inefficiencies generally associated with taxes in an efficient market system. Thus, substituting the normal income and commodity taxes with environmental taxes should in theory be able to generate the same revenue for the authorities as before but at a lower social cost, i.e. in a more efficient way. This is the so-called "double dividend"(Goulder, 1995).

One would expect that this double dividend would make environmental taxes widely used. But this is not the case in real life(Sandmo, 2009). There are several reasons for this, some of which will be discussed in more detail.

3.4 The incidence of a tax

The effectiveness of an environmental tax depends on who bears the cost of said tax, the tax incidence, and whether it has the intended consequences when it comes to lessened input factor intensity, decreased total consumption of a good or incentivizes investment in new equipment.

The current tax on CO_2 emissions is a specific tax. In other words it is a tax of a certain amount of money per unit (of fuel) sold, which follows the definition of specific taxes in Pindyck and Rubinfeld (2005). If the burden of the tax is split equally between suppliers and consumers we have the situation described in figure 10 below.

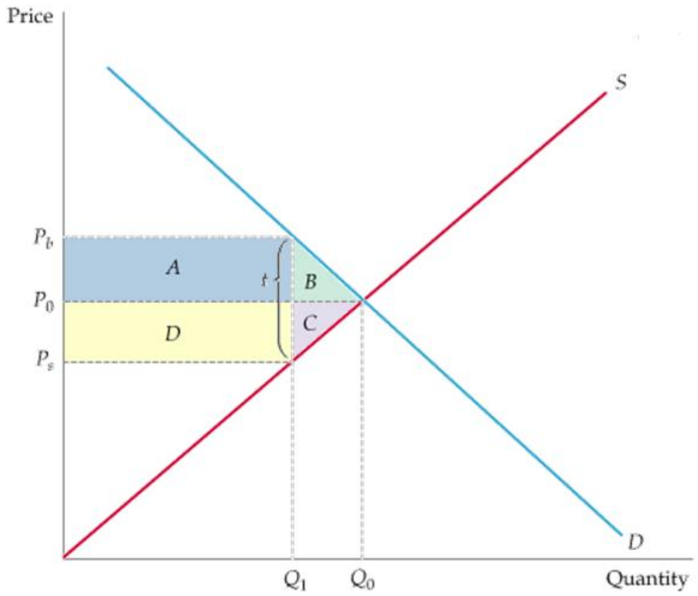

Figure 9: Incidence of a tax (Pindyck & Rubinfeld, 2005)

In figure 9 the tax is shared equally by the suppliers and the consumers. In effect the consumer price P_b rises with half the tax and the supplier price P_s is cut by half the tax. This solution requires four conditions to hold (Pindyck & Rubinfeld, 2005).

1. The quantity sold and the consumer price P_b has to be on the demand curve:

$$Q^D = Q^D(P_b)$$

2. The quantity sold and the supplier price P_s has to be on the supply curve:

$$Q^S = Q^S(P_s)$$

3. Quantity demanded must equal the quantity supplied (*Q1*):

$$Q^D = Q^S$$

4. The difference between P_b and P_s must be equal to the tax *t*:

$$P_b - P_s = t$$

By estimating the demand curve Q^D (P_b) and the supply curve Q^S (P_s) and knowing the tax t, these equations can be solved for the consumer price P_b, the supplier price P_s and total quantity demanded. Here P_b is the price that consumers have to pay. P_s is the price that the suppliers receive. P_0 is the price that would clear the market without the tax. Consumers will lose A+B, suppliers will lose D+C while the government earns A+D in revenue from the tax. B+C represent the deadweight loss associated with this very generic scheme.

3.4.1 Who bears the burden of the tax?

In the case in figure 10 the burden of the tax is shared equally by consumers and suppliers. In the real world however the elasticities of demand and supply vary with the good in question. These differences in elasticities have huge effects on who bears the burden of a tax. Consider the figure below showing two different cases, one with very an inelastic demand and relatively elastic supply curve, and the other vice versa:

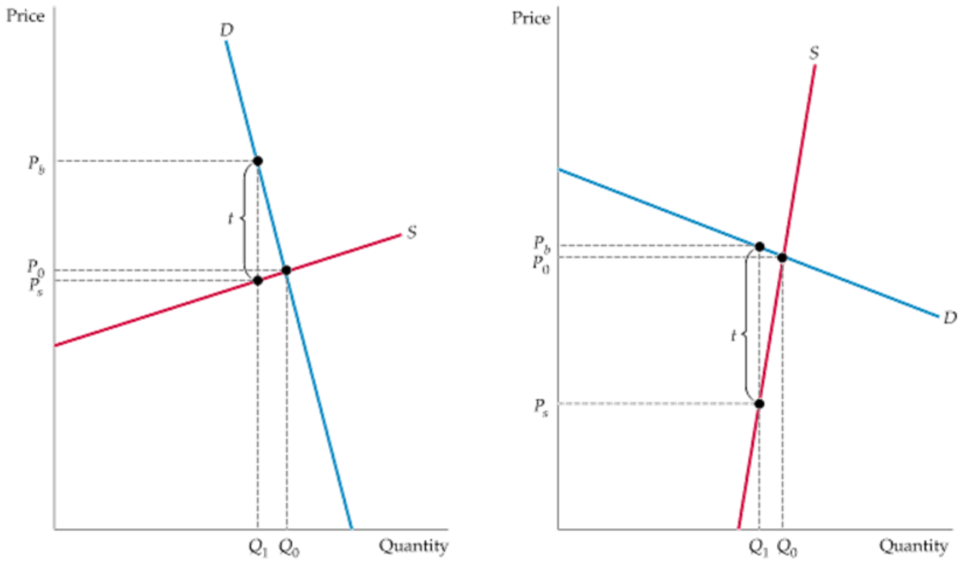

Figure 10: Impact of taxes depends on the elasticities of supply and demand(Pindyck & Rubinfeld, 2005)

Figure 10 shows that if demand is relatively inelastic and supply is relatively elastic the burden of the tax will fall mostly on consumers. This is easy to see from the graph to the left. A reduction in demand requires a relatively large change in price, whereas a reduction in supply only requires a small price change. This is a typical situation for addictive goods such as cigarettes. Sumner and Wohlgenant (1985) showed that a tax on cigarettes is mostly taken up by consumers due to the relatively inelastic demand of this product (about -0.4). The figure to the left shows the opposite case, which may be more relevant to the issues of this paper.

According to Pindyck and Rubinfeld (2005) the benefit of this relationship is that we can say something about the likely tax incidence without resorting to deriving elasticities for the entire supply and demand curves, which in many cases can be difficult. We can estimate roughly who will bear the burden of the tax using only a small range of elasticities or point elasticities. In most cases a tax will fall mostly on the consumer if E_d/E_s is small and mostly on the supplier if the E_d/E_s is large. This gives us the "pass-through formula"(Pindyck & Rubinfeld, 2005):

$$\frac{E_d}{(E_d - E_s)} = Pass - through\ fraction$$

Where E_d is the elasticity of demand and E_s is the elasticity of supply. The formula gives us the fraction of the tax that is passed through to producers in the form of higher prices. Table

3 below shows how much of a tax the producer has to bear with different combinations of elasticities of supply and demand.

Suppliers share of a tax with different elasticities						
			Demand Curve			
			Perfectly inelastic	Inelastic	Unity inelastic	Elastic
			0	-0,5	-1	2
Supply curve	Perfectly inelastic	0	0	-100 %	-100 %	-100 %
	Inelastic	0,5	0	-50 %	-67 %	-80 %
	Unity inelastic	1	0	-33 %	-50 %	-67 %
	Elastic	2	0	-20 %	-33 %	-50 %

Table 3: Suppliers share of a tax with different elasticities

To sum up, we need the price elasticity of both supply and demand to determine how the burden of the mineral oil tax will be divided between the actors in the market. This will be dealt with later. There is of course also the opportunity for either customers or the supplier to avoid paying the tax to consider.

4. Analysis

First, in order to evaluate the Norwegian CO_2 mineral oil tax one the governments stated goals for the development of the industries should be given account for and discussed in context with the governments goals for reducing CO_2 emissions. This approach will provide a framework for evaluating both the economic, political and environmental aspects of the effort to reduce emissions by reducing the refund of the tax on mineral oil.

4.1 Climate and CO_2-reduction goals

Over the years the Norwegian government has developed its foundations for how to evaluate climate policies. The principal document for how the climate policy is conducted today is the report "A climate friendly Norway" (NOU 2006:18, 2006), which has been updated and refined ever since. Based on this report and others wide support was given to the government resolution "klimaforliket" or "climate agreement" (Innst. S.nr. 145 (2007–2008)). The latest set of principles for evaluating climate policies in Norway is found in the "Norwegian Climate Policy" report No.21 to the Parliament (2011-2012) (Ministry of Climate and Environment, 2012). The frameworks used in these reports are in turn based on the report NOU 2012:16 "Economic Analysis" (NOU 2012:16, 2012) published by the Department of Finance. These evaluations have in turn led to the sustainability goals defined in the national budgets ever since 2012 (Ministry of Finance, 2011, 2013a). The principles, goals and result parameters are as follows:

Fair distribution

The government states that according to our foundational values there should be a fair distribution between those living today and future generations. The government will continue to work for economic growth, but this growth has to be sustainable so that future generations' income potential is not diminished. This further entails combating poverty both in the Norwegian society and abroad. Citing the fact that most of the emissions done so far has been contributed by industrial countries, the government holds the view there is a case to be made that more developed nations should make reductions first.

International solidarity

Building on the prior point, both rich and poor nations have a combined but differentiated obligation to avoid climate change. This does not mean that poorer nations should not comply with the regulations, but it means that richer nations should help them comply. As nations emerge from poverty they are expected to take a greater share of the responsibility.

The precautionary priciple

The precautionary principle basically means that where there is scientific uncertainty, any doubt should be interpreted in favor of the environment. This further means that if there is a risk for serious or irreversible harm to the environment, lack of knowledge should not be used as an argument for delaying or suspending actions to mitigate this damage.

