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An Economic and Legal Analysis of an EU Trading Scheme for Maritime Emissions

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Abstract

On the basis of a joint economic and legal analysis, we evaluate the effects of a "regional" (European) emission trading scheme aiming at reducing emissions of international shipping. The focus lies on the question which share of emissions from maritime transport activities to and from the EU can and should be included in such a system. Our findings suggest that the attempt to implement an EU maritime ETS runs into a dilemma. It is not possible to design a system that achieves emission reductions in a cost efficient manner and is compatible with international law.

Keywords: Emission trading, international shipping, maritime emissions, regional emission trading, international jurisdiction for emission trading schemes

JEL-Classification: L91, Q58, R48

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1 Introduction

1.1 Background

Transport is a key contributor to global greenhouse gas (GHG) emissions (ITF/OECD, 2010). Despite the need for a comprehensive approach to fight global warming, so far, the global community has failed to agree on global mechanisms to reduce GHG emissions resulting from transport. At date, emissions from air and water transport are generally excluded from the United Nations Framework Convention on Climate Change (UNFCC). According to Article 2(2) of the Kyoto Protocol to the UNFCC, states shall pursue the limitation or reduction of emissions of GHG from aviation and marine bunker fuels, working through the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO). The duty of the contracting states to cooperate within IMO and ICAO refers to the potentially most effective way forward for international climate politics. However, a prohibition of unilateral measures such as the implementation of a regional regulation by the EU cannot be derived from the Kyoto Protocol.

Given this situation, the EU has decided to consider unilateral action. In fact, since 2012, air transport emissions are regulated in the EU by means of an inclusion of aviation activities in the European emission trading scheme (EUETS) (EU Directive 2009/29/EC). In addition, the EU has made clear that it is willing to regulate maritime emission as well if IMO does not develop a mechanism targeting shipping emissions in the near future (EU Decision 1600/2002/EC). Indeed, in summer 2013 the European Commission submitted a draft regulation to the European Council and the European Parliament (EU Proposal 2013/0224 (COD), hereinafter referred to as MRV-Proposal) proposing the monitoring, reporting and verification of carbon dioxide emissions from maritime transport starting in 2018. Eventually such a mechanism could be extended in the future and evolve into a mechanism aiming at reducing maritime emissions.

With respect to aviation in 2013 the EU has backed away from applying its scheme for aviation fully to flights to and from the EU to third party countries (EU Memo MEMO/12/854; EU Proposal 2012/328 (COD)) reacting to the difficult economic situation, the criticisms made by foreign states as the United States of America, China, India and Russia as well as the progress made at ICAO regarding a global mechanism. Instead, the EU now proposes amending the EUETS so that only the part of a flight that takes place in European airspace is covered by the EUETS (EU Proposal 2013/0344 (COD)). It is hence conceivable that the EU may choose a corresponding approach also for maritime emissions and may consider regulating only emissions generated by ships in EU waters in the future.

In this paper we evaluate the effects of a potential regional emission trading scheme (ETS) aiming at reducing emissions of international shipping. Thereby we focus specifically on different definitions of the scope of a possible future scheme regulating maritime emissions by the EU. Building on a joint economic and legal analysis, we show that a comprehensive regional EU-scheme that regulates not only shipping emissions in the territorial waters of EU Member States but also in the Exclusive Economic Zones (EEZ) and on the High Sea could, in fact, contribute to a reduction of emissions and bring about an environmental benefit in an efficient manner. However, a trading scheme with such a wide field of application would presumably not comply with international law.

The remainder of this paper is organised as follows. First, we provide a brief overview of the literature discussing market-based mechanisms to reduce emissions from international shipping. Then we outline and briefly review the general setup of a possible European maritime emission trading scheme (EUMETS) seeking to reduce maritime emissions. The described ETS will serve as a basis for the subsequent analysis. Next and on the basis of different possible definitions of the scope, we study the environmental effectiveness, the economic rational and the legal feasibility of the scheme and discuss associated issues in detail. Subsequently, we contrast our findings from the different dimensions and elaborate the implications of our findings regarding the design of a regional scheme for maritime

emissions. Finally, we conclude with a brief summary of our findings and relate them to the current developments at the EU and IMO level.

1.2 Current State of Research

While there exists a rather broad literature with regard to regulating emissions from aviation using a regional emission trading scheme (e.g. Anger and Köhler, 2010; Klement, 2007; Pache, 2008; Athen, 2012), reducing maritime emissions by means of a market-based mechanism (MBM) has so far not attracted so much attention. However, there is a small set of economic and legal reports dealing with some form of European action to regulate shipping GHG emissions.

On the field of economic research, Miola et al. (2011) provide an overview of the instruments that are being discussed at IMO. Above all, they reason that due to its diversity and complexity, the maritime industry does not allow for a simple and clear-cut GHG reduction policy. As a result policy makers will have to dare to balance binding long-term targets with a high degree of flexibility with regard to the implementation of the measure.

In a technical support paper commissioned by the EU Commission, a consortium around CE Delft discusses various policy options to reduce CO_2 emissions from maritime transport (CE Delft, 2009). Overall, they conclude that an ETS or a tax for maritime emissions should be the instrument of choice when targeting a reduction of CO_2 emissions of maritime transport. Reports realised at the French Ministry of Transport (2012) and by Franc and Sutto (2014) investigate on the basis of a modelling exercise a cap-and-trade scheme in the maritime sector focusing on the effects of shipping lines and ports. Their findings suggest that an ETS restricted to Europe will lead to distortions and thus argue in favour of a global scheme. In this context, they point in particular to the risk of an undesired modal shift for inter-european transport services.

Koesler et al. (2012) in turn take the perspective of ship operators and evaluate the effects of an ETS for maritime emissions on the organisation and operations of shipping companies. According to their analysis which builds on a series of interviews among ship operators, it is unlikely that a maritime ETS will add significant overhead costs to shipping operations because most of the required monitoring and reporting processes and similar trading activities are already in place due to business reasons or other regulations.

The literature features also some analysis of legal aspects. König and Morgenstern (2009) focus on whether a regional EU trading scheme for maritime transport would comply with international law and give a negative answer, while Lassen (2010) reaches the opposite conclusion. Kremlis (2010) deals with different design options for the implementation of a trading scheme from a legal perspective. Ringbom (2011) addresses various international law questions linked to a potential future EU emission trading scheme for shipping. According to him, international law does “not necessarily” prevent the establishment of a trading scheme that covers emissions that have occurred beyond the territorial waters of the member states or even in other states’ maritime zones but places “a number of important limitations on its design”. Engel (2013) gives a short legal analysis of the EU Commission’s MRV-proposal mentioned above.

A detailed interdisciplinary research on environmental, economic and legal aspects of the integration of Marine Transport into the European Emissions Trading System is carried out by Bäuerle et al. (2010) in a study on behalf of the Federal Environment Agency (Germany). This work tackles a similar research question as our paper. It also investigates a possible integration of maritime transport into the EUETS and studies the issue taking a legal and an economic perspective. However, the authors build their analysis on a different concept with regard to which emissions are covered in the scheme and explore regulating a ship’s historic emissions over a certain period, the emissions of a ship during its last voyage and an approach regulating not the ship’s emissions but rather the maritime transport emissions related to the carried cargo. With regard to a potential environmental benefit, they

argue that regulating historic emissions is more effective than the other two options. But this approach seems to be prone to some legal challenges. Nevertheless, they conclude that regulating maritime emissions by including shipping transport into the EUETS is environmentally effective, possible from a legal point of view and it will not entail significant negative effects. This holds true in particular if the reach of the scheme is extended beyond only European shipping activities.

1.3 Outline of a EU maritime emission trading scheme

There are many possible options of how a future European maritime emission trading scheme could be designed. Here we focus in our analysis on the implications of different definitions of the scope of the scheme and, for the time being, take most other elements of the system as given.[6] In Table 1 we outline the basic elements of the scheme which we use as a framework for our analysis if not explicitly stated otherwise. Thereby we build on the IMO proposal for a global emission trading scheme by Norway (IMO Submission MEPC 60/4/22) and the EU regulation for emissions from aviation (EU Directive 2009/29/EC; EU Proposal 2013/0344 (COD)).

Table 1: Principle design elements of the maritime emission trading scheme under investigation.

