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Climate change and the European Marine Strategy

Magdalena Dediu

Faculty of Economic Sciences, Dunarea de Jos University

magdadediu@yahoo.co.uk

Abstract:

The European Union (EU) is actively campaigning for the global regulation of carbon emissions generated by maritime bunker fuels because these emissions are presently barely regulated and are projected to increase significantly in the coming decades. However, since a global regulation has not been reached yet, the EU is seeking ways to include the shipping sector in its greenhouse gas reduction commitment for 2020.
In this paper, we look at the effect of including the shipping sector's emissions in the EU reduction commitment that is based on the nationality of a ship. Emissions that are generated by ships owned, operated or flagged by the 27 EU countries are allocated to the EU total GHG emissions. We first analyse the effects on the reduction commitment caused by the three allocations. We then use marginal abatement cost curves (MACCs) in order to determine how much the shipping sector of the 27 EU countries, defined by the three allocations, could contribute efficiently to a total given emission reduction target for all sectors in the EU. Moreover, we use MACCs in order to determine if some country fleets could reduce emissions in the shipping sector relatively more efficiently than other countries under a given emission reduction target for all sectors. Our findings indicate that the shipping sector could contribute efficiently to the EU's emission reductions by up to 8.5%. Since the composition of the individual country fleets and applied measures are similar across countries, their individual reductions relative to their fleet-specific business-as-usual (BAU) emissions are on average the same.

Keywords: EU, climate change, shipping sector, CO2 emissions, marginal abatement cost curve
JEL classification: Q52, Q54, Q58

1. Introduction

Carbon dioxide emissions generated by the shipping sector accounted for about 3% of global carbon emissions in 2007.1 These emissions are projected to increase significantly by 2050 and are presently barely regulated (Buhaug et al., 2009). Discussions on how to regulate such carbon dioxide emissions2 have originated over 15 years ago in the UN Framework Convention on Climate change (UNFCCC) and are still continuing in the International Maritime Organization (IMO), in the European Union (EU), and in the scientific community. These discussions focus on the question whether the shipping sector's emissions should be capped or whether they should be subject to other means of regulation (UNEP, 2011). The EU is actively engaged in making progress in this matter with a global solution being the most preferred way. On the one hand, it has proposed a global reduction target of 20% relative to 2005 levels by 2020 for the shipping sector (Council of the European Union, 2009). On the other hand, it is seeking ways to include emissions generated by the shipping sector in its greenhouse gas reduction commitments should no global regulation be reached in the IMO (EU, 2009). To prevent the most severe impacts of climate change, the international community has agreed that global warming should be kept below 2ºC compared to the temperature in pre-industrial times. That means a temperature increase of no more than

1.2°C above today's level. To stay within this ceiling, the scientific evidence shows that the world must stop the growth in global greenhouse gas emissions by 2020 at the latest, reduce them by at least half of 1990 levels by the middle of this century and continue cutting them thereafter.

The European Commission has taken many climate-related initiatives since 1991, when it issued the first Community strategy to limit carbon dioxide (CO 2) emissions and improve energy efficiency. These include: a directive to promote electricity from renewable energy, voluntary commitments by car makers to reduce CO 2 emissions by 25% and proposals on the taxation of energy products.However, it is clear that action by both Member States and the European Community needs to be reinforced if the EU is to succeed in cutting its greenhouse gas emissions to 8% below 1990 levels by 2008-2012, as required by the Kyoto protocol.

The EU Council of Environment Ministers acknowledged the importance of taking further steps at Community level by asking the Commission to put forward a list of priority actions and policy measures.

An important question that needs to be addressed before implementing any regulation as regards the shipping sector's emissions is the size of emission reduction that the shipping sector could contribute efficiently to a given overall target. In this paper, the focus is thus on how much the shipping sector could contribute to a given emission reduction target for all sectors in the EU, assuming a policy instrument that equalizes the marginal abatement costs of all sectors. This gives us an idea if the shipping sector could at all contribute efficiently to a given emission reduction target. In order to do this, we first have to define a way of allocating a proportion of the shipping sector's emissions generated globally to the EU consisting of 27 countries. In doing this, we look at a way that is based on suggestions made by the Subsidiary Body for Scientific and Technological Advice (SBSTA) of the UNFCCC. It has suggested using various allocation rules to allocate the shipping sector's emissions to individual countries (SBSTA, 1996).

One rule (SBSTA rule No. 4) is to use (1) the nationality of the ship owner, (2) the nationality of the ship operator, or (3) the flag state registration to allocate emissions. Doing so, would increase the EU countries' total national emissions and thus the EU's reduction effort to achieve its committed emission target. However, if abatement in the shipping sector is more cost-effective than in the currently regulated sectors, then including the shipping sector in the reduction efforts to achieve the EU's target may reduce overall abatement costs.