The polluter pays

Those who pollute should bear the real costs incurred by damage to humans and to the environment. Making the polluter pay should result in reduced environmental damage and better utilization of resources. A consistent implementation of this principle will result in the climate goals being reached at the lowest possible cost.

This goes against the Coase theorem as discussed in the theory section however which states that if property rights are defined, given certain conditions then, regardless of how these property rights was initially distributed, liabilities or legal entitlements, the parties that are affected by an externality will bargain and negotiate between themselves and arrive at an efficient outcome (Norman & Orvedal, 2010). This goes to show that the government may be a bit one-sided in its approach to emissions reduction.

The government is not consistent on this principle, if we interpret the application in a wider context. For instance in the case of cigarettes the consumer is the one who is taxed not the producer of the cigarettes (Sumner & Wohlgenant, 1985). This is of course due to the tax incidence in the case of cigarettes, which the government is perfectly aware of. In cases where supply is very inelastic, meaning that the same amount is likely to be produced regardless of cost to the supplier with corresponding stable emission levels there is a case to be made for the consumer being taxed, or rather, being made to pay.

Combined effort

Sustainable development involves all segments of society, not only the authorities. Therefore the government must make it easy for its citizens to make the right choices.

Sustainability - natures limit

Here I refer to the discussion in the theory section. But, in short, this criterion means that any policy should aim to contribute to the 2°C increase target.

Effective governance

The principle of effective governance should dominate when a measure to do anything with an environmental issue is chosen. Effective governance means that the chosen approach should be the one that has the highest probability of reaching the desired goal. The issue of climate change is complex, as stated in the theory section; this breeds uncertainty and the measures taken need to reflect this complexity. Sources of such uncertainty may be that the reduction potential of any measure is difficult to quantify. This uncertainty may be related to whether the approach leads to the desired measures in the next step or on contextual factors such as population growth.

A cap and trade system may for instance be deemed effective governance in the case of CO_2 due to the fact that we can say that with relative certainty the reduction goals will be reached, even if we do not know where the reductions will occur. With tradable quotas the system will also be cost effective. For an incredibly toxic substance such as arsenic on the other hand a quota system would not suffice. Here the effective governance approach may be to forbid the release of the substance.

Cost effectiveness

Cost effectiveness means that any measure taken should lead to the largest possible reduction at the lowest possible cost. If the government deviates from this principle, it will result in a loss of welfare.

A cost effective climate policy is reached when all decision makers in society are faced with the same incentives to reduce their emissions. An equal price for the release of GHGs is an example of a cost effective measure. As stated in the theory section authorities have limited information about which measures will be the most effective, an equal price on emissions leaves the decision of where to reduce to the market.

Cost effective fulfillment of a global stabilization goal, like the two degree goal (IPCC, 2007) also requires that the incentives to reduce are the same regardless of regions and countries. Because the reduced emissions of GHGs have the same effect regardless of where it is done, climate policies should emphasize global cost effectiveness.

Other

In areas where general measures already apply, further regulation should be avoided. At the same time, the possibility of combining other measures in addition to quotas and fees must be upheld in these sectors. Especially in situations where measures may be cost effective over a projects lifetime when future, presumably rising, quota prices are in place.

The government emphasizes that a good and active national climate policy also has to be a good industrial policy. The climate policy should therefore contribute to the development of more climate friendly industries. And the final and perhaps most important point when it comes to putting these principles into practice: "An ambitious climate policy also has to be reasonable in a global context. This entails paying heed to the consequences of the quota system, the danger of carbon leakage and the competiveness of Norwegian industries when policies are formed" (Ministry of Climate and Environment, 2012).

4.2 Goals for the short sea sector

The aims and goals for the Norwegian short sea sector is found in the "National transport plan 2014-2023" (NTP2013) published by the Department of Transport in 2013 (Ministry of Transport, 2013). In the most recent report the Department emphasizes that Norway has special circumstances relating to distances, settlements and wage levels that is bound to constitute somewhat higher costs than nations we compete with nations. These conditions set some parameters for Norwegian transport policy. At the same time the Department underscores the government's desire to create an efficient and environmentally friendly transport system, which can at the same time reduce transport costs, the competitive disadvantages and the environmental damage from transport.

These are ambitions goals to be sure. The government has further subdivided its goals into an overarching goal of securing effectiveness in all sectors, road, rail, sea and air through continued development of infrastructure and better conduction of transport in general. The other singled out sub-goal is to encourage a transition of the transport of goods from road to rail and sea.

4.2.1 Transfer of goods from road to sea and rail

According to NTP2013 the government intends for the majority of the projected increase in transport to be diverted to sea and rail rather than road.

At the same time the government acknowledges that all modes of transport have their distinct advantages. Road transport is highly flexible, offering nationwide door-to-door service and with high security of delivery. Sea- and rail transport has a substantial cost advantage over longer distances, where higher volumes/weights are a factor and in cases where time is not the major service factor. In a Norwegian context, according to Ministry of Transport (2013) rail has the lowest costs per ton/km, followed by sea. This goes against many other sources, but Norway is a relatively small country and therefore quantities transported are not large. Most other sources hailing the environmental properties of sea transport use huge oil tankers and container vessels as benchmarks. Put simply, no 18,000 TEU containerships are used in Norwegian domestic transport. Over substantially long distances and with large quantities and weights however, nothing beats ships. Sea transport also has a high security of delivery and maintenance costs are low. As stated sea-transport is an important part of the Norwegian transport system. It comprises 90 percent of transport work in foreign trade and 42 percent of domestic transport work. Sea transport has relatively low costs in infrastructure, area needed, congestion, noise, accidents and person damage, in addition to its relatively low emissions on a ton/km basis.

One caveat with both sea and rail is that both are dependent on road transport at both ends. Therefore in many aspects the different modes of transport are complimentary to each other. Therefore if demand rises for rail or sea, the demand for road transport at the distribution points are also likely to increase. The only place where there is outright competition between them is therefore in long haul transport.

According to the same report road transport over 500 km is a small part of total tons transported but comprises close to 40 percent of transport done on road. Thus there is a case to be made that even a small transfer of goods to either sea or rail could have a huge impact on emissions, bearing in mind that road transport is a major source of emissions in Norway and also that this is where emissions per ton/km is the highest.

Sea transport has its completive advantage where freight distance between terminals is over 250 km. It already dominates tank and bulk, thus the greatest potential going forward is regular goods. The prognosis in NTP2013 states that transport of goods will increase by 40 percent by 2030, where a relatively high portion will be covered by road, if current trends persist. Sea transport however has a lot going for it in terms of population growth in urban and concentrated areas, which may increase the quantity of goods that needs to be transported between the ports close to the larger cities, thereby catering to the advantages of sea transport in terms of higher volumes. Also the European commission in its white paper on European transport from 2011 aims to increase the amount of goods transported by ships (European Commission, 2011). This development by the EU puts pressure on the Norwegian government to prepare its ports for larger quantities of goods from the EU arriving by sea. The government intends to meet this demand by strengthening the short-sea infrastructure and further the competitiveness of short-sea shipping. In short their proposed measures in different sources are (Ministry of Fisheries and Coastal Affairs, 2013c; Ministry of trade and industry, 2013; Ministry of Transport, 2013):

- Develop measures to stimulate increased use of short-sea shipping
- Governmental subsidies to certain harbors
- Governmental subsidies to harbor cooperation and concentration of goods
- Support research on transport
- Increase the competitiveness of short-sea shipping
- Enable transitions between different transport forms
- Combine terminals for rail and sea where this is possible
- Invest in maritime infrastructure and ensure security in Norwegian waters.

4.3 Goals for the fisheries sector

According to the Ministry of Fisheries and Coastal Affairs (Ministry of Fisheries and Coastal affairs, 2013a, 2013b, 2013c, 2013d) the previous governments' goals for the fisheries sector were (these have not been changed by the present government):

The goals come in four major categories. *First*, the government has the ambition that the Norwegian fleet should be at the forefront in technology, security, quality and profitability. This includes the reduction of subsidies and overcapacity. *Second*, the fleet should be varied along sizes and scope and contribute to value creation, activity and settlements in coastal areas. *Third*, a sustainable and knowledge based approach to the management of resources to ensure a high and long term dividend, while at the same time paying heed to environmental concerns. *Fourth*, ensure stable operating conditions to pave the way for continued development and through "good" fisheries management.

The fundamental prerequisite for all of these goals is the wellbeing of the different fish stocks and productive ecosystems. This is the overarching goal of all the different fisheries authorities. Thus any year-by-year adjustments to policy are second to the adjustment of quotas which is set for one year only. According to Meld. St. 22 (2012-2013) over 90 percent of the fish stocks relevant to Norwegian vessels are shared with other nations, therefore unilateral agreements are essential to the success of these policies.

At the same time the government emphasizes that the fishing fleet has to generate profits to contribute to society. There are still problems with overcapacity in certain segments and too many people have fishing as a part time, rather than as a full time occupation. Here there is a goal conflict that is not really addressed in the government's plans. On the one hand the government wants to ensure profitability in the sector while at the same time it relies on the smaller vessels that in turn are dependent on local infrastructure and distribution to maintain settlements and opportunities for employment in coastal areas (understood as areas that are not larger cities). This conflict stems from the fact that with the current prices in the market and quota sizes being what they are, several smaller vessels (under 11 meters) are not profitable after capital expenses. Meld. St. 22 (2012-2013) refers to a study by Nofima conducted in 2013 which confirms this picture (Hermansen, Larsen, & Henriksen, 2013). The government should sort out its priorities here; vessels in this segment cannot compete in the long term without subsidies. Even the most active vessels in this category, who fulfil their quotas, cannot be said to be profitable over their lifespan (Hermansen et al., 2013). Implementation of new subsidies to this segment goes against the government's intention in its first goal

In addition to these goals the government also has goals for the industry in terms of emissions outlined in the white paper on climate strategies for the Ministry of fisheries and coastal affairs (Ministry of Fisheries and Coastal Affairs, 2013b). Here the government plans to reduce any subsidies in the form of refunds, such as the refund of the mineral oil tax, to invest in research on new technologies and it has commissioned studies on further reduction of overcapacity which includes the possibilities of subsidized scrapping. These policies are likely to further increase the economic strain that smaller vessels are facing (Hermansen et al., 2013; Isaksen & Hermansen, 2009). But, from an economic and environmental standpoint this approach may be reasonable.