Element	Design Option
Regulated entity	All ships with more than 400GT traveling to or from EU ports irrespective the flag they are sailing under
Geographical scope	Depends on scenario: - WR: global, emission on the whole route are regulated - EEZp: only emissions within the European Economic Zone and European territorial waters are regulated - ETW: only emissions with in European territorial waters are regulated
Links with other ETS systems	No
Allocation of emission rights	Full auctioning by EU
Use of revenues	Possible revenues are included in national budgets
Reference value for emissions	Bunker fuel consumption during the voyage to or from the EU
Reduction target	0%, 5%, 10%, 20%, 30% with respect to 2009 emission levels

1.4 Methodology of environmental and economic impact assessment

We assess and quantify the environmental and economic implications of a regional maritime ETS on the basis of a general equilibrium analysis using a task-specific extended version of the basic WIOD CGE model (Koesler and Pothen, 2013). This model is a multi-region, multi-sector computable general equilibrium (CGE) model of global trade and energy use which is calibrated to data from the World Input-Output Database (WIOD) (Timmer et al. 2012; Dietzenbacher et al. 2013). The WIOD model is particularly suited for this analysis, as it is capable of reproducing international trade flows on the basis of trade in intermediates. To be able to address the research question of this paper, we developed a transport module which is integrated into the basic model. Thereby the model is enlarged by three main elements: an explicit modelling of international transport services, a modified trading structure accounting for trade specific transport costs, and special provisions required by a regional

[6] Discussions of other design elements can be found inter alia in CE Delft (2009) and Koesler et al. (2012).

market based mechanism targeting transport emissions. Other parts of the basic WIOD CGE model remain unchanged.[7]

The original WIOD data includes for each region three sectors associated to transport services, namely air, inland and water transport. But in reality transport service providers can be active globally and their activity need not be in relation to their home region. As a consequence, input-output data does not allow inferring where the activity of a regional transport sector has actually taken place. For example, although one knows that there has been some form of activity in the US water transport sector, it is impossible to say whether this is generated by a US ship travelling from Japan to the US or from Australia to China. Thus, the regional differentiation of the transport sectors in the input-output data is only of low value and of no importance for the research question here. It may even be misleading if one relates a regional transport sector to the import and export flows of that region. Following this idea of a global transport supply, all regional transport sectors are aggregated and our model eventually includes only three – now international – transport sectors that supply transport services to the remaining regional sectors and final demands.

A regional maritime market based mechanism targets emissions and thus activity arising at certain point of the globe and does not differentiate between the origins of the transport service provider. In contrast to a more standard application of a cap-and-trade approach, for example the EUETS for stationary installations, such a scheme has to cater for the fact that only a certain part of the emissions of the international transport pool is subject to the regulation. Imagine for example an ETS regulating only the total amount of emissions resulting from shipping freight to the EU and leaving out emissions for instance arising from transporting freight from Australia to China. Given the importance of specific transport flows for our research question, instead of using transport services directly as an input in the different sectors or for final demand, in our model, the output of the international transport pool is put into relation with the trade flows present in the economy. Similar to the production of standard commodities in the basic WIOD CGE model, all transport services associated with a particular trade flow are produced on the basis of a four-level CES function as outlined in Figure 1. The sum of value-added $VA_{(r)}$ from all regions is joined with a Leontief aggregate of energy $A_{(eg,r)}$ and related emissions $EM_{(em)}$ in the third nest. The value-added-energy composite is then combined with an aggregate of non-energy commodities $A_{(neg,r)}$ at the second level of the production function. Potential process emissions of transport arise at the last production stage. In this study, we only consider CO_2 emissions.

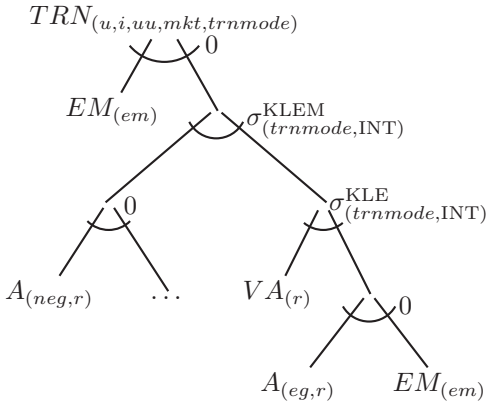

Figure 1: Production structure of trade-specific transport flows.

[7] For more information on the basic WIOD CGE model, the reader is kindly referred to Koesler and Pothen (2013).

Moreover, as a consequence of interpreting transport as a complement to trade flows, the Armington (1969) aggregation of the basic model is updated so that it additionally includes transport costs. As illustrated in Figure 2, the Armington composite is now produced on the basis of a four-level CES production function. As before, the Armington composite is domestic production in combination with an import aggregate and the import aggregate is a composite of all imports of a commodity composed in the second level of the Armington production function. On the now additional third level, imports of a commodity are combined with necessary transports cost from all transport modes arising from moving the commodity from its origin to the importing region. The fourth level combines the transport costs from the different transport modes (air, inland, water). Note that transport costs are trade flow specific.

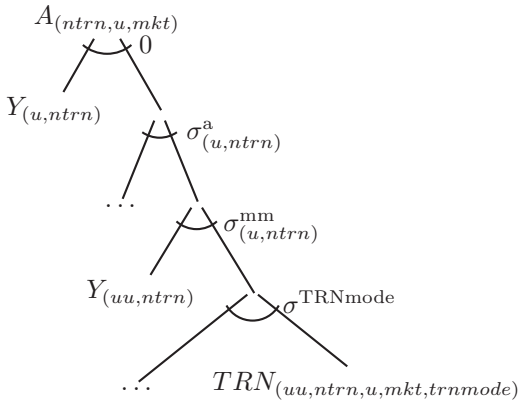

Figure 2: Armington structure of trade-specific transport flows

The model is calibrated to the year 2009 using an extended WIOD input-output table including the transport costs implied by each individual trade flow. The analysis is done for the year 2015. To cast the economic structure of 2009 into the future, we employ estimations for annual average real GDP growth rates from the OECD (2012). The basis for computing trade-flow-specific transport costs is information on ad-valorem costs implied by transporting commodities from one region to another region. Ad valorem transport costs for maritime transport were calculated on the basis of the Maritime Transport Costs (MTC) database provided by OECD (2012). Costs for air and road/inland transport were approximated on the basis of average cost proportions between maritime, air and inland transportation given in World Bank Group (2009).[8] For substitution elasticities we turn to estimates from Koesler and Schymura (2012). Armington elasticities are taken from GTAP7 (Badri and Walmsley, 2008). We assume that air, water and inland transport are perfect substitutes for transportation between regions. Inland transport between regions with no land link is however not possible.

For our analysis of a regional maritime ETS installed by the EU, we consider five regions with different distances to the EU namely “Europe” (EU), “North America” (NAM), “Middle Distance” (MID), “Far East” (FEA) and “Rest of the World” (ROW). An overview of the regions is given in Table 3 in the Annex of this paper. With regard to the sectoral aggregation, we distinguish between three different sectors on the basis of their ad-valorem transportation costs: HIGH, LOW and NTR,

[8] In order to ensure that the WIOD dataset remains balanced, we are obliged to adjust some of the data provided by the MTC database. In the process we scale the ad-valorem transport costs of all inputs to one sector / final demand agent by the same parameter such that the overall input transport costs of the sector / final demand agent match the corresponding transport input in the WIOD dataset. Note that this process does not distort the original input cost structure of the sector, as it does not affect relative input costs.

three transport modes: AIR, INLAND, WATER and one energy carrier ENERGY which also features high ad-valorem transport costs. NTR covers sectors with no cross-regional international transport needs like construction. Table 4 in the Annex gives an overview of the sectors.

To analyse the effects of different geographical scopes of a regional maritime emission trading scheme installed by the EU, we use information on shipping routes and lengths given in NGA (2001) to calculate the share of emissions which are released within the limits of European territorial waters (ETW) and the European economic zone plus European territorial waters (EEZp) for different routes. Thereby we assume that for all routes at least 50 nautical miles are travelled within ETW. An overview of the respective shares is given in Table 6 in the Annex. The model is run for a set of scenarios covering different scopes (Whole Route, only EEZp and only ETW) and emission reduction targets with regard to 2009 emission levels (0% to -30%). An overview of the scenarios studied in this paper is given in Table 5 in the Annex.

2 Environmental effectiveness is not affected by definition of scope

The overall aim of the ETS is to reduce emissions. Given the effectiveness of the cap-and-trade approach, the introduction of the system clearly reduces emissions within the scope of the scheme and could upfront be considered to be environmentally successful. But in the context of a regional scheme with only limited coverage, the more intriguing question are if the scheme is successful in reducing global emissions and if the definition of the scope of the system affect its environmental effectiveness.