Several studies (Eide et al., 2011, Faber et al., 2011, Buhaug et al., 2009, Faber et al., 2009) conclude that there are ways that the shipping sector could reduce emissions cost-effectively. Moreover, another study (Heitmann and Peterson, 2012) discusses the shipping sector's potential contribution to efficient global emission reductions and its effect on global cost savings. However, the magnitude of the contribution and the cost savings depend heavily on the assumed reduction potentials and costs of the various measures applied to specific shipping fleets. Hence, from a regional or a country perspective, the contribution of a country's or region's fleet to reducing total national emissions efficiently might be important.

While there is a growing number of studies that look at the effects on regions or countries of various allocation rules applied to the shipping sector's emissions (den Elzen et al., 2007, Gilbert and Bows, 2012, Heitmann and Khalilian, 2011, Wang, 2010), only a few studies exist on how to include the shipping sector's emissions in the EU reduction commitment (Faber et al., 2009, Nelissen and Faber, 2012). Faber et al. (2009) provide estimates of emissions generated by ships in various regions and in particular in the EU region, whereby emissions generated by ships in a region refer to emissions generated by ships calling at or departing from ports in a particular region. In doing so, Faber et al. (2009) show that the EU accounted for 31% of the shipping sector's emissions generated globally in 2006. Moreover, they present and discuss various policy instruments on how to reduce the shipping sector's emissions in a European framework, namely: an emission trading scheme (ETS), an emission-based tax,

an efficiency standard, a baseline-and-credit trading scheme, and voluntary action. They conclude that emissions generated by ships in the EU region account for a large share of the shipping sector's emissions generated globally and that an ETS would be the policy instrument that is environmentally effective and feasible to implement. Nelissen and Faber (2012) carry out a qualitative analysis of how the main policy instruments that are currently discussed at the EU level, namely two types of compensation funds managed by industry, an ETS, a fuel-based or emission-based tax, and two types of mandatory emission reduction per ship (for more details, see ECCP, 2011) would affect emissions in the EU. They conclude that an ETS covering emissions of ships calling at, departing from, or moving between EU ports would be the best choice as regards environmental effectiveness. However, Nelissen and Faber point out that controlling for emissions of ships departing from EU ports may be challenging. Moreover, they point out that a quantitative assessment is currently not possible because detailed data as regards the ships that would be in the scope of the various policy instruments is lacking.

We contribute to the literature by analyzing how the allocation rule No. 4 of the SBSTA, which includes three allocation ways, would alter the EU's total emissions and its reduction commitment for the year 2020. Beyond that, in a first step, we determine with the help of marginal abatement cost curves (MACCs), how much the EU shipping sector (defined by the three allocation ways), compared to the other EU sectors, could contribute to the reduction commitment. In a second step, we determine if some country fleets could reduce emissions in the shipping sector relatively more efficiently than other countries under the given emission reduction commitment. Furthermore, we assess the increase in abatement costs that is caused by including the shipping sector's emissions in the reduction commitment.

2. Climate change policy

The anthropogenic emission of greenhouse gases (GHG) causes an increase in the atmosphere's GHG concentration, thereby affecting the Earth's average global temperature and causing climate change (IPCC, 2007). The emission of GHG is a negative externality that impacts mankind globally and independent of its geographical location (see, e.g., Perman et al., 1999). It is thus a global problem that requires a global solution. Climate change policy to combat climate change takes place on various levels. It takes place on the international level within the framework of the UNFCCC, on regional levels, e.g., in the framework of the EU climate and energy package,6 and even on national levels, e.g., in the framework of the German Integrated Energy and Climate Package (BMU, 2007) and Energy Concept Germany (BMWi and BMU, 2010).

The first step undertaken towards combating climate change internationally was that the world community adopted the Kyoto Protocol in 1997 in the framework of the UNFCCC. It obliged a group of industrialized countries to reduce their greenhouse gas emissions (GHG) by 5% in the period 2008–2012 (called first commitment period) against 1990 emission levels. Emissions of the international sectors aviation and maritime shipping are excluded from the 1990 emission levels The Kyoto Protocol has been prolonged for 8 more years (second commitment period 2013–2020) at the UN Climate Change Conference in Doha in December 2012 (UNFCCC, 2012).

Currently, the Kyoto Protocol is the only existing international agreement that is legally binding. However, not all countries have legally binding reduction commitments under the Kyoto Protocol . Despite this, in particular major emitters such as China and India, pledged in addition to many countries national reduction targets for 2020 in the course of the UNFCCC conference in Copenhagen in 2009 (UNFCCC, 2010a, 2010b), called the Copenhagen Pledges. These pledges, however, are not legally binding.