4.4 The Norwegian CO_2 tax exemptions

Even though Norway tries to adhere to the creed that it adapts its climate policy so that it "does its part in a good international climate policy" (NOU 2007:8, 2007), some sectors were initially exempt from paying these taxes. Norway has a long experience with environmental taxes and fees, and was an early mover when it introduced a CO_2 fee on gasoline, diesel oil, mineral oil and petroleum extraction of petroleum in 1991 (NOU 2009:16, 2009). According to NOU 2009:16 (2009) the responsibility for taxes and fees lies with the Ministry of Finance. Changes to the system usually come in the form of a proposition to the parliament and a final decision is reached as a part of the budgetary negotiations for the following year. The legal foundation for the CO_2-tax is found in "precept concerning special duties" (forskrift om særavgifter) number for-2001-12-11-1451 (2001).

As stated the fisheries sector, the domestic short sea shipping and the domestic air traffic are some of the major contributors to the release of CO_2. In spite of their noticeable contributions these sectors were exempt from paying or reimbursed for taxes on CO_2. According to NOU2007:8 (2007) the reasoning behind the exemptions differed for each sector. The exemptions cited international competition for the shipping and air traffic, while the fisheries sector got their exemption from the initial "grunnavgift" or "base fee" in 1988 on the grounds of low profitability in the industry. When the CO_2-fee was introduced in 1991 the "base fee" was discontinued and the reimbursement was given for the new fee instead. The situation for the fisheries sector is somewhat more complex than it is for the shipping and the air traffic, which were simply not required to pay the taxes. The fisheries sector on the other hand had a reimbursement scheme, but the economic effects of the different schemes are the same and thus they will not be outlined here in more detail.

Ever since its inception the exemptions from the taxes have been debated. One notable incidence is in the government report NOU1996:3 (1996) on green taxes. Here the commission was divided in its recommendation of whether to continue the exemptions or not. The majority suggested ending the exemptions and implementing a low tax on all the areas that was currently exempt.

4.4.1 The tax today:

As stated above the government's stance on the tax is evolving. In light of the recent targets for emissions reductions the authorities have therefore decided to remove the tax exemption for the fisheries and domestic/short sea shipping sector. This has so far been done in two tiers. First in 2013 and the most recent one effective from January 1st 2014 (Ministry of Finance, 2013b). The fees for 2014 are as presented in the table below (NOK/USD conversion 5,9NOK/1USD).

CO_2 tax 2014	NOK per l/Sm³/kg	NOK per ton CO_2	USD per l/Sm³/kg	USD per ton CO_2
Gasoline/petrol	0,92	397	0,16	67
Mineral Oil				
– Light	0,88	330	0,15	56
– Heavy	0,88	281	0,15	48
– Mineral oil with road fees	0,62	233	0,11	39
– Mineral oil used in domestiv air travel (quota paying)	0,56	219	0,09	37
– Mineral oil used in domestiv air travel (other)	0,84	329	0,14	56
– Reduced fee light mineral oil	0,31	116	0,05	20
– Reduced fee heavy mineral oil	0,31	99	0,05	17
– Reduced fee for fisheries in coastal/close waters	0,26	98	0,04	17
Domestic use of gas				
– Natural gas	0,66	332	0,11	56
– LPG	0,99	330	0,17	56
– Reduced fee natural gas	0,05	25	0,01	4

Table 4: CO_2-fees on petroleum and mineral oil products (Ministry of Finance, 2013b)

As mentioned above the exemptions were done by giving a refund of the fee paid "at the pump". This mechanism is still in place, but the amount refunded has been reduced. For the fisheries sector the refund reduction is as follows: In 2013 the fleet paid NOK 0.61 at the pump and got a refund of NOK 0.48, resulting in a reduction of NOK 0.13/liter. In 2014 the fleet paid NOK 0.88 at the pump and got a refund of NOK 0.62, resulting in a reduction of NOK 0.26/liter. Thus the effective tax for the fisheries sector is NOK 0.26/liter which represents a cost of NOK 98 or USD 17 per ton CO_2 emitted. In other words, the sectors are still subsidized relative to full tax on the fuel they use.

For the short-sea shipping sector, operating in Norwegian waters there is also a reduced refund in place. For 2014 the effective tax paid is NOK 0.31 or USD 0.05 for both light and heavy mineral oil. But due to different resulting emissions from burning these fuels the cost per ton CO_2 emitted is USD 20 for light and USD 17 for heavy mineral oil.

4.4.2 Reasons for current exemptions

The legal reasoning behind the current exemptions could be topics for master thesis of their own; these will only be dealt with briefly here. Even though Norway strives to implement its climate policies in such a way that "We do our part in a good international climate policy", it can in certain cases be argued that this main principle does not apply for some sectors (Ministry of Finance, 2001, 2013b; NOU 2009:16, 2009). The arguments for such exemptions can be summed up in three groups.

1. Following the principle will give another result than would be the case if all other nations followed the principle
2. There should be no double taxation or double regulation of sectors that are already covered by the EU ETS or other systems.
3. Additional regulations of emissions that are a part of the EU quota system (or any other system) will only shift emissions, within the bounds of the total level of emissions set, from Norwegian emitters to other emitters in the same system.

With regards to the first group these arguments stem from the fact that the costs and prices and therefore competitive environment will be severely to the disadvantage of Norwegian organizations or production based in Norway if only Norway implemented schemes that follow the principle. This especially holds true for emissions intensive industries. This would constitute most of production for exports, which would in turn harm the Norwegian import-export balance (Norman & Orvedal, 2010).

There is no problem with implementing an enhanced taxation for sectors that are already under the regulation of other schemes such as the EU ETS if the price set by the relevant scheme is deemed too low (in accordance with the government's estimate of optimal social cost of carbon). The reason why this generally is, in addition to the same reasons given above, that many believe that one should not undermine the EU ETS in any way. They cite the belief that, despite its shortcomings, it is a relatively good example of a unilateral deal to regulate emissions.

The third group is really readily explained above. Additional regulations of emissions that are a part of any other system will only shift emissions from Norwegian emitters to other emitters in the same system. Additional regulations set exclusively for Norwegian companies will therefore not reduce total emissions; only relocate those emissions to some other jurisdiction. At the same time this will be a cost to Norway in terms of lost jobs, export income etc.

4.5 The cost of running vessels

To develop a general framework for the costs of running a vessel the frameworks given in Stopfords "Maritime Economics"(2009) will be used. This book is mainly concerned with shipping, but the basic theory holds for both classes.

There is no generally accepted cost classification in the maritime industry. According to Stopford (2009) the costs can be divided into five categories:

1. Operating costs – The cost of running the vessels daily operations, including crew, maintenance, stores, administration and. These costs will incur regardless of what kind of fisheries is being done.
2. Periodic maintenance costs i.e. maintenance where normal operations are suspended like time spent in dry docks, engine overhauls and special surveys.
3. Voyage costs are variable costs and examples are fuel costs and port charges. Also, emissions costs can vary for a vessel depending on where it operates and is as such a voyage cost.
4. Capital costs depend on the financing of the ship, but staple items will be interest and debts.
5. Cargo-handling costs. This is the cost related to the handling of cargo, such as loading, stowing and discharging. This is a point where fishing differs from

traditional shipping, but the discharging cost is still valid and a substantial part of costs.

The introduction of a tax on CO_2 emitted will not influence all these cost items however. The most relevant one is naturally the voyage costs (fuel and emissions fees), at least in the short run. In the long run also the capital costs (as the tax may incentivize investment in new technology, equipment or selling the vessel/buying a new one), operating costs (new equipment may require new skills, crew or affect maintenance) and periodic maintenance costs (adapting to new standards may require the vessel to go out of service for a time) can be affected. The only factor not really affected in the short or long run is the cargo-handling.

As an example the cost structure of a 10-year old Capesize bulk carrier at 2005 prices is shown in the table below. As shown capital costs and voyage costs are the most important items by far. Furthermore, of the voyage costs 76 % is accounted for by the fuel costs (diesel and fuel oil combined). This goes to show that fuel costs are a defining factor of the vessels profitability.

General cost classification		Cost items	
1. Operating costs		Manning costs	42 %
	14 %	Stores and lubricants	14 %
		Repair and maintenance	16 %
		Insurance	12 %
		General costs	16 %
2. Periodic maintenence costs	4 %		n.a.
3. Voyage costs	40 %	Fuel oil	66 %
		Diesel	10 %
		Port costs	24 %
		Canal dues	n.a.
4. Cargo-handling costs	n.a.		?
5. Capital costs	42 %	Interest/dividend	?
		Debt repayment	?
SUM	100 %		

Table 5: Running costs of a Capesize carrier (Stopford, 2009)

Of course this may only serve as an example with limited application to the fishing sector. Isaksen and Hermansen (2009) gives an outline of the cost structure for fishing vessels in their report which is maintained in their report on "factors that influence energy consumption in the Norwegian fishing fleet" (my translation) (Donnelly & Henriksen, 2012):

Cost structure for fishing vessels		
	Segment	
Cost Item	Pelagic	Demersal
Wages	36	44
Maintenance	16	15
Fuel	15	14
Other	12	13
Depreciation	14	7

Table 6:Running cost for fishing vessels (Isaksen & Hermansen, 2009)

We see that fuel is a relatively lower share of total costs for fishing vessels even though it is smaller and varies more in its speed like fishing vessels can be said to do. It is worth mentioning that, fishing vessels in operation have equipment deployed which may cause significant drag, which in turn increases fuel costs. There are significant differences in the kind of equipment used when it comes to size and therefore manpower needed, therefore the cost structures are divided into pelagic and demersal indicating what kind of fishery is in question.