According to our simulation results, a regional ETS regulating all maritime emissions on voyages to and from the EU on global emissions is effective in reducing emissions. Compared to a business as usual situation (BAU), global transport emissions drop in 2015 by 0.8% when a 5% reduction target is applied and by 2.8% in case of a 30% target. There are no noteworthy effects on emissions of other non-transport sectors. This was to be expected as transport generally composes only a very small share of input costs. Global emissions from water transport reduce between 5.2% and 19% compared to the reference scenario. The emission change for inland transport is positive but in no case more than 1.2%. Emissions from air transport do not change much as a result of regulating shipping emissions and even in the case of a very stringent reduction target (-30%), air transport emissions increase only by a maximum of 0.2%. So while there is some carbon leakage to other transport modes in consequence of the EU scheme capping a part of shipping emissions, the overall emission reduction is positive. There are three main reasons for such a limited shift of transport emissions. First, of all transport modes, water transport is the cheapest option for transporting most commodities and apparently even the introduction of a regional emission regulation does not impede this comparative advantage. Second, leakage to inland transport is limited to the cases where there is a land link between regions. Third, until recently and still in our simulations, European air transport is also included in the EUETS and thus a corresponding shift would also incur additional emission costs.

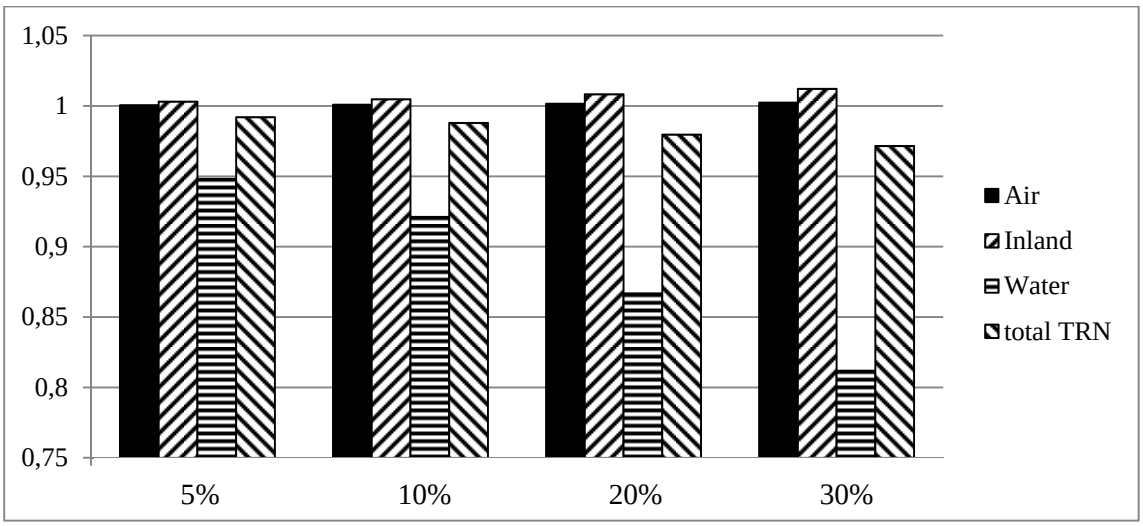

Figure 3: Relative change in global transport CO_2 emissions relative to benchmark as a result of a regional ETS regulating all maritime emissions arising on voyages to and from the EU for different emission reduction targets.

When determining the scope of the scheme, policy makers are often primarily concerned about the potential environmental benefit, that is how many emissions can be reduced by the scheme implied by their choice. But from an aggregated perspective, for a given stringency (equal reduction targets), the scope of the scheme has no direct effect on the amount of avoided emissions. This becomes clear when recalling two things. First, although the total amount of regulated emission may vary for different scopes, for a specific requested absolute emission reduction, the cap implied by a certain reduction target will be scaled accordingly. Thus if the regulation covers a bigger amount of emissions but the same absolute emission reductions are demanded, the corresponding reduction target can be set less strict and the overall cap will be bigger. Second, for ships, almost all CO_2 abatement technologies involve high fix costs or are non-variable in their use.[9] This implies that in total, abatement options are applied homogenously during the complete voyage of a ship and are not applied only when a ship enters regulated waters. As a consequence emission intensities can be assumed to be constant along the whole route.

So eventually it is the stringency of the system that determines how many emissions are reduced and the costs of the regulation. The mere scaling of the regulated emissions, that is what share of emissions is included, has no effect to this regard. This also becomes clear when recollecting that the total amount of emission of a regulated industry *TE* is:

$$TE = \sum_j \left(\left(\alpha_j \frac{e_j}{s_j} s_j - a_j \right) + \left(1 - \alpha_j\right) \frac{e_j}{s_j} s_j \right)$$

where a_j is the total amount of emission that are reduced by entity j as a result of the regulation, e_j is emissions irrespective of any regulation, s_j is the distance travelled and α_j the share of e_j that is regulated. Thereby the term in the first parenthesis of the sum includes regulated emissions and the entities reaction in form of abated emission. The second term includes the unregulated emissions of the entity. Both feature the constant emission intensity e_j/s_j. Summing over all a_j makes it clear that the

[9] Consider for example the installation of alternative propulsion systems such as Sky Sails or the application of special hull coatings to reduce water resistance. Since there is a strictly positive and convex relationship between emissions and speed, except for extreme cases, also slow steaming makes most sense when applied homogenously along the whole route.

total amount of emissions is independent of α_j and thus the total amount of emissions is not directly influenced by the choice of the scope. Accordingly, from an environmental point of view, when designing a regional maritime ETS, policymakers can choose whatever scope they prefer and do not have to fear consequences with regard to the effectiveness of the scheme.

3 Only a comprehensive approach grants cost-efficiency

Thanks to their effectiveness in establishing financial incentives for emission abatement in the form of an emission price and the cost-efficiency that comes along with it, market based mechanisms are generally acknowledged by economists to be a superior approach to deal with the externalities of CO_2 emissions (e.g. Stavins, 2003). Thereby the potential advantages of such mechanisms depend crucially on what they cover and initially hold only within the system. Cost-efficiency in the EUETS for example is only granted among entities regulated by the EUETS (e.g. other EU power plants) and not relative to entities outside the EUETS (e.g. domestic heating in EU or US power plant). But while usually this problem relates to the question which entities are incorporated, in a regional system covering mobile entities such as ships, cost-efficiency may not always be granted even among regulated entities and may not be achieved for certain designs of the scope of the system. The stringency of a scheme is generally seen as the parameter determining the costs of the regulation. The mere scaling of the emissions should have no effect. This however neglects that the neutrality of the scope holds only if the scaling of the emissions is homogenous across entities. In the context of regulating transport emissions this may however not be the case. Transport services with European involvement feature a highly varying share of regulated emissions with respect to different definitions of the scope. In such a case, emission costs of entities are not distributed solely on the basis of their share of emissions.

Table 2: Example illustrating the economic issues associated with the definition of the scope of a maritime ETS.

	Distance Travelled	Emission Intensity	Share of Emissions in Coastal Waters
Ship 1	100 nm	1 nm / 1 nm	100%
Ship 2	100 nm	1 nm / 1 nm	50%

Case 1 **Whole Route**	Emission Reduction	Acquired Allowances	Allowance required for one additional Ton of Emissions	Share of Allowance Costs
Ship 1	10 t	90	1	50.0%
Ship 2	10 t	90	1	50.0%
Total	20 t	180 (=cap)		
Case 2 **Coastal Waters**				
Ship 1	10 t	90	1	66.7%
Ship 2	5 t + 5 t	45	0.5	33.3%
total	20 t	135 (=cap)		

Table 2 illustrates the issue on the basis of a simple example. There are two ships which both travel the same distance and feature the same emission intensity and same convex abatement costs. The only difference between the two ships is that the first cruises solely through coastal waters while the second is 50% on the high sea and only 50% in coastal waters. Both ships are subject to an ETS with a 10% reduction target, but depending on the scope may not see the same amount of emissions regulated. In the first case, emissions along the whole route are regulated. Thus in the face of the 10% reduction target both ships implement emission reductions to reduce their emission by 10t and buy 90

allowances. If one of the ships would choose to emit one ton more, it would be required to buy one additional emission allowance. In the second case only emissions in coastal waters are regulated. To comply with the regulation, the first ship again abates 10t of emissions and buys 90 allowances. The second ship in turn finds only 50% of its route / emissions subject to the regulation, but must also reduce its emission intensity by 10% and buys 45 allowances to comply. Because of the reasons stated before, the emission intensity is however constant along the whole route, so Ship 2 also saves 10t (5t+5t) of emission in total. In this situation Ship 1 again requires one allowance to emit an additional ton of emission on its route. But at the same time, Ship 2 now needs only half an allowance for the same purpose. Thus in the second case, the marginal costs for one additional ton of emissions are not equal and cost-efficiency – the main benefit of a market based mechanism – is not achieved. What is more, for the same environmental benefit, Ship 1 has to carry a higher share of the burden associated with the reduction target. This implies that a scheme regulating only a share of total emission along a route comes along with distortions which may have a disproportional negative effect to routes featuring a relatively high share of regulated emissions.