The EU belongs to the group countries of the Kyoto Protocol and it also committed it self to reduce its GHG emissions in the course of the UN Climate Change Conference in Copenhagen. The EU pledged to reduce its emissions unilaterally by 20% by 2020 relative to 1990 levels (this reduction is called the unconditional or low pledge because it is not conditional on other countries pursuing more ambitious reduction targets). In addition, the EU also pledged to reduce its emissions by 30% by 2020 relative to 1990 levels conditional on other countries also pursuing more ambitious reduction targets (this reduction is called the conditional or high pledge). According to den Elzen et al. (2011), the EU's maximum GHG emissions would amount to 4.45 GtCO2-eq. with the unconditional pledge and to 3.90 GtCO2-eq. with the conditional pledge in 2020. According to a European Environment Agency report (EEA, 2012), the EU's GHG emissions amounted to 4.60 GtCO2-eq. in 2011 and to 5.58 GtCO2-eq. in 1990.
To reach the emission reductions in the first commitment period of the Kyoto Protocol and under the Copenhagen Pledges, the EU has implemented various climate change policy instruments, whereby the EU ETS is the most important one. It includes over 11,000 power and heat plants, energy-intensive industrial plants, and commercial airlines.9 However, the shipping sector's emissions are neither included in the EU ETS nor tackled by any other climate change policy instrument.

3. Allocation rules and effects of including the shipping sector's emissions in the EU reduction commitment

As mentioned in the introduction, the EU is seeking ways to include the shipping sector's emissions in its 20% reduction target. Possible approaches to include the shipping sector's emissions are: (1) keeping the absolute target for 2020 and enlarging the set of regulated sectors or (2) reassessing the 1990 base year emissions and enlarging the set of regulated sectors.10 In the following, we focus on the EU's 20% reduction target, the unconditional pledge, because it seems more realistic when looking at the current status of climate negotiations.

The first approach assumes that the absolute emission target in the reference year remains constant and that shipping emissions are added on top of the currently regulated business-as-usual emissions in the reference year (2020). The base year emissions (emissions in 1990) remain the same, i.e., no shipping emissions are added on top. We call this approach the *partial integration approach.*
The second approach assumes that the relative reduction target in the reference year 2020 remains the same (20%), but that the shipping sector's emissions are both included in the set of base year emissions (emissions in 1990) and added on top of the regulated business-as-usual (BAU) emissions in the reference year (2020). This approach would cause an increase in the base year emissions and would make it necessary to raise the absolute emission target in the reference year (2020) in order to achieve the same relative target of 20% reduction.

4. Generating marginal abatement cost curves for the shipping sector in the 27 EU countries

We use MACCs in order to determine how much the shipping sector of the 27 EU countries (henceforth EU fleet) could contribute efficiently to a total given emission reduction target for all regulated sectors in the EU. Moreover, we use MACCs in order to determine if some countries could reduce emissions in the shipping sector more efficiently than other countries under the given emission reduction target for all sectors.
Eide et al. (2011) and Faber et al. (2011)/Wang et al. (2010) present a methodology to generate MACCs for the shipping sector. This methodology includes, in general, three elements:

1. Projection of the fleet composition, i.e., the projection of the current fleet composition (ship-type/ship-age categories) to the reference year based on ship-type-specific growth and scrapping rates.

2. Determination of a business-as-usual (BAU) emission scenario, i.e., the determination of the fleet emissions in the reference year if no abatement measures are applied.

3. Calculation of project-level abatement costs (*AC*), i.e., the calculation of the abatement costs per measure applied to a specific ship-type/ship-age category.

5. Analysis of policy scenarios

We start by describing scenarios for the BAU emissions of the shipping sector and all other production and consumption sectors (*AoS*) in the EU 27 that use fossil fuels. This is necessary in order to determine the required emission reductions both sectors, shipping and *AoS*, have to achieve under the two reduction commitment scenarios The emission reductions of the shipping sector relative to its BAU emissions is in a range between 20% to 25% in the *hrlc* scenario and significantly less, in the order of less than 3%, in the lrhc scenario. Compared to this, the emission reductions of *AoS* relative to its BAU emissions is between 16% and 21%, depending on the assumed reduction potentials/costs scenario and on the approach to include the shipping sector's emissions into the reduction commitment.

6. Discussion

Our results show that including the shipping sector's emissions into the EU 27 reduction commitment for 2020 always, as a matter of course, increases the amount of required emission reductions and thus the abatement costs. This is particularly pronounced if we apply the allocation ways *owner* and *operator* and opt for the more ambitious approach (*partial integration approach*) to include the shipping sector's emissions into the reduction commitment.