In addition, as the vessels or ships get older, fuel costs as a share of total costs is likely to increase as capital expenditures go down while the engine gets less efficient, the hull generates more friction and the propeller and its shaft gets worn due to cavitations and rust. Thus, as fuel costs are likely to increase over time for older ships the effect of the tax increase will also be felt relatively more for these vessels

One item that may seem missing from this picture is taxes. The reason for this is that Stopford (2009) deals with shipping which, as an international industry, is notoriously difficult to regulate and tax. Any ship can sail under a flag of convenience and therefore most shipping nations have very beneficial taxation for shipping companies to keep their businesses. This also holds for some of the fishing fleet, especially the large "factory trawlers". For the smaller vessels that operate within the economic zone of one country however there may be significant taxes that they will not be able to avoid. In the case of the fishing vessel examples the taxes are incorporated in the cost items given (Isaksen & Hermansen, 2009).

4.6 The price of oil

According to Stopford (2009) the oil price, and thus the price of fuel will have a great impact on operational costs. As we can see from figure 12 below the oil price, while fluctuating a lot as increased substantially from 2005 until today. The years from 2007 to 2011 shows huge fluctuations mainly due to the financial crisis. After 2011 the prices seem to have stabilized somewhat, Markets (2014) in their market outlook for 2014 even projects a downward trend down to 96 USD/brl in 2017.

Figure 11: Brent price development 10yrs, last date 05.12.2014 (NASDAQ, 2014)

As with all commodities the future oil price is determined by the outlook of the supply and demand. The primary demand drivers are according to DNB Markets that the global dependence on oil is not set to decrease in the foreseeable future. China and other rapidly growing countries are increasing their demand faster than the western world reduces its dependence. The rapid growth of the BRICS countries (Brazil, Russia, India, China and South Africa) has lifted millions of people out of poverty and these new participants in the world economy can now afford to consume more oil. These emerging markets now consume over 50% of oil globally, and they are still increasing. This leads both DNB Markets and the International Energy Agency (2013) to the view that demand will be strong in the years to come, and that this will keep prices high compared to historical levels even though there is a slight downward trend.

On the supply-side we find the major driver of potential shocks, such as the "Arab spring". The continuing instability in the Arab region is a major source of uncertainty in the forecasts of both DNB and the IEA. Traditionally such instability have caused major risk premiums in the oil price, and these have in turn been the drivers of large fluctuations depending on the shifting of threat assessments. The advent of unconventional oil sources in the US may however moderate these fluctuations. These new sources may also shift the import-export relationships we see in the world today, for instance making the US self-sufficient by 2035. This increase of supply may be enough to satisfy the increasing demand from emerging markets. The price is unlikely to decrease by much however because the price of developing these new unconventional sources are relatively high. In sum both DNB Markets and IEA projects an oil price of around the 100USD/brl mark for at least 5-10 years (International Energy Agency, 2013; Markets, 2014). RS Platou holds the view that the oil price will probably exceed these estimates, citing geopolitical risks (RS Platou ASA, 2014).

4.7 The price of fuel

Today most vessels operating in Norwegian and European waters that are designated as ECAs use various blends of low sulfur IFO. The most common of these are IFO180 and IFO380. In addition some vessels use MDO and MGO. These two latter ones are distillates and are considered the best option from an environmental point of view, due to the fact that burning these types of fuel produces less undesirable bi-products. The price differentials for the last year are shown below. Figure 13 shows regular blends and figure 14 shows low sulfur options respectively. MGO is more expensive than the IFO options, as shown by the graphs below.

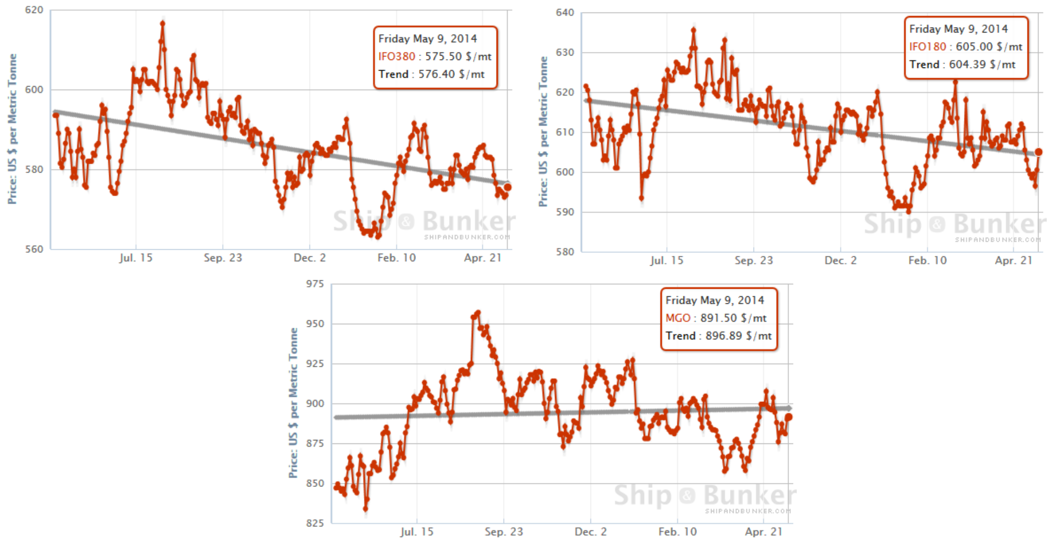

Figure 12: Regular IFO380, IFO180 and MGO delivered in Rotterdam

The regular blends have seen a downward trend over the last year, while the demand for MGO is increasing and this results in a slight upward trend (RS Platou ASA, 2014).

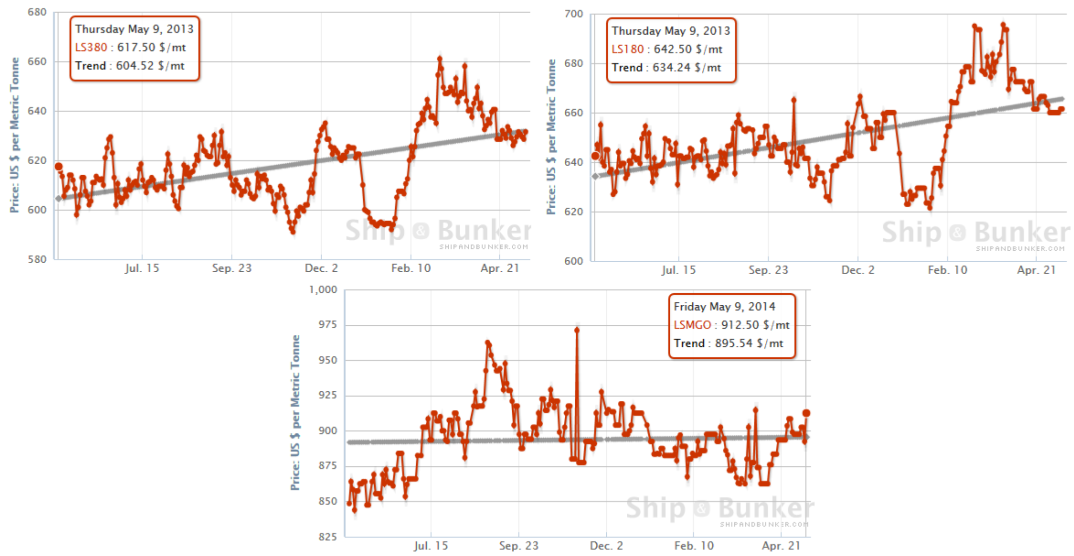

Figure 13: Low sulfur IFO380, IFO180 and MGO delivered in Rotterdam

The demand for low sulfur options is increasing relative to the demand for regular alternatives. This is the main driver for the increased price over the last year. This is driven by the impending enhanced SECA regulations. These new regulations state that the level of sulfur allowed in shipping fuel will decrease from 1% to 0.1% from 2015. As stated above this is a step in the general effort to reduce the amount of pollution generated by the shipping industry. In order to comply, operators will have to switch to a low sulfur fuel.

The combined enhanced SECA-, ECA-, CO_2-, NOX- and other MARPOL annex VI regulations is likely to drive the trend towards low sulfur fuels in the short and medium term. In the long term alternatives such as LNG and scrubbers may become more viable, both in technology terms (for both LNG and scrubbers) and in availability terms for LNG fuel.

4.8 Increased fuel prices due to tax increase

The Mineral Oil tax is determined based on the emission of CO_2. With the current scheme the tax is as follows. Some other estimates of the social cost of carbon are included to emphasise that the Norwegian level must be considered low compared to optimal levels.

Fee per ton CO2 (USD)				
	Current Fee	Nordhaus (2010)	US Gov (2013)	Arrow et.al (2014)
MGO light	20	35,3	43,5	50,6
MGO Heavy	17	30	37	43
Fisheries	17	30	37	43

Table 7: Fee per ton CO_2 released

To determine how this will affect operating costs for a fishing vessel or a ship these fees must be converted to fee per ton bunkers. The specific weights used are MGO 0,845 g/cm3gir which gives 1 183 liters/ton and IFO380 with specific weight of 0,950 g/cm 3 which gives 1 053 liters/ton. The fee per ton fuel is therefore:

Fee per ton Bunkers (USD)				
	Current Fee	Nordhaus (2010)	US Gov (2013)	Arrow et.al (2014)
MGO light	62,60	110,47	136,25	158,34
MGO Heavy	54,23	95,70	118,03	137,17
Fisheries	54,23	95,70	118,03	137,17

Table 8: Fee per ton bunkers (converted)

The fee for the fisheries sector does not differentiate between fuel types. There are a variety of blends that could be discussed, for simplicity these are ignored however.

Bunker prices vary a lot, both over time and between delivery sights. Both the absolute price and relative prices between MGO and IFO380 will vary over time. The only readily available price data in bunkers is from Rotterdam, which is used throughout this thesis.

4.9 The impact on vessel/ship costs

Now that we have established a base for determining the cost of fuel and the corresponding CO_2 tax levied, we can determine the impact on the running costs of fishing vessels and ships.