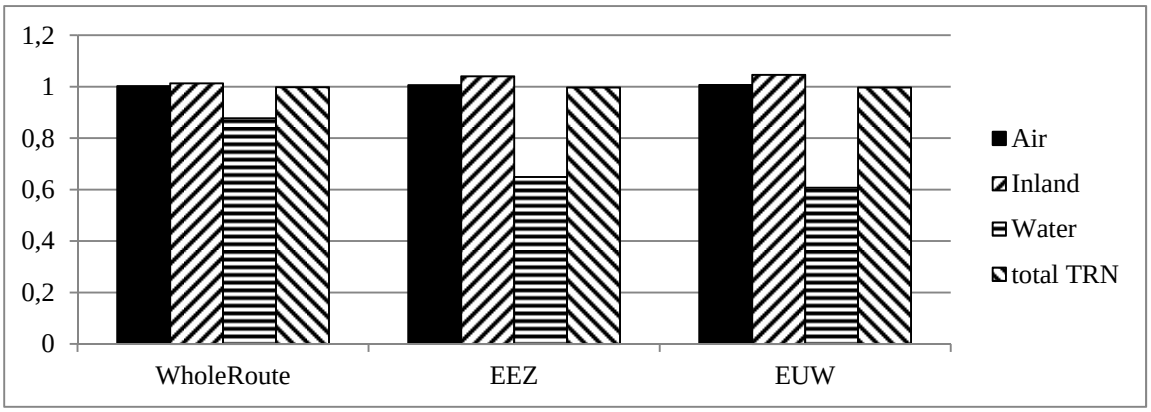

Figure 4: Relative change in transport activities from or to Europe relative to benchmark for different definitions of the scope in the case of a maritime ETS with a 20% reduction target.

This issue is also apparent in our simulation results. Figure 4 illustrates the development of all transport activities either originating from or traveling to Europe for different definitions of the scope in the case of a 20% reduction target. Clearly, limiting the scope of the scheme to a share of emissions arising along the routes of ships has a negative effect on shipping activities and leads to an increase in modal shift, in particular to inland transport. The effect of the distortions is even clearer when studying the effect on specific routes which are illustrated in Figure 5 for a 20% reduction target. In a setting covering all emissions of a voyage, all routes are affected in a similar manner (-15.5% to -19.5% relative to BAU). Differences relate to the possibilities to substitute to other transport modes. Transport between NAM and Europe for example cannot be shifted to inland transport because there is no land link and thus water transport is affected less. But the picture is different for other definitions of the scope. For the reasons outlined above, short routes with a relative high share of regulated emissions are affected more than longer routes in such a case. As they must carry a comparatively high burden, in particular voyages linking MID and Europe suffer from a limited scope (-63.5%).

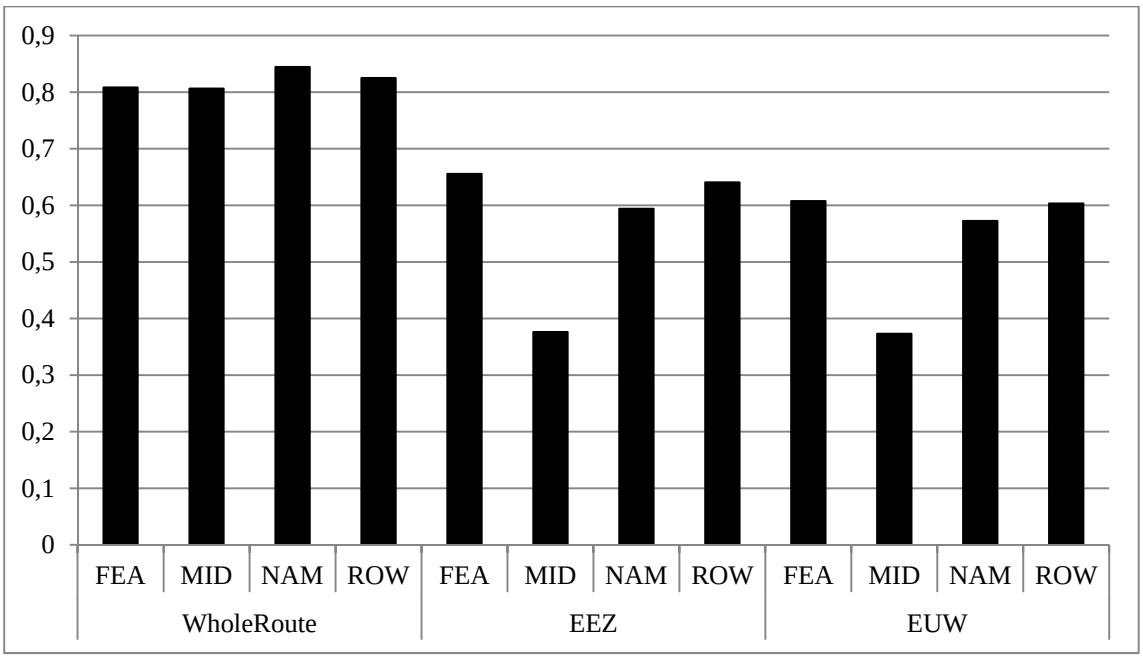

Figure 5: Relative change in water transport activities on different routes from or to Europe relative to benchmark for different definitions of the scope in the case of a maritime ETS with a 20% reduction target.

Hence, limiting the scope of a maritime ETS provokes distortions and puts a higher burden on routes featuring a high share of regulated emissions. Moreover it impedes cost-efficiency. As a consequence, from an economic point of view, policy makers should choose a comprehensive definition of the scope and include all emissions arising on the whole route that is travelled by a ship.

4 A comprehensive approach is not compatible with international law

4.1 Assumptions and applicable law

From a legal point of view, a maritime ETS is based on the obligation to surrender allowances ("permission to emit one ton of carbon dioxide during a specified period", cf. EU Directive 2003/87/EC) equal to the total emissions of shipping activities calculated on the basis of a ship's fuel consumption in a past period. Under the regime of a maritime ETS the total annual amount of allowances for navigation is capped in order to achieve a reduction in GHG emissions. Allowances may, however, be sold and purchased. Non-compliance with the obligation to surrender allowances would lead to penalties and the loss of the right to carry out shipping activities within the EU.

Within a comprehensive EUMETS model, the obligation to surrender allowances would not only apply to vessels sailing under a flag of a Member State, but also to vessels from anywhere else. Moreover, it would include all emissions stemming from sea voyages arriving at or departing from a port situated in the territory of an EU-Member State regardless of their point of departure and their destination and would include all parts of a sea voyage and not only to the parts that lie within EU-Member States Exclusive Economic Zones (EEZ) or their territorial seas. However, with respect to the right to innocent passage (Article 17 UNCLOS) vessels just passing through the territorial sea of an EU-Member State would not fall within the scope of the application of a comprehensive EUMETS.

Such a legal design raises a number of questions concerning the compatibility of an EUMETS with international law. We have focussed our legal analysis on the following legal provisions:

- UNCLOS, as the "constitution for the oceans" (Tan (2006), 192) with many of its provisions merely expressing and clarifying customary international maritime law as developed over time (ECJ, Case C-286/90 – Poulsen and Diva Navigation [1992], ECR I-6019, para. 10; Ringbom (2011), p. 613 (629); Graf Vitzthum (2006a), para. 106).
- In the absence of explicit provision in UNCLOS by directly applying rules of customary international law. In any case, the special provisions of UNCLOS have to be seen and interpreted in the light of these underlying more general rules.
- The International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978 (MARPOL), which has been drafted and is exercised by IMO.
- Bilateral treaties in form of so called mixed agreements concluded between both the EU and its Member States on the one hand and a third country on the other, in particular the Agreement on maritime transport between the European Community and its Member States and the government of the People's Republic of China which came into force on 1st March 2008.[10]
- Bilateral treaties that have been concluded by Member States of the European Union with third countries, e.g. the Friendship, Commerce and Navigation Treaty (Freundschafts-, Handels- und Schiffahrtsvertrag) between the Federal Republic of Germany and the United States of America, which was signed 29 October 1954 and entered into force 14 July 1956.
- World Trade Law, namely the General Agreement on Tariffs and Trade (GATT) and the General Agreement on Trade in Services (GATS).