We start to discuss our results by comparing the two approaches to include the shipping sector's emissions into the EU reduction commitment. The comparison shows that opting for the approach that keeps the relative target of 20% (*full integration approach*) should be the preferred option.

First, the approach also gives rise to significant emission reductions, but at the same time incurs less abatement costs (abatement costs increase non-linear). Second, the approach seems to be politically more feasible. The reason is the following: as mentioned before, the EU committed itself to reduce its emissions in 2020 at least by 20% against 1990 levels or even up to 30% if other countries would also pursue more ambitious reduction targets (EC, 2008).29 However, the commitment was based on a specific set of activities and sectors resulting in GHG emissions that excluded international bunker fuel emissions.30 It can be assumed that the EU decided not to include international bunker fuel emissions into its reduction commitment because these emissions had been excluded from any commitment stated in the Kyoto Protocol during that time and thus were exempted from the national emissions regulated by the Kyoto Protocol. Instead the Kyoto Protocol's states should reduce emissions from international marine bunkers fuels by working through the IMO.

7. Conclusions

While it is clear that the EU aims to include the shipping sector's emissions in its reduction commitment, it has not been analyzed so far how the inclusion would affect the EU reduction commitment for 2020 and the abatement costs. In this paper, we analyze these effects with the help of MACCs. Moreover, we determine if some country fleets could reduce emissions in the shipping sector relatively more efficiently than other country fleets under a given emission reduction target for all sectors. In order to do this, we first allocated the shipping sector's emissions to the EU27 based on the SBSTA rule No. 4: allocate emissions based on the nationality of (1) the ship owner, (2) the ship operator, or based on (3) the flag state registration. Second, we proposed two approaches to include the shipping sector's emissions into the EU 27 reduction commitment for 2020: *partial integration approach*, which leaves the absolute target of 4.45 GtCO2-eq. constant and adds shipping emissions on top of total emissions in 2020, and the *full integration approach*, which leaves the relative target of 20% reduction constant and reassesses the base year emissions in 1990 by including the shipping sector's emissions. we conclude that the EU27 should include the shipping sector's emissions in its reduction commitment if no global solution is achieved in the near future. Otherwise, these emissions are left outside any regulation and jeopardize the achievement of climate change goals, in particular, the 2°C target. Comparing the two integration approaches, the discussion in Section 5 shows that the relative target of 20% reduction in combination with a reassessment of the base year emissions in 1990 should be applied. Beyond that the shipping sector should also be included into abatement efforts. The reasons for this are that the shipping sector's emissions are substantial and thus a contribution to overall emission reductions, as other sectors of the economy are required to do, seems to be appropriate. At the same time, the shipping sector provides cost-effective abatement potential that should be exploited in order to alleviate the increase in abatement costs. However, the practicality of including the shipping sector's emissions in the EU reduction commitment based on one of the allocation ways needs to be analyzed in greater detail. On the one hand, all three ways tend to be vulnerable to regulation evasion, thus making it harder to control the shipping sector's emissions effectively. On the other hand, the reassessment of the base year emissions is limited due to data availability. The approach of including the shipping sector's emissions into EU ETS by obliging all incoming and outgoing ships to surrender EU ETS allowances, independent of the nationality of the *owner*, *operator*, or *flag state registration*, would control emissions more effectively. However, the EU commission's moratorium on the aviation sector that excludes the aviation sector from surrendering EU ETS allowances in April 2013 for emissions generated in 2012 shows that regulating international mobile emitters by a regional policy instrument is a challenging task. Therefore, we conclude that regulating the emissions of the shipping sector by mandating the implementation of particular measures, i.e., the measures that are cost-effective under the optimal scenario, might be an effective policy instrument to reduce emissions in the shipping sector in the shot-run. In the long-run, however, emissions of the shipping sector should be included in a global market-based policy instrument with other sectors. But all these questions are deferred to future research. Overall, the IMO should foster to improve the data availability relating to emissions in order to reduce the level of uncertainty that is prevailing in all current studies.

A number of limitations are worth mentioning. Determining the emissions of the fleets in 1990 in order to reassess the base year emissions is challenging because we have neither information about ship owners, ship operators, or ships' flag state registration nor about the operational profiles of these ships for the year 1990. For this reason we have worked with the assumption that the projected relative shares of the EU shipping sector's emissions on the global shipping sector's emissions in 2020 were the same

proportionately as in the base year of 1990. Moreover, including the aviation sector's emissions in the analysis is currently not possible because of data availability. Finally, we worked with data for only 14 ship types. These 14 ship types do not represent the whole world fleet, yet they represent a very large proportion of the transported tonnage globally.

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