4.9.1 Impact on short-sea costs

In the following I will concentrate on the smaller ships as they are most likely to mainly operate in Norwegian waters. Larger ships will have a greater opportunity to travel outside Norway or indeed outside Europe. With regards to ship types, fuel consumption and capacity this section draws its numbers from Olsen (2000) which in turn got his numbers from Wilson Ship Management. These numbers may seem relatively old, but according to the report "Stø Kurs 2020" many ships operating in Norwegian waters are relatively old (Ministry of trade and industry, 2013). The selected ships are dry-bulk ships. There are three sizes; 1500 DWT; 3500 DWT and 6000 DWT. An important distinction is that the largest ship uses IFO380 whereas the other two use MGO.

For simplification the cost per ton cargo is calculated with the assumption of 100% utilization. Capacity utilization grade will not affect the percentage cost increase. Costs per ton cargo for one trip is given by (Stopford, 2009):

$$\frac{C_b + C_h + C_f}{CC}$$

Where cost of bunkers C_b, harbor C_h and fixed daily costs C_f is divided by the cargo capacity CC. Bunker costs are dependent on time at sea, specific bunker use at different speeds and fees. Harbor costs vary by number of port calls. Fixed costs are by their nature fixed. Fuel used for other purposes such as start engines are ignored. The capacities, calculation speed and corresponding fuel consumption for the three different ships are:

Ship	Capasity	Speed	Fuel consumption	Type
Ship 1	1850	9	3,5 ton/day	LFO
Ship 2	3500	11,5	4,7 ton/day	LFO
Ship 3	1859	12,5	11 ton/day	HFO

Table 9: Capacities, speed and corresponding fuel consumption

This gives us the following cost increases per ton cargo:

Increase in fuel cost per ton cargo due to CO2 fee by ship capacity					
1850 ton		3500 ton		5850 ton	
3,5 ton/day MGO		4,7 ton/day MGO		11 ton/day IFO180	
Prior fee	Present fee	Prior fee	Present fee	Prior fee	Present fee
0	20	0	20	0	17
1,73	1,76	1,23	1,25	3,65	3,75
Increase	2,19 %	Increase	2,19 %	Increase	2,75 %

Table 10: Price increase per ton cargo

As we can see from table 10; the cost per ton cargo increases by 2.19 percent for the two smaller vessels and by 2.75 percent for the larger one. With shorter distances time in port will be more significant and the increased fee has less effect. Over longer distances bunker costs become a more significant factor and the effect of the increased fee will rise correspondingly. Olsen (2000) gives a range from 3 percent increase up to 15 percent depending on distance, albeit at a higher fee of USD 34 per ton CO_2 emitted, compared to the fee of USD 17 and 20 used here.

An increase of 2.19-2.75 percent may not seem like a huge increase, but this must be considered a lowest possible value. Also in a highly competitive market such as transport this may be enough to shift competition in favor of e.g. road transport, which has a substantially larger environmental footprint by any measure (Ministry of Transport, 2013).

The cost increase is largest for the heaviest ship due to this ship having relatively low bunker costs as it uses IFO380, and thus the fee represents a higher percentage increase in costs.

According to Olsen (2000) and the discussion of competition in the national transport plan of (2010-2019) which is mentioned as unchanged in the current NTP2013 (Ministry of Transport, 2009, 2013) there is little competition between sizes of ships. For the smaller ones the value of the cargo is relatively high and cargo size small. They may combine different cargos and frequency and high numbers of port calls are important. The differences in transport costs, and thus freight rates, between ship sizes are high and therefore an increased tax is not likely to shift competition between the sizes.

4.9.2 Impact on fishing vessel operation costs

According to the national budget (Ministry of Finance, 2013a) and the government white paper on taxes in 2014 published in 2013 (Ministry of Finance, 2013b) there is no differentiation in the CO_2 tax for fuel types in the fisheries industry. Regardless most vessels use types of MGO. Here the costs are based differentiated by vessel length. According to Isaksen and Hermansen (2009) in their report prior to the reduction of the refund to the fisheries sector one can divide the vessels into 6 groups based on cost characteristics. The table below shows the number of vessels in each group and the total fuel used by this group in 2007. The consumption of fuel is based on the amount that was reported to receive the refund. This must therefore be considered representative for actual consumption. This number is further divided by number of vessels to get annual consumption per vessel in each group and converted to tons.

Vessel length group	Number of vessels (2007)	Total 1000 l	Fuel consumption per vessel	Converted to tons
Under 8 m	312	557	1785	2
8-9,9 m	1233	3994	3239	4
10-14,9 m	1740	20295	11664	14
15-20,9 m	256	9617	37566	44
21-27,9 m	226	35888	158796	188
Over 28 m	242	173555	717169	849

Table 11: Annual consumption per vessel

Once this has been done we can easily calculate the increased costs represented by the new fee. This is done in the table below:

Vessel length group	Consumption pr vessel/tons	Fuel price	Old fee (8 USD/ton CO2)	New fee (17 USD/ton CO2)	Increase
Under 8 m	2	913	1842	1858	0,9 %
8-9,9 m	3	913	2762	2787	0,9 %
10-14,9 m	14	913	12891	13008	0,9 %
15-20,9 m	44	913	40515	40881	0,9 %
21-27,9 m	188	913	173111	174673	0,9 %
Over 28 m	849	913	781764	788815	0,9 %

Table 12: Cost increase

Note that here there has already been an increase done in 2013, the new fee thus represents only the increase from 2013 to 2014. Total increase over the last two years is 1.8 percent.

Seeing that, as in the short-sea sector, the cost of fuel is a substantial part of operational costs for fishing vessels an increase of 1.8 percent over two years is substantial. And as stated before, this is only the effect of the mineral oil tax. Over the last years both sectors have been subject to enhanced taxation and fees on both sulfur and NOX emissions. Combined these enhanced regulations therefore is likely to affect the market substantially.

Who bears the cost of these enhanced regulations is not certain however, until we have explored the tax incidence of these new regulations. Only then can we determine whether the vessel and ship owners manage to shift the cost to their customers or if they have to shoulder the increase themselves. This brings us to the next section.

4.10 Who will pay the tax, consumers or the industry

As stated in the theory section we need the price elasticity of both supply and demand to determine how the burden of the mineral oil tax will be divided between the actors in the market. We will look at the incidence from the perspective of the suppliers i.e. the ship or vessel owners. When viewed from this perspective the pass-through rate, the share of any tax increase that has falls on the supplier is as follows:

Suppliers share of a tax with different elasticities						
			Demand Curve			
			Perfectly inelastic	Inelastic	Unity inelastic	Elastic
			0	-0,5	-1	2
Supply curve	Perfectly inelastic	0	0	-100 %	-100 %	-100 %
	Inelastic	0,5	0	-50 %	-67 %	-80 %
	Unity inelastic	1	0	-33 %	-50 %	-67 %
	Elastic	2	0	-20 %	-33 %	-50 %

Table 13: Suppliers share of tax increase

With a perfectly inelastic demand the supplier will be able to pass on the entire tax burden to its customers. We also see that where the elasticities are equal the burden will be shared evenly. Where the demand elasticities are between -0.5 and -2, and where the supply elasticity at the same time is inelastic the supplier will have to shoulder most of the burden of any tax increase.

These elasticities are also interesting from an environmental and emissions reduction point of view. If either supply or demand (or indeed both) are relatively inelastic the transport or fishing effort is not likely to decrease regardless of the price increase. If this is the case the tax will only be an extra source of income for the government, but have no effect on the environment as the effort put in will not be reduced and therefore emissions also will not be reduced. This goes back to the "Double dividend"-discussion in the theory section. If demand or supply is inelastic there will be no double dividend.

In the following two segments we will look at the short-sea and fisheries sector separately.

4.10.1 Tax incidence in the short-sea sector

Unfortunately, and somewhat surprisingly, there is little research on the elasticities of both elasticities of supply and for demand in the shipping sector as a whole, and for the short-sea sector specifically. Therefore the determination of tax incidence and pass-through rate must necessarily be quite anecdotal. But a better understanding of how supply and demand interacts in the shipping market through the freight rate mechanism will give us a good approximation.

According to Stopford (2009) the freight rate at any given time reflects the balance of ships (supply) and cargoes (demand) available in the market. The freight rate is determined after negotiations between ship-owners and charterers. When the supply of ships is high, freight rates are low, and vice versa. The supply-side can be illustrated as follows:

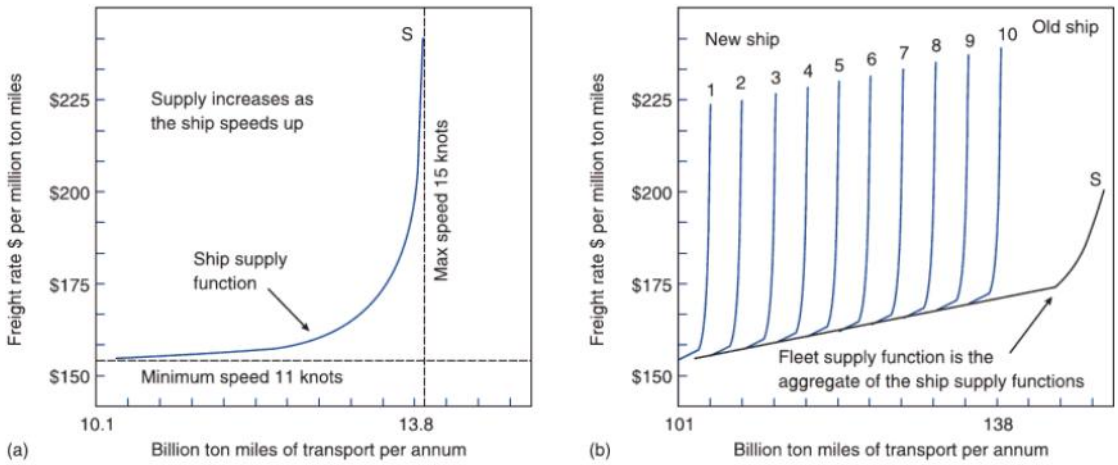

Figure 14: a) Supply increases as the ship speeds up. b) As the rate increases more ships enter the market

As we can see from the graphs, when prices (freight rates) are above break even for a ship it will enter service. When it has entered service its supply is relatively inelastic. If prices are below breakeven the ship is likely to be laid up.