Our analysis has not covered legal limitations arising from European Union Law itself. Needless to say a Directive establishing a scheme for the trade of emission allowances would have to comply with the various legal provisions as set forth in the Treaty on European Union (TEU), the Treaty on the Functioning of the European Union (TFEU) and the Charter of Fundamental Rights of the European Union (ChFREU).

4.2 Infringements of international law

The analysis of the legal provisions mentioned above cannot be presented here in detail. For this reason, we will draw attention to the most significant outcome of our considerations. We will show that the EU and its Member States do not have law-making competence (prescriptive jurisdiction) for the regulation of GHG emissions resulting from vessels sailing under Non-EU flags outside the territorial seas due to the EU lacking jurisdiction to regulate these kinds of activities.

4.2.1 Division of jurisdiction

The core prerequisite of the legality of a legislative act is that the legislator has "Prescriptive Jurisdiction" on this subject. The division of powers to set binding rules for international shipping activities is basically governed by UNCLOS as interpreted in the light of and amended by customary law. Within this legal framework jurisdiction is distributed between three key players, namely the port state, the coastal state and the flag state (Molenaar (1998), p. 91–95). Furthermore, jurisdiction depends on where the regulated activity takes place. In this respect the law distinguishes the territorial sea (Article 2 UNCLOS), the EEZ (Article 55 UNCLOS) and the high seas (Article 86 UNCLOS). For the purpose of this paper the differentiation between the EEZ and the high seas is not of importance since in general the UNCLOS-provisions for the high seas "apply to the exclusive economic zone in so far as they are not incompatible with this Part" (Article 58 (2) UNCLOS). Consequently, with respect to the international jurisdiction emissions in the EEZ are to be considered emissions on the high seas.

[10] For an overview of international agreements with participation of the EU on the field of Transportation see http://eurlex.europa.eu/Result.do?RechType=RECH_AccorMat&mat=TRAN&repihm=Transport.

In the following, the jurisdiction of the EU to implement an EUMETS is considered for three different models of regulation. To be discussed first is an EUMETS designed to cover solely emissions produced on the territorial seas of the EU-Member States (4.2.2). The second and third models of an EUMETS impose the obligation to surrender allowances for emissions irrespective of where the emissions were produced. Insofar one has to distinguish between an EUMETS encompassing EU-vessels only (4.2.3) and a comprehensive scheme applicable irrespective of the flag the ship is sailing under (4.2.4).

4.2.2 Jurisdiction for emissions on the territorial seas of EU-Member States

In general, each sovereign state exercises prescriptive jurisdiction over its own territory (territorial principle). With regard to the law of the seas this principle of customary international law is confirmed by Article 2 UNCLOS. The territorial sea forms the maritime part of the territory of a State and covers a zone not exceeding 12 nautical miles from the baseline (Article 3 UNCLOS) plus the maritime internal waters (Article 8 UNCLOS).

The territorial principle is in some respects limited by UNCLOS and other rules of international law (explicitly Article 2 (3) UNCLOS), namely by the right to innocent passage through the territorial sea (Article 17 UNCLOS) and by the obligation not to hamper the free entry into a State's port or internal waters (Article 211 (3) UNCLOS). Though Coastal States may implement regulations for the prevention, reduction and control of marine pollution from foreign vessels passing through their territorial water (Article 211 (4) UNCLOS), these regulations "shall not apply to the design, construction, manning or equipment of foreign ships unless they are giving effect to generally accepted international rules or standards" (Article 211 (4), Article 21 (2) UNCLOS, with an exception in Article 211 (6) UNCLOS). It is widely accepted that this refers to environmental regulations of MARPOL and the IMO (Ringbom (2011), p. 21, 22). According to Article 211 (3) UNCLOS even the Port State's law-making competence to set out "particular requirements for the prevention, reduction and control of pollution of the marine environment" is limited. Thus, the right to innocent passage and the right of free entry into a port and the internal waters limits the State's competences for unilateral environmental regulation on their territorial seas.

However, these restrictions of national sovereignty do not affect the jurisdiction for the establishment of an EUMETS. Art. 211 (3) UNCLOS and the MARPOL only cover measures against pollution "of the marine environment" as defined by Article 1 Nr. 1 (4) UNCLOS: the introduction by man of substances or energy into the marine environment which results or is likely to result in deleterious effects. Even if a measure that purports climate protection might as well have an indirect influence on the marine environment, it is not within the scope of these provisions. Furthermore and even more importantly, the provisions of Article 211 (3), (4) and Article 21 (2) UNCLOS refer only to requirements directly concerning the vessel's technical characteristics including construction and equipment (cf. Ringbom (2011), p. 613, 621). This interpretation takes account of the objective of UNCLOS to establish international acknowledged rules and standards, which cannot be amended unilaterally, thereby enabling the free movement of vessels without the need to adapt to different standards for maritime navigation (Ringbom (1999), p. 21, 22). Thus, Article 211 (3) and (4) UNCLOS merely hinder the implementation of protective measures as the technical characteristics of a vessel are concerned. Since a maritime ETS does, however, not impose the duty to comply with specific technical requirements it does not interfere with the legal interest protected by Article 211 UNCLOS.

As a result, on the basis of the territorial principle the EU could, in principle, establish a maritime ETS for emissions transmitted in the territorial seas of its Member States including emissions resulting from vessels sailing under foreign flags.

4.2.3 Prescriptive Jurisdiction for extra-territorial emissions from EU-vessels

It is comprehensible that the EU would go one step further and implement an EUMETS that calculates GHG emissions on the basis of shipping activities not only on the territorial seas, but also on the high seas and on foreign territorial seas.

Under international law there are several principles giving law-making competences as to the regulation of extra-territorial behaviour. Of relevance in the model at hand is the personality principle that allows states to exercise jurisdiction over their nationals. As ships have the nationality of the state flag they are entitled to fly (Article 91 (1) UNCLOS), they fall within the scope of the prescriptive jurisdiction of that state (Article 92 (1) and 94 (1) UNCLOS, cf. Molenaar (1998), p. 83)). This flag state jurisdiction does not cease to exist when a vessel sails into the territorial seas of another state. Therefore, EU-Member States would have jurisdiction to regulate extra-territorial emissions attributable to ships sailing under their own flags. If the EU were to limit the personal scope of an EUMETS to EU-vessels, this would not raise any legal concerns.

4.2.4 Prescriptive Jurisdiction for extra-territorial emissions from Non-EU-vessels

However, in order to avoid flagging out by European ship operators and competitive disadvantages to EU-companies, a comprehensive EUMETS would in all probability include extra-territorial emissions of ships sailing under foreign flags. Such a regulation could constitute an infringement of the flag-state principle and the freedom of the high sea, i.e. the prohibition to all States to subject any part of the high seas to its sovereignty (Article 87, 89 UNCLOS).

4.2.4.1 Incompatibility with flag-state-principle

According to Article 92 (1) UNCLOS there is an exclusive rule-making competence of the flag state for all shipping activities on the high seas as defined in Article 86 UNCLOS (Graf Vitzthum (2006c), para. 30; Proelß (2010), para. 64). International Sea Law provides exceptions from these basic provisions in just a few cases, such as the cooperation in the suppression of illicit traffic in narcotic drugs and psychotropic substances engaged in by ships on the high seas (Article 108 UNCLOS).

Apart from these clearly defined exemptions States are not allowed to regulate shipping activities of foreign vessels on the high seas – including the EEZ (Article 58 (2) UNCLOS) – and a fortiori (Article 2 (1) UNCLOS) in parts of the sea that are included in the territorial sea of another State. The EU, which exercises – from the international law perspective – the national sovereignty of their Member States, does interfere with the flag-state-principle when imposing legal duties on ships sailing under foreign flags in the high seas.

4.2.4.2 EUMETS as “extra-territorial” regulation

Furthermore, it has to be considered whether and to what extent a comprehensive EUMETS model that calculates fuel consumption on the basis of sea voyages without geographical limitation has to be regarded a “regulation” of activities on the high seas and therefore beyond the limits of national jurisdiction.