On the demand side the elasticity depends on the alternatives available to owner of the goods to be shipped. The graph below illustrates a case where there are few substitutes, such as intercontinental shipping by VLCCs.

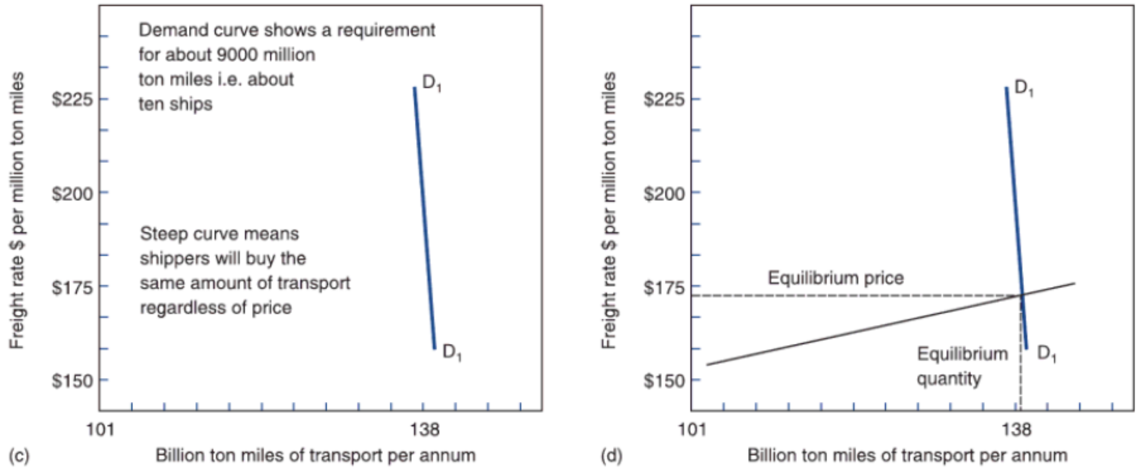

Figure 15: a) Demand curve, b) Market Equilibrium

Here, as we can see the charterer is dependent on shipping the relevant cargo, and thus the demand is relatively inelastic. The figure to the right (d) shows equilibrium where the market is cleared at about 170 USD per million ton miles.

As we can see in these cases both demand and supply is relatively inelastic. But, these examples are drawn from Stopford (2009) and his examples are mainly relevant for international shipping, where there are few substitutes and the only real option to making a deal is to either layup the ship on the supply side when faced with low freight rates or in the opposite case to not ship the relevant goods in the case where the freight cost would erode your profits entirely.

In short-sea however the substitutes are in the very least road transport or rail, for instance shown by Evensen (2000) and Hovi and Grønland (2011). Thus the inelastic demand shown in the most recent graph above is not likely to apply. At least not for heterogeneous cargo (not bulk or tank), and cargo where timing is of the essence. In these cases it may be argued that the pass-through rate will be found in the region indicated by the blue square in the table below.

Suppliers share of a tax with different elasticities						
			Demand Curve			
			Perfectly inelastic	Inelastic	Unity inelastic	Elastic
			0	-0,5	-1	2
Supply curve	Perfectly inelastic	0	0	-100 %	-100 %	-100 %
	Inelastic	0,5	0	-50 %	-67 %	-80 %
	Unity inelastic	1	0	-33 %	-50 %	-67 %
	Elastic	2	0	-20 %	-33 %	-50 %

Table 14: Indicated area of pass-through rates

This implies that the majority of the tax increase will fall to the owners of the ships, rather than to the customers.

4.10.2 Tax incidence in the Fisheries sector

Fortunately there is more research done on the elasticities in the fisheries sector, at least when it comes to the demand side. This is mainly due to the end product being a consumer good. Most of these studies are in turn done on salmon, but for simplicity we will not differentiate between different species of fish here.

With regards to the demand elasticity there are quite a few studies that have been done. As the Norwegian fleet supplies both the domestic and international market it is interesting to look at elasticities for both consumer segments. Indeed due to the size of the catch the domestic market would not be able to soak up a substantial fall in demand in other markets. In addition such a comparison is interesting in light of the fishing industry being one of Norway's major export industries.

Seale, Regmi, and Bernstein (2003) and Muhammad, Seale Jr, Meade, and Regmi (2011) have estimated price elasticity's for different foods in more than 114 nations as a part of the international comparison project, among them Norway. For the product group "fish" the average price elasticity was estimated to be -0.35 in the EU and -0.31 in Norway, meaning that if the price of fish increases with 1 percent demand will decrease by 0.3 percent.

Bendiksen (2008) lists several demand elasticities for fish in his report. The majority of sources he cites use elasticities in the region of -1 to -2 based on product categories and species. Among them are Kinnucan and Myrland (2002) who estimate a price elasticity to be -1.93 in the EU and -1.08 in Norway for Norwegian salmon. Fousekis and Revell (2004) estimate in their study a range from -0.45 to -1.65 depending on product in British retail stores. There are however differences in the elasticities depending on type of catch, with the industrial catches such as capelin which is used in the production of fish meal having a relatively inelastic demand whereas more luxury goods such as lobster and fresh cod having a relatively elastic demand.

Turning to the supply side, the story may be quite different. Here unfortunately, as was the case with research on the supply side in short-sea shipping, there is little research. Bendiksen (2008) however has an interesting perspective on the issue of supply elasticities in the fisheries sector. Following his reasoning we would denote the supply as perfectly inelastic, due to the quota regulations in the major fisheries in Norwegian waters. Because fish is a limited resource the government regulates how much the stock can be taxed in any given year. This is done either by quotas that are limited or by limiting the time period when a certain catch is allowed. It follows that, due to the mentioned regulations, even if prices increase due to demand the industry is not allowed to catch more to capitalize on the situation. This is illustrated as follows:

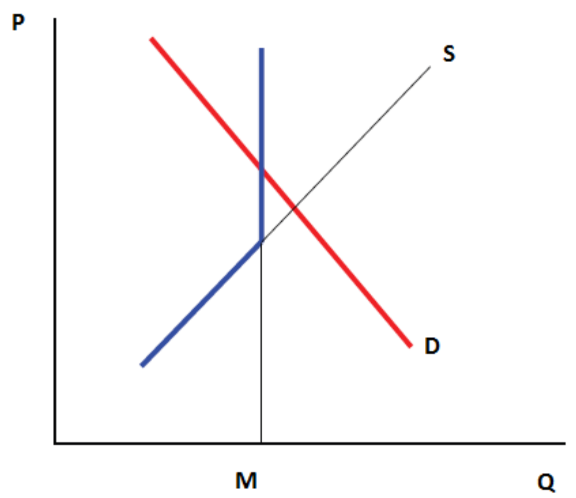

Figure 16: kinked supply curve due to quotas

Here the supply-curve has no effect above the level of the quota set by the government M. For quantities demanded over M the demand is perfectly inelastic. Bendiksen (2008) cautions however that there are fisheries where the full quotas are not fully utilized, or where there are redistributions in the fleet that secures full utilization.

For the major fisheries this analogy holds however. In fact it can be assumed that the price elasticity on wild caught fish is low and in many cases almost perfectly inelastic. For instance if the price of cod drops by 25 percent, the full quota will still be used, as indeed happened in the period from 2001 to 2003 (Bendiksen, 2008).

Thus the inelastic supply shown in the most recent graph above is likely to apply, whereas the demand is shown to be relatively elastic. As with the case of short-sea shipping it may be argued that in the case of fisheries the pass-through rate will be found in the region indicated by the blue square in the table below.

Suppliers share of a tax with different elasticities						
			Demand Curve			
			Perfectly inelastic	Inelastic	Unity inelastic	Elastic
			0	-0,5	-1	2
Supply curve	Perfectly inelastic	0	0	-100 %	-100 %	-100 %
	Inelastic	0,5	0	-50 %	-67 %	-80 %
	Unity inelastic	1	0	-33 %	-50 %	-67 %
	Elastic	2	0	-20 %	-33 %	-50 %

Table 15: Indicated area of pass-through rates

This implies that the majority of the tax increase will fall to the owners of the ships, rather than to the customers, even for the luxury catches.

4.10.3 Summary of tax incidence

In short, elasticities of supply for both the fisheries sector the short-sea sector are relatively inelastic and the elasticity of demand relatively elastic. In other words we see that both sectors fall within the section of our table where the demand elasticities are between -0.5 and -2, and where the supply elasticity at the same time is inelastic. Hence for both our sectors the supplier will have to shoulder most of the burden of any tax increase.

4.11 Can the taxes be avoided?

Now that we have determined that the supply side is likely to have to bear the majority of the tax increase it is interesting to explore whether there are opportunities to avoid or circumvent the tax. One such opportunity is fueling in other jurisdictions, and is relevant to both the fisheries and short-sea sector.

There is the danger of giving segments of the industries advantages as some have the opportunity to purchase fuel in other jurisdictions, thus avoiding the tax all-together, some have the opportunity to do it to some extent, while some do not have the option what so ever. This advantage in addition follows size, where larger ships and vessels may have greater access to these remedies than smaller ones. For instance some short-sea ships travel internationally and some do not. In the shipping sector one may give an implicit advantage (or indeed increase the current advantage) to ships that travel internationally over those who mainly operate between Norwegian ports. It may also give an advantage to foreign operators.

In economic terms one can assume that the vessels that have the opportunity to do this will do it if, and only if, the savings associated with fueling in another jurisdiction is higher than the cost of making the journey (all factors considered).

5. Discussion

Based on the analysis and information above we can now answer the questions asked in the introduction. To remind ourselves, these are;

1. How will the reduction of the mineral oil tax reimbursement scheme affect the Norwegian short-sea shipping and fisheries sectors?
2. Will the reduction help the government in reaching its "climate goals" and sector specific goals?
3. Are there potential for "double dividends" in terms of tax revenue, goal achievement and reduced emissions?
4. Could anything be done differently?
5. Based on the findings; what are the recommended course of action/polices going forward?

Naturally these questions are somewhat overlapping, but in the following I will try to separate them. I remind the reader that this thesis see these issues from the regulators standpoint. The first thee questions will be discussed here, while question four will be treated in the next chapter.

5.1 The effect on the sectors

The analysis in section 4 suggests that increasing the tax on mineral oil through reducing the tax refund is likely to affect the industries substantially. Costs are expected to rise by at least 2.2 % for the short-sea shipping sector and at least 1 % for the fisheries sector. The increase is further expected to be shouldered almost entirely by the operators based in the tax incidence determined by the elasticities of supply and demand. Profits and returns are therefore likely to suffer.

For the fisheries sector total input is not likely to be reduced due to the desirability of the quotas and the "kinked" nature of supply, described in figure 18, resulting in perfectly inelastic supply. Some vessels may be scrapped if profitability is too low, reducing overcapacity. If some vessels exit the market their quotas would be distributed between the incumbents or new entries. This would either increase the utilization of the incumbent vessels or perhaps induce investment in newer more efficient and environmentally friendly vessels. There is likely to be a combination of these effects.

The short-sea sector may see some reduced input due to higher breakeven freight rates for some ships. Ships that are no longer profitable will be laid up or moved to other jurisdictions. Seeing that the demand for transport is not likely to decline the reduced supply of transport services from ships is likely to filled by other modes of transport such as rail and road. Bulk is believed to be more persistent than goods in this regard as road transport is not considered an appropriate substitute. Rail may become more competitive, but has limitations with regards to availability.

The tax increase is expected to affect smaller actors more severely than larger ones in both sectors due to the latters' opportunities to avoid paying the tax by refueling in other jurisdictions and by having more sophisticated business models.

Because this thesis wants to evaluate this from the viewpoint of the regulator the question of whether these effects are to be considered beneficial or not must be determined in light of the governments' goals for the sectors and its climate goals.

5.2 Goal fullfillment

5.2.1 Climate goals

With regards to the governments' principles for measures to reduce emissions the measure of reducing the refund seems like an easy measure to implement and may in the long term have some positive effects with regards to investment in new technology in both sectors and reduced overcapacity in the fisheries sector. Here the principles will be discussed one by one.

Fair distribution and international solidarity

In terms of fair distribution between generations, the reduction is a step in the right direction. There is however a long way to go according to the estimates of the social costs of carbon that are projected and shown section 4.4.1, the current effective emissions tax falls way short of most of these estimates. Indeed taken at face value, as the scheme is still a net refund it can still be interpreted as a subsidy to the sectors compared to other sectors of the Norwegian economy that face the full cost of emissions. Viewed as a net subsidy one can even argue that the current scheme is directly opposed to the interests of future generations as subsidies generally lead to intensified input and thus to increased emissions.

Viewed in light of Brander and Spencer (1985) the current scheme may even be seen as an export subsidy for the Norwegian fisheries industry. The article by Brander and Spencer shows that export subsidies, in whatever form, can be seen as attractive policy tools because they can be used to improve the relative position of a domestic firm in competition with foreign firms. As the World Trade Organization (WTO) is intensifying its focus on reducing export subsidies, this may increase pressure to eliminate the refund in the years to come.

Since the subsidy now is being reduced the effort must be seen as a step in the right direction when it comes to equitable distribution between rich and poor countries and thus international solidarity as artificial advantages of the Norwegian fisheries sector is reduced.

It is important to note that although there is still a net subsidy; the reduction of the refund will be seen as a tax increase by the sectors.

The precautionary priciple and sustainability - natures limit

Unfortunately, the measure must be said not to be in line with the precautionary principle. While points are given for the effort, we must yet again remind ourselves that the current tax still falls way short of most estimates of the social cost of carbon. The potential devastating effects of climate change has been known for several years, the reduction of the refund was only implemented two years ago.

The polluter pays

As we have seen in the discussion about the tax incidence the principle that the polluter pays must be said to be fulfilled. As the discussion in analysis section 4.9.1 and 4.9.2 showed; the suppliers are likely to bear the majority of the cost increase due to relatively elastic demand compared to the elasticity of demand. This is however somewhat mitigated by the potential to avoid the tax for some segments of the industry, mainly the larger entities that have the opportunity to refuel in different jurisdictions. At least the polluter now pays more than before.

Combined effort

This principle states that sustainable development involves all segments of society, not only the authorities. Therefore the government should make it easy for its citizens to make the right choices. In light of this, as stated before, the measure may incentivise investment in new technologies, equipment and vessels/ships that are more environmentally friendly. But using a "sticks and carrots"-metaphor, this measure would perhaps be seen as a "stick" from the sectors point of view rather than a "carrot". One may take issue with the introduction of a tax being something that makes it "easier" to make the "right" choices. To constitute a combined effort the introduction of the tax must be combined with other measures on behalf of the government to induce change in the sectors, such as; investment in research and infrastructure.

Effective governance

Whether it can be considered effective governance is a complex issue. The measure certainly targets the right variable, and in the case of fisheries may be said to be effective in that it has the potential to reduce overcapacity. For the short-sea sector the picture may be different however depending on how it affects the relative competitive strength of short-sea shipping compared to road transport. If this new regulation is not matched by enhanced regulation for road transport the benefits may be few. NTP2013 states that the costs for road transport are decreasing due to foreign labor and operators, thus this industry is capturing market share. If however the reduction of the refund is compensated by substantially lowering harbor fees, other taxes not directly related to the environment and investing in infrastructure, the increased fuel tax may incentivize the operators to invest in new ships and technology while at the same time not giving road transport a relative advantage. This dual approach seems to be lacking though, and there seems to be a conflict between the goals for increased transport by sea (and the following environmental advantages) and the implementation of this tax.

Cost effectiveness

The measure cannot be considered cost effective as the collection of the tax at one end, and a refund at the other to the same entity must result in an efficiency loss. Also, all sectors do not face the same cost, and thus the market cannot decide where the reductions can be done in the cheapest way. There is also a problem with regards to the measure being likely to affect the smaller actors more severely than the larger ones (due to the larger ones opportunity to dodge the tax), which goes against the governments stated goals for both settlements in rural areas and its emphasis in small businesses. But from a solely economic perspective the ambition to maintain settlements may not be desirable; in that case a shift to larger and more efficient vessels may be cost effective. This last point hinges on the economic viability of the governments settlement policies and a discussion of this policy's merits is beyond the scope of this thesis.

Other

When it comes to the "other" factor much of the apparent contradictions may well be explained as this principle more or less serves as an escape clause if the prior principles ask too much in too short a time. The principle states that an ambitious climate policy also has to be reasonable in a global context. This entails paying heed to the consequences of the quota system, the danger of carbon leakage and the competiveness of Norwegian industries when policies are formed. In the sectors discussed here this most certainly applies. Both sectors are important for exports as well as employment and could easily be replaced by foreign operators and labour.

I would describe the current situation as a "Prisoners Dilemma" where the individual nations actions are relative to the actions of the competitors. If a one nation implements enhanced regulations in the current economic climate its companies are likely to have to raise their prices and would therefore loose to its competitors resulting in lost jobs etc. for the nation that regulates. Its dominant strategy is therefore not to regulate, as it is the best course of action for the individual nation given what the competitors are doing under the current regulatory regime (or indeed: game setup).

In light of this last point it is therefore completely understandable that Norway does not make its domestic companies face the full cost of the externalities they create when their competition do not have to face these costs. Here the Norwegian government has to work to change the rules of the game rather than just playing it differently. This will be discussed further in the next chapter however.

5.2.2 Goals for the short-sea sector and "double dividends"

With regards to the "double dividend" potential, in the case of the short-sea sector it seems to be especially detrimental. First, due to the inelasticity of supply in this sector, where if the ship is marginally profitable it will maximize its utilization, and if it is not profitable it will be laid up there is not much emissions reduction potential for a ship in operation. The only likely effect is that the breakeven freight rate for ships is likely to increase, resulting in ships being laid up faster.

This may push some of the older and more polluting ships out of the market, and incentivize ship-owners to invest in more environmentally friendly designs in the future which would be a positive outcome.

However, the tax increase for the short sea sector is not matched by a corresponding tax increase for road transport and demand for transport is not likely to decrease. Thus cargo is likely to shift to road-transport where road transport is competitive, such as in some segments of container transport (Hovi & Grønland, 2011; Riksrevisjonen, 2014). As road transport generates more emissions per ton/kilometre the net effect of the tax increase may be increased emissions in total. This result also goes against the governments stated goals for more goods transported at sea. In terms of emissions reductions there are therefore limited possibilities for a positive outcome.

The tax increase will generate revenue for the government, which may in itself be regarded as positive from the governments standpoint. If the tax is used to fund some of the goals for the sector such as reduced harbour fees, investment in infrastructure and research in new technology the tax may even be considered a net positive from an industry standpoint, provided that the government also matches this contribution or even invests a larger amount. Then the measure could truly be called a combined effort.

Although this last point shows potential unfortunately a very recent report (published May 22nd 2014) by Riksrevisjonen, evaluating the governments work on increasing the share of goods transported by sea points to this not being the case (Riksrevisjonen, 2014). The government has set lofty goals, but done very little to fulfil them. It seems that the revenue from the tax has been used on other causes. Main findings in the report are that "1. There is weak governance related to the goal of transferring goods from road to sea. 2. Investment in important infrastructure can be improved and 3. The tax system aids the goal to a very small degree" (p.10). Thus the report largely supports the findings of this study. It should be noted that the report must be seen as an evaluation of the previous governments' efforts. One may hope that the new one will make a better effort.

In other words there are no "double dividends" likely to materialize in this case and the measure in total seems to work against the governments goals for the industry. Because the tax may even shift demand for transport from sea to road the measure may even indirectly increase emissions.

5.2.3 Goals for the fisheries sector and "double dividends"

With regards to the double dividend potential in the case of fisheries one might even be as bold as to hope for a potential "triple dividend" in the sense that the tax could generate increased income for the government, emission reductions and a reduction in the overcapacity in the industry.

Alas, this ideal case may not materialize mainly because of to the inelasticity of supply due to the quota scheme. As discussed earlier the quotas have been fulfilled even when prices have dropped substantially, indicating that fishing efforts are at normal levels even under such conditions. Thus, "normal" emissions levels are likely to persist even after the implementation of the tax.