One has to keep in mind that as long as vessels do not enter a port of an EU-Member State, an EUMETS does not impose any legal duties on vessels sailing on the high seas. The decision to sail into the territorial sea and to enter a port therein remains free from legal restrictions. Thus, contrary to the legal situation for emissions from permanent installations such as factories falling within the scope of the existing ETS (cf. Article 4 EU Directive 2003/87), vessel’s operators would presumably not need a special permission for emitting GHG in the EU’s territorial seas. The allowance trading scheme is only activated when a vessel factually enters a Member State’s port for the first time.

At first glance, any activity on the high seas, in the EEZ, and on foreign territorial seas, remains legally unrestricted. The same applies if the operator fails to comply with his obligation to surrender emissions allowances. European Law would provide penalties (cf. Article 16 (3) EU Directive 2003/87) and attribute the competence to the European Commission to decide on the imposition of an operating ban on the shipping operator as the last resort (cf. Article 16 (5) EU Directive 2003/87). In any case, in accordance to international law, the geographical scope of an operating ban would be limited to the territorial seas of the EU-Member States. Once again, in sensu strictu the freedom of navigation on the high seas seems to be unlimited. However, further examination reveals that even when vessels are sailing on the high seas and on foreign territorial seas, operators are directly affected by EU legal provisions. An EUMETS would entail the duty to monitor the emissions of the vessel and report them to the administration (cf. Article 14 (3) and Part B of Annex IV to EU Directive 2003/87) for the purpose of determining the number of allowances to be surrendered (cf. Article 12 (2a) EU Directive 2003/87). In this respect EU law governs extra-territorial behaviour.

Beside this, one must not only take legal duties into account. When adopting a rather material approach one has to admit that the obligation to surrender emissions allowances for parts of any sea voyage performed outside the EU territorial seas has consequences for behaviour that is as such not subject to the prescriptive jurisdiction exercised by the EU Member States (cf. Pache (2008), p. 65). Although extra-territorial activities are not directly addressed by legal duties, they are subject to the steering effects of the trading scheme. The legal duties of vessels' operators set out by an EUMETS Directive are designed to influence shipping activities on the high seas in order to reduce GHG emissions. It purports vessels' operators to react to the regulation with operational measures such as slow steaming or different route planning, and possibly with technical measures such as alternative fuels. Furthermore, ship operators would be encouraged to reduce the distance of direct sea voyages to or from an EU port to an absolute minimum (for example via intermediate stops in North Africa).

The question whether to factor the economic effects when deciding on the EU's jurisdiction depends on the interpretation of the UNCLOS. It follows from Article 24 (1) lit. a UNCLOS that beyond legal restrictions international sea law also inhibits measures that have the "practical effect of denying or impairing" the freedom of navigation. Although Article 24 applies directly only to the right to innocent passage, its rationale can be transposed by analogy to the freedom on the high seas as defined in Article 87 UNCLOS. Hence, "freedom of navigation" (Article 87 (1) lit. a UNCLOS) means not only freedom from legal restrictions but also the effective freedom to navigation by absence of all influences not authorized under the UNCLOS regime. If read as a guarantee of legal freedom only, the provision of Article 87 (1) UNCLOS would – aside the flag-state principle (Article 92 UNCLOS) and the prohibition to purport to subject any part of the high seas to national sovereignty (Article 89 UNCLOS) – be superfluous.

This interpretation is in conformity with the Convention's provisions on environmental protection. Though – in accordance with customary international law – UNCLOS does not provide state competences for investigations in respect of any activities carried out on the high seas in general, concerning pollution offences Article 218 (1) UNCLOS provides for an exception forming an "universal" port state jurisdiction (Boyle (2006), p. 15, 24). According to this provision the port state shall have the limited competence to undertake investigations and institute proceedings in respect of any illegal discharge from that vessel on the high seas whenever a vessel is voluntarily within the port. The fact that UNCLOS does explicitly empower the legal authority of a state to exercise such competences suggests that states may not tie any administrative consequences as to activities outside the territorial sea (cf. Graf Vitzthum (2006b), para. 88).

The ECJ did not share the foregoing opinion in its Judgment of 2011, concerning the inclusion of aviation activities in the Scheme for GHG emission trading, however:

> "It follows that the European Union had competence, […] to adopt Directive 2008/101, in so far as the latter extends the allowance trading scheme laid down by Directive 2003/87 to all

flights which arrive at or depart from an aerodrome situated in the territory of a Member State." (ECJ (2011), para. 130)

In its reasoning, the ECJ adopted an extremely limited point of view stating that Directive 2008/101 would not infringe the principle of territoriality or the sovereignty of third states, being only applicable to aircraft flights which depart from or arrive at an aerodrome situated in the territory of one of the Member States. While aircrafts are "physically in the territory" of the European Union, they are, according to the Court, subject to the "unlimited jurisdiction of the European Union". And while flying over the high seas, they are not subject to the allowance trading scheme (ECJ (2011), para. 125 et seq.).

This argument of the ECJ disregards the legal duties for monitoring and reporting as well as the economic impacts of the ETS. As follows from the foregoing, a purely formal approach is not convincing in the light of international law, especially in the field of navigation. Moreover, it does not fit in the European legal framework as the European fundamental rights (cf. ChFREU) as well as the Basic Freedoms of the TFEU as interpreted by the ECJ protect against any measures enacted by the Union itself or its Member States which are – not only by imposing legal obligations but also de facto – capable of hindering the usage of freedom (cf. ECJ, Case 8/74 – Dassonville [1974], ECR 837, para. 5). It is therefore not surprising that the ECJ Judgment on the Air transport sector faces criticism (cf. Athen (2012), p. 337, 339 et seq.; Mayer (2012), p. 1113, 1128 et seq.).

Hence, it is more convincing to interpret UNCLOS as not allowing, in principle, any state to generate considerable economic impacts on navigation on the high sea as an EUMETS purports and would probably have.

4.2.4.3 No Justifiifaction of "extra-territorial" regulation by the effects principle

There exist, however, principles of customary international law establishing extra-territorial jurisdiction over non-nationals that our analysis should consider in order to examine a possible justification of the implementation of an EUMETS. In particular, the so called "effects principle" may allow exceptions from the basic principles of national sovereignty, exclusive flag-state-authority and freedom of the high seas. In core terms, according to the effects principle a state may have jurisdiction to rule on extra-territorial behaviour in order to prevent the occurrence of significant and foreseeable effects for a state, its population or its territory (Molenaar (1998), p. 71; Ringbom (2011), p. 630). In this context the effects principle authorizes states to defend its economic interests against interference caused by foreign public authorities or private companies situated in a foreign country (e.g. cartel agreements concluded extra-territorially but affecting the competition interests of national companies) (Doehring (2004), para. 823). However, in the practice of the Courts the application of the effects principle has always been limited to competition and antitrust law (König and Morgenstern (2009), 181, 189; Ringbom (2011), 630). Whether it could and would be applied in the field of international environmental law and in particular the combat against global warming is left to speculation (cf. Ringbom (2011), 613, 630). Apparently, little legal basic research has been dedicated to this topic. A "handbook" of the law of the Sea does not even mention the effects principle as being capable of justifying interference with the freedom of the high seas with regard to environmental protection (Graf Vitzthum (2006b), paras. 82–93).

As far as legal literature has *explicitly* touched the question, most authors are nevertheless in favour of the application of the effects principle as a justification of a maritime ETS (König/Morgenstern (2009), 181, 189; Lassen (2010), 570, 574; with regard to the aviation sector Pache (2008), 75 et seq.; Bäuerle et al. (2010), 85 et seq.; Athen (2012), 337, 340; Mayer (2012), 1113, 1130). For this purpose, they argue that the goal of climate protection is a common good that is of essence for individual states as well as the international community. On the further premise that all states and their population would suffer under the effects of a global climate change, it is then argued that all states have a sufficient interest to pass legislation that combats GHG emissions.

While initially plausible, at second glance this motivation is not convincing. The mere fact that climate change is a global phenomenon and does therefore affect national interests of all states cannot be sufficient to extend national legislation on all extra-territorial activities producing GHG emissions. The exceptional nature of the effects principle prompts a narrow interpretation. Thus the effects principle gives jurisdiction to regulate such activities that are only formally performed outside its territory, but having consequences exclusively or at least primarily inside that territory. It is persuasive from a more material point of view to regard such activities "territorial". Insofar effects of GHG emissions on the high seas or on foreign territorial seas cannot specifically attributed to EU-Member States. Obviously, effects of gas emissions are different from the pollution of a State's coast caused by the average of an oil tanker within the EEZ (Mayer (2012), 1113, 1130 et seq.). Due to the high complexity of the climate change process, a chain of causes and effects that would clearly link GHG emissions from vessels anywhere in the world with specific environmental outcome, can scarcely be identified.