There may be some potential for scrapping of older vessels and thus a reduction of overcapacity; this will however not result in less quantity caught. However, since overexploitation is not a major problem in most of the fisheries relevant to Norwegian vessels, the fact that the total catch is likely be the same may not be a problem.

Reduced overcapacity may improve the profitability of the sector as the remaining vessels may be more fully utilized which are in line with the governments goals for the sector. This would alleviate the rent dissipation experienced in the sector.

The government will take in more tax-revenue. But even here the net economic benefit may be negative. Larger vessels may have more opportunities to avoid paying the tax as they can travel longer distances (i.e. to other jurisdictions) and refuel there, provided that the cost of making the journey is less than paying the higher price in Norway. Larger corporations are also likely to be more sophisticated in their business practices and therefore have more opportunities to avoid the tax or compensate in other areas, for instance by transfer pricing etc. This would give an implicit advantage to these operators over the smaller vessels which according to the governments’ goals are singled out for "extra protection" as they are an integral part of maintaining settlements and employment in rural areas. This goes against the governments goals, but as stated before a discussion of the economic merits of efficiency in fisheries vs. settlements in rural areas is beyond the scope of this thesis.

In sum some goals may be achieved in the case of fisheries with regards to profitability, reduced overcapacity/redundancy and investment in new technology. This may reduce emissions in the long run, but in the short run emission levels are likely to be the same.

6. Alternatives

In light of the discussion in the theory section of quotas vs. fees and taxes it is worth mentioning that a "cap and trade system" may be more efficient than the current scheme. In practice a simple system of tradable permits can be distributed among firms equal to the maximum amount of emissions that can be generated. This efficiently creates a market for externalities (Pindyck & Rubinfeld, 2005). This approach combines the simplicity of a quota system with the cost advantages of a fee system. This works by the cap serving as an effective "quota" and the trading mechanism allows abatement to be done at the lowest cost as in the case of an optimal fee system.

As mentioned cap and trade systems mimics these features and work in practice by authorities auctioning off a fixed number of emissions permits to firms and other actors that are willing to bid. The firms also have the opportunity to trade between themselves. One permit could for instance be equal to one metric ton of CO_2, as is the case in the EU ETS. A company that manages to reduce its emissions can either sell the spare permits to other companies thus offsetting the costs of the reduction or "store" the permits for use at a later date. This flexibility, in line with the basic theory outlined in the theory section, will lead to cost-efficient emissions cuts, with abatements taking place where it is cheapest/most effective, and those who cannot reduce at a reasonable cost still have to pay for the externalities they cause as they have to buy permits for the emissions in excess of their initial "allowance".

This may also alleviate the burden of scrapping vessels or ships as the companies in question at least will be able to sell these permits or transfer them to other parts of their operation.

While on the subject of cap and trade; an introduction of tradable quotas in fisheries may also lead to more efficient use of the most economically efficient vessels. Being able to sell quotas may also help ease the burden of scrapping vessels.

7. Recommendations

A potential Prisoners dilemma was alluded to earlier as the reason behind the government not making the sectors face the full social cost of carbon. A "Prisoners Dilemma" where the individual nations actions are relative to the actions of the competitors. If a one nation implements enhanced regulations in the current economic climate its companies are likely to have to raise their prices and would therefore loose to its competitors resulting in lost jobs etc. for the nation that regulates. Its dominant strategy is therefore not to regulate, as it is the best course of action for the individual nation given what the competitors are doing under the current regulatory regime (or indeed: game setup).

From this Prisoners Dilemma we may deduce that nations are neither oblivious to the potential benefits of emission reduction, nor to the projected damages from the current practice, but the game they are a part of is "rigged" so that they cannot make a difference individually without sustaining huge losses. Also, if one nation takes these losses other nations are likely to capture their market share and emissions will be the same i.e. it will only lead to carbon leakage. This calls for collaboration with other entities to step in and change the rules of the game. These entities may be the unilateral deal with other nations or unions such as the EU or the US or international bodies such as the IMO. Where the EU seems the most determined to make this happen. Norway should work together with the EU in this effort, as we currently indeed are. This effort should be intensified.

I also believe that the actors in both the shipping and fisheries industry have an untapped potential to influence the Norwegian government, the EU and later other large entities by working with them rather than against them which seems to have been the "modus operandi" so far. Shipping has a number of bargaining chips up its sleeve: it already is less polluting than other transport methods on a ton/mileage basis, it is vital to global trade and it is the key for developing countries to access global markets. But its high dependence on oil, the flavor of public opinion and technological advances in other sectors poses that shipping is lagging behind.

A strategy emphasizing the benefits of shipping to markets everywhere, which at the same time focuses on the constrained economic situation faced by the companies in the sectors, could be a potent argument. An effort to sway public opinion should also be made by asking the EU and the Norwegian government to "put their money where their mouth is". The public is likely to understand that the sector needs clear guidelines and schemes to make the transition; it is easy for politicians to demand action as long as they are not accountable for the costs. The cost of not acting far exceed the costs of facilitation for the industry, with this comes bargaining power; if the public can be convinced.

This could be a potential win-win. By supporting increased further efficiency and sustainability in the shipping and fisheries sectors and better serving of customers' (or inhabitants) expectations, the sectors can maintain a reasonable rate of return while implementing the changes. At the same time, at global level, the EU and Norway could be seen as a leading entities ensuring the functioning of trade links, PR it desperately wants (and needs) both internally and externally. Mandating Ships/vessels that enter or operate in EU' and Norwegian waters to comply with EU regulations has the potential to shift global standards in shipping and thus also raise demand for schemes to facilitate a financially viable transition in other economic areas as well.

Turning to the climate and sector specific goals I hold the view that there are some conflicts between the climate goals and the sector specific goals in terms of the scheduling of the implementation of the reduction of the reimbursement scheme when it comes to short-sea shipping. I believe that the sector specific goals should be fulfilled before the reduction was implemented. Based on the discussion in section on the goals for the short-sea sector and potential double dividends above, the reduction as it has been implemented now has failed on reducing emissions and transitioning goods from road to sea. On the contrary the reduction seems to have increased the current negative trend of goods shifting from sea to road as largely confirmed by the very recent report from Riksrevisjonen (Riksrevisjonen, 2014).

The government has stated that the reduction of reimbursement scheme is to continue. Contrary to this I would recommend that the reimbursement is held at its current level until of the other goals for the sector is fulfilled.

In the case of the fisheries sector the government should make clear its priorities when it comes to efficiency, reduced emissions, profitability and reduction of overcapacity on the one hand and maintaining settlements on the other. Based on the findings in this thesis these goals seem somewhat mutually exclusive. If it is determined that efficiency, reduced emissions, profitability and reduction of overcapacity is valued over settlements; the reimbursement scheme may be further reduced for the fisheries sector.

In both sectors the government should "earmark" the revenue from these taxes to work on abating the negative externalities these sectors generate. This could be done by research, investing in infrastructure etc. I believe that if this was the case the tax increase would be met with more understanding from the industries.

8. Summary and conclusion

The purpose of this thesis was to conduct an analysis of the effects of reducing the mineral oil tax reimbursement scheme for the Norwegian short-sea shipping and fisheries sectors. An important contribution of this study has been to review this measure in a wide context based on the Norwegian governments own principles and goals relating to climate, environment and its goals for the short-sea shipping and fisheries sectors. Based on the dynamics of supply- and demand elasticities for the sectors the likely tax-incidence of this measure is shown. The tax incidence is in turn used to discuss and contrast the different outcomes for the sectors. The overall discussion answers the following questions:

1. How will the reduction of the mineral oil tax reimbursement scheme affect the Norwegian short-sea shipping and fisheries sectors?
2. Will the reduction help the government in reaching its "climate goals" and sector specific goals?
3. Are there potentials for "double dividends" in terms of tax revenue, goal achievement and reduced emissions?
4. Could anything be done differently?
5. Based on the findings; what are the recommended course of action/polices going forward?

Answering these questions the study has shown that the effects of the increased tax on mineral oil through reducing the tax refund are likely to affect the industries substantially. Costs are expected to rise by at least 2.2 percent for the short-sea shipping sector and at least 1 percent for the fisheries sector. This increase is further expected to be shouldered almost entirely by the operators based on the tax incidence determined by the elasticities of supply and demand. The tax increase is expected to affect smaller actors more severely than larger ones due to the latters' opportunities to avoid paying the tax by for instance refueling in other jurisdictions.

The measure has also been evaluated in light of the governments own principles and goals for an environmental tax, and its goals for the individual sectors.

In terms of the principles and goals for environmental taxes the effort is found to be a step in the right direction, but still somewhat lacking as it falls short of estimates of the social cost of carbon.

The tax is believed to be a better fit for the fishing industry and its situation, than it is for the short-sea sector. The short-sea sector has environmental benefits over its closest competitors, such as road transport and the tax increase may shift competition in favor of road transport. In fact the measure may even result in an increase of emissions in transport. This thesis also sees a conflict between the measure and the goals stated for the short-sea sector. Here the government needs to prioritize.

When it comes to the fisheries sector some sector goals may be achieved with regards to profitability, reduced overcapacity/redundancy and investment in new technology. This may in turn reduce emissions in the long run, but in the short run emission levels are likely to be the same due to the elasticity of supply being perfectly inelastic.

The sources of the shortcomings of the measure are discussed in terms of a prisoner's dilemma situation. Drawing on the result of this "game", this thesis holds the view that Norway should work with the EU to implement the same regulations in all European waters. The sectors may also have the ability to influence policymakers to achieve more favorable terms if they work with the regulators rather than against them.

I recommend that going forward the reimbursement scheme should be held constant for the short-sea shipping sector at least until other sector goals are achieved. For the fisheries sector however, the reduction of the reimbursement should continue.

Truly, a summary of this evaluation of the total evaluation of the effects of reducing the mineral oil tax reimbursement scheme for the Norwegian short-sea shipping and fisheries sectors shows a story of conflicting goals leading to dubious results.

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