But even if the outcome could be described precisely, the effects of climate change would be tangible world-wide and would not lead to particular and extraordinary significances for EU-Member states. Member States and their population are not affected by shipping emissions as "individuals", but only as part or constituents of the international community. With regard to the effects principle, their interests ought not be considered sufficient to establish extra-territorial jurisdiction. Where all states are affected the same way, there is no reason to allow for an exception from the basic principles of national sovereignty and of the freedom of the high seas in favour of specific states. Giving up these basic principles would cause severe risk of overlapping and contradictory regulation, of duplication of measures and costs, and the prospect of uncontrolled addition of interferences within the scope of fundamental rights. The international community of states has reasonably placed the environmental protection regards shipping emissions in the hands of the IMO; a global ETS should be implemented on this basis and not under the jurisdiction of a single player as the EU.

Moreover, even if the effects principle covered measures against global warming, that does not necessarily mean establishing jurisdiction for the inclusion of emissions of foreign flagged vessels outside the territorial seas of the EU-Member States. The effects principle is limited by the principle of proportionality. In its broadest sense this principle entails three criteria, i.e. suitability, necessity, and proportionality in the narrow sense. When it comes to balancing (principle of proportionality in the narrow sense) the interests that are to be taken into account are to be confined precisely. As the effects principle exceptionally provides law-making competences for extra-territorial behaviour, the proportionality-test does not include a free balancing of advantages and disadvantages of a maritime ETS as a measure against global warming (different point of view: Lassen (2010), 570, 575). It is not decisive whether a maritime ETS is an appropriate measure, but merely whether the EU-Member States shall have the jurisdiction for its implementation. For this purpose, it is necessary to examine whether the legislation-interests of EU-Member States, namely the importance of regulation for the regulating state, the extent to which other states regulate such activities and the degree to which the desirability of such regulation (cf. Ringbom (2011), 613, 631 f.), prevail over the sovereignty of the countries affected by EUMETS (Molenaar (1998), 82). Other aspects to consider are the extent to which the regulation is consistent with traditions of international law, the likelihood of conflicts with regulation imposed by other states, and finally the importance of regulation for the international political, legal or economic system should be considered. As GHG emissions affect EU interests neither directly nor specifically the EU would by establishing a maritime ETS act rather as a procurator in behalf of global than of own interests. In other words, the specific importance of the regulation for the regulating player can be seen as relatively low. An EUMETS would aim to subject the high seas to the Union's sovereignty in order to achieve a political goal that other states – exercising their sovereignty – do not share or do not try to achieve via the implementation of a

maritime ETS or other regulatory means.[11] The lack of an IMO agreement demonstrates the controversy on a global emission allowance trading scheme. The decision a political goal such as the reduction of GHG emissions is set, and which measures are taken to its achievement should remain in the realm of national sovereignty.

The analysis concludes that a comprehensive EUMETS would not meet the requirement of proportionality in the narrow sense as set out by the effects principle.

4.2.5 Result

One has to state as a result that international law does not hinder the EU to implement an EUMETS that encompasses emissions produced within the territorial seas of EU-member states. Likewise, an EUMETS designed to capture territorial as well as extraterritorial emissions of EU vessel does not raise deep concerns as to its compatibility with international law. A comprehensive EUMETS model, however, that includes emissions of non-EU vessels irrespective of their local production would have relevant extra-territorial effects incompatible with the flag-state principle (Article 92 UNCLOS). Furthermore, it would disregard the prohibition to all states to subject any part of the high seas to its sovereignty (Article 89 UNCLOS) as well as the national sovereignty over the territorial sea (Article 2 UNCLOS).

5 Summary and Conclusion

On the basis of a joint economic and legal analysis, we evaluate in this paper the effects of a "regional" (European) emission trading scheme aiming at reducing emissions of international shipping. The focus lies on the question which share of emissions from maritime transport activities to and from the EU can and should be included in such a system.

Our findings suggest that the attempt to implement an EUMETS runs into a dilemma. It is impossible to design a scheme that achieves the goal of emission reductions in a cost efficient manner and is compatible with international law:

From an *economic point of view*, the EU should choose a comprehensive definition of the scope and include all emissions arising on the whole route that is travelled by a ship. In contrast to this, limiting the scope of the ETS would put a disproportional burden on routes featuring a high share of regulated emissions, i.e. short routes traveling mainly within EU territorial waters, and impede cost-efficient emission abatement among regulated ships. From a *legal point of view*, however, deep concerns as to the compatibility of a comprehensive scheme regulating all emissions arising on voyages to and from the EU with international law arise. A comprehensive scheme would have extra-territorial effects in conflict with the flag-state principle (Article 92 UNCLOS) and disregard the prohibition to all states to subject any part of the high seas to its sovereignty (Article 89 UNCLOS).

The aforementioned dilemma does not arise in a situation with an ETS applied to shipping activities on a global basis. As a consequence, although the effects of such a global maritime ETS remains to be studied in detail, policy makers should continue working on an international agreement to reduce maritime emissions instead of resorting to regional schemes.

[11] Cf. for the aviation sector Mayer (2012), 1113 (1138): "[…] an attempt by 27 States to concert and use their sovereign rights to promote the aims of international law".

6 References

Anger A. and J. Köhler (2010), Including Aviation Emissions in the EU ETS: Much ado about nothing? A review. *Transport Policy* 17(1), 38-46.

Armington, P. S. (1969), A Theory of Demand for Producers Distinguished by Place of Production, IMF Staff Papers Vol. 16, 159-178.

Athen, M. (2012), „Hinterm Horizont geht's weiter!"- Einbeziehung des Luftverkehrs in den Handel mit Treibhausgasemissionszertifikaten, Europäische Zeitschrift für Wirtschaftsrecht (EuZW) 2012, 337-341.

Badri N. G. and T. L. Walmsley (2008), Global Trade, Assistance, and Production: The GTAP 7 Data Base, Center for Global Trade Analysis, Purdue University, Purdue, USA

Bäuerle, T., J. Graichen, M. Kulessa, M. Oschinski (2010), Integration of Marine Transport into the European Emissions Trading System – Environmental, economic and legal analysis of different options, on behalf of the Federal Environment Agency (Germany), available at http://www.umweltdaten.de/publikationen/fpdf-l/3942.pdf.

Boyle, A. (2006), EU Unilateralism and the Law of the Sea, *The International Journal of Marine and Coastal Law* 21(1), 15-31.

CE Delft (2009), Technical support for European action to reducing Greenhouse Gas Emissions from international maritime transport, Report, Delft, The Netherlands.

Dietzenbacher, E., B. Los, R. Stehrer, M. Timmer and G. de Vries (2013), The construction of world input-output tables in the WIOD project, *Economic Systems Research* 25(1), 71-98.

Doehring, K. (2004), Völkerrecht: Ein Lehrbuch, 2nd edition, Heidelberg, Germany

ECJ (2011), Case 366/10 – Air Transport Association of America [2011]), delivered 21 December 2011.

Engel, G.-E. (2013), Treibhausgasemissionsbezogene Maßnahmen in der Seeschifffahrt, *Neue Zeitschrift für Verwaltungsrecht (NVwZ)*, 1384-1389.

EU (2002), Decision No 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 Laying down the Sixth Community Environment Action Programme, Brussels, Belgium.

EU (2009), Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 Amending Directive 2003/87/EC so as to Improve and Extend the Greenhouse gas Emission Allowance Trading Scheme of the Community, Brussels, Belgium.

EU (2012a), Memo MEMO/12/854 of the European Commission of 12 November 2012 regarding Stopping the clock of ETS and aviation emissions following last week's International Civil Aviation Organisation (ICAO) Council, Brussels, Belgium.

EU (2012b), Proposal 2012/328 (COD) of the European Commission for a Decision of the European Parliament and the Council derogating temporarily from Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowance trading within the Community, Brussels, Belgium.

EU (2013), Proposal 2013/0224 (COD) for a Regulation of the European Parliament and of the Council on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport and amending Regulation (EU) No 525/2013, Brussels, Belgium.

EU (2013), Proposal 2013/0344 (COD) for a Directive of the European Parliament and the Council amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community in view of the implementation by 2020 of an international agreement applying a single global market-based mechanism to international aviation emissions, Brussels, Belgium.

Franc, P. and L. Sutto (2014), Impact analysis on shipping lines and European ports of a cap-and-trade system on CO_2 emissions in maritime transport, *Marine Policy & Management* 41(1), 61-78.

French Ministry of Transport (2012), Evaluation des conséquences économiques sur l'activité maritime et portuaire de la mise en place d'un marché de permis d'émissions de CO_2 dans le secteur du transport maritime international, Paris, France.

Graf Vitzthum, W. (2006a), Kapitel 1: Begriff, Geschichte und Rechtsquellen des Seerechts, Graf Vitzthum (Ed.), Handbuch des Seerechts, München, Germany.

Graf Vitzthum, W. (2006b), Kapitel 2: Martimes Aquitorium und Anschlusszone, Graf Vitzthum (Ed.), Handbuch des Seerechts, München, Germany.

Graf Vitzthum, W. (2006c), Kapitel 4: Hohe See und Tiefseeboden (Gebiet), Graf Vitzthum (Ed.), Handbuch des Seerechts, München, Germany.

IMO (2010), Prevention of Air Pollution from Ships – A Further Outline of a Global Emission Trading System (ETS) for International Shipping, Submitted by Norway, IMO MEPC 60/4/22, London, United Kingdom.

ITF/OECD (2010), Transport Greenhouse Gas Emissions: Country Data 2010, ITF/OECD, Paris, France.

Klement, J. (2007) Kollisionen von Sekundärrecht der Europäischen Gemeinschaft und Völkerrecht – Eine Studie am Beispiel der geplanten Emissionshandelsrichtlinie für den Luftverkehr, *Deutsches Verwaltungsblatt – DVBl*, 1007-1016.

Koesler, S., M. Achtnicht and J. Köhler (2012), Capped Steam Ahead – A Case Study Among Ship Operators on a Maritime ETS, ZEW Discussion Paper No. 12-044, Mannheim, Germany.

Koesler, S. and M. Schymura (2012), Substitution elasticities in a CES production framework: An empirical analysis on the basis of non-linear least squares estimations, ZEW Discussion Paper No. 12-007, Mannheim, Germany.

Koesler, S. and F. Pothen (2013), The Basic WIOD CGE Model: A Computable General Equilibrium Model Based on the World Input-Output Database, ZEW Documentation No. 13-04, Mannheim, Germany.

König, D. and L. Morgenstern (2009), CO_2-Emissionen aus dem Schiffsverkehr, *Zeitschrift für Öffentliches Recht in Norddeutschland (NordÖR)*, 181-190.

Kremlis, M. (2010), The Inclusion of the Shipping Industry in the EU ETS, *European Energy and Environmental Law Review*, 145-156.

Lassen, M. (2010), Einbeziehung des Schiffsverkehrs in das Emissionshandelssystem, *Zeitschrift für Umweltrecht (ZUR)*, 570-579.

Mayer, B. (2012), Comment on Case C-366/10, *CML Rev* 49, 1113-1139.

Miola, A., M. Marra and B. Ciuffo (2011), Designing a Climate Change Policy for the Internationa Maritime Transport Sector: Market-Based Measures and Technological Options for Global and Regional Policy Actions, *Energy Policy* 39(9), 5490-5498.

Molenaar, E.J. (1998), Coastal State Jurisdiction over Vessel-Source Pollution, The Hague, The Netherlands.

NGA (2001), Distance between ports, National Geospatial-Intelligence Agency (NGA) PUB. 151, Bethesda, USA.

OECD (2012), OECD.Stat, (database), doi: 10.1787/data-00285-en, accessed on 7.2.2013.

Pache, E. (2008), Zur Vereinbarkeit der Einbeziehung der Treibhausgasemissionen des internationalen Luftverkehrs in das System des EU-Emissionszertifikatehandels durch die beabsichtigten Änderungen der EU-Emissionszertifikatehandelsrichtlinie mit internationalen Vorgaben, Rechtsgutachten im Auftrag des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit, available at http://www.bmu.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/flugverkehr_emissionshandel.pdf.

Proelß, A. (2010), Raum und Umwelt im Völkerrecht (5. Abschnitt), Graf Vitzthum (Ed.), Völkerrecht, 5th edition, Berlin, Germany.

Ringbom, H. (1999), Preventing Pollution from Ships – Reflections on the "Adequacy" of Existing Rules, *Review of European Community and International Environmental Law* 8(1), 21-28.

Ringbom, H. (2011), Global Problem – Regional Solution? International Law Reflections on an EU CO_2 Emissions Trading Scheme for Ships, *The International Journal of Marine and Coastal Law* 26, 613-641.

Stavins, R. N. (2003), Chapter 9 Experience with Market-Based Environmental Policy Instruments, Karl-Göran, M. and R. V. Jeffrey (Eds.), Handbook of Environmental Economics Vol. 1, Amsterdam, The Netherlands.

Tan, A. K.-J. (2006), Vessel-Source Marine Pollution. The Law and Politics of International Regulation, Cambridge, United Kingdom.

Timmer, M. P., A. A. Erumban, R. Gouma, B. Los, U. Temurshoev, G.J. de Vries, I. Arto, V. Andreoni Aurelien Genty, F. Neuwahl, J. M. Rueda-Cantuche, A. Villanueva, J. Francois, O. Pindjuk, J. Pöschel, R. Steherer, G. Streicher (2012), *The World Input-Output Database (WIOD): Contents, Sources and Methods,* available at http://www.wiod.org/database/index.htm.

UNFCCC (1998), Kyoto Protocol to the United Nations Framework Convention on Climate Change, UNFCCC, Bonn, Germany.

World Bank Group (2009), *The World Bank Group: Air Freight: A Market Study with Implications for Landlocked Countries*, Washington, USA.

7 Annex

Table 3: List of regions

Short	Region	Associated WIOD Region
EU	Europe	AUT, BEL, BGR, CYP, CZE, DNK, ESP, EST, FIN, FRA, GBR, GER, GRC, HUN, IRL, ITA, LTU, LUX, LVA, MLT, NLD, POL, PRT, ROM, SVK, SVN, SWE
NAM	North America	CAN, MEX, USA
FEA	Far East	CHN, JPN, KOR, TWN
MID	Middle Distance	RUS, TUR
ROW	Rest of the World	AUS, BRA, IDN, IND, ROW

Table 4: List of sectors

Short	Sector	Associated WIOD Sector
INLAND	Inland Transport	60
WATER	Water Transport	61
AIR	Air Transport	62
NTR	No Transport Costs	F, 50, 51, 52, H, 63. 64, J, 70, 71t74, L, M, N, O, P
HIGH	High Ad-valorem Transport Costs	AtB, 15t16, 20, 21t22, 34t35, 36t37
LOW	Low Ad-valorem Transport Costs	17t18, 19, 24, 25, 26, 27t28, 29, 30t33,
ENERGY	Energy	C, 23, E

Table 5: List of scenarios

	Scope of ETS		
Reduction Target of ETS (w.r.t. 2009 Emission Levels)	Whole Route (WR)	European Economic Zone plus Territorial Waters (EEZp)	European Territorial Waters (ETW)
0%	WR0	EEZp0	ETW0
5%	WR5	EEZp5	ETW5
10%	WR10	EEZp10	ETW10
20%	WR20	EEZp20	ETW20
30%	WR30	EEZp30	ETW30

Table 6: List of share of regulated emissions

	Share of Regulated Emissions		
Route	Whole Route (WR)	European Economic Zone plus Territorial Waters (EEZp)	European Territorial Waters (ETW)
EU-NAM NAM-EU	100%	9.0%	2.2%
EU-FEA FEA-EU	100%	3.2%	0.8%
EU-MID MID-EU	100%	22.5%	5.6%
EU-ROW ROW-EU	100%	4.9%	1.2%

Table 7: Overview of legal framework

Short	Description
Directive 2003/87/EC	Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC, as last amended by Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009
GATS	General Agreement on Trade in Services
GATT	General Agreement on Tariffs and Trade
Kyoto Protocol	Kyoto Protocol to the United Nations Framework Convention on Climate Change
MARPOL	International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978
MRV-Proposal	Proposal for a Regulation of the European Parliament and of the Council on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport and amending Regulation (EU) No 525/2013, COM(2013) 480 final
UNCLOS	UN Convention on the Law of the Seas