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Economic Effects of Maritime Environmental Legislation in the North and Baltic Sea Area: An Exploratory Sequential Mixed Methods Approach

Thea Freese

***Abstract*—**Environmental legislation to protect North and Baltic Sea areas from harmful vessel-source emissions has received increased political attention in recent years. Legislative measures are expected to show positive effects on the health of the marine environment and society. At the same time, compliance might increase the costs to industry and have effects on freight rates and volumes shipped with potential negative repercussions on the environment. Building on an exploratory sequential mixed methods approach, this research project will study the economic effects of maritime environmental legislation in two phases. In Phase I, exploratory in-depth interviews were conducted with 12 experts from various stakeholder groups aiming at identifying variables influencing the relationship between environmental legislation, freight rates and volumes shipped. Influencing factors like compliance, enforcement and modal shift were identified and studied. Phase II will comprise of a quantitative study conducted with the aim of verifying the theory build in Phase I and quantifying economic effects of rules on shipping pollution. Research in this field might inform policy-makers about determinants of behaviour of ship operators in the face of the law and might further the development of a comprehensive legal system for marine environmental protection. At the present stage of research, first tentative results from the qualitative phase may be examined and open research questions to be addressed in the quantitative phase as well as possible research designs for phase II may be discussed. Input from other researchers will be highly valuable at this point.

***Keywords*—**Clean shipping operations, compliance, maritime environmental legislation, maritime law and economics, mixed methods research, North and Baltic Sea area.

I. Context and Motivation

A significant amount of environmental legislation targeted at shipping in the European seas has been passed and will be passed in the coming years. New emission reduction requirements for marine fuels have come into force on 1 January 2015 with further limits on SO_x applicable from 2020 onwards [1], and the IMO has designated both the Baltic and the North Sea as NO_x emission control areas from January 1, 2021 forward. [2] Ballast water management will become mandatory in September 2017 [3], and an inclusion of shipping into the EU's CO_2 emission trading system from 2023 onwards is currently discussed [4], [5]. The researcher aims to understand how maritime environmental legislation is affecting shipping freight rates in the specially protected areas of the North and Baltic Sea. The North and Baltic Sea area was specifically chosen as it is characterized both by strict legislation on environmental protection and road and rail networks on land that might make modal shift feasible. The knowledge gained will provide insights into the mechanisms behind abstract legal rules influencing company decision making towards increasing prices for the shipping industry specifically and the transport industry in general. As the choice in mode of transport is largely dependent on the respective freight rates a thorough understanding of how freight rates are determined is of great importance in view of preventing unwanted consequences of environmental transport legislation, e.g. modal shift. Contributing to the aim of achieving a clean environment for future generations and increasing the welfare/well-being of people, animals, and plants are the author's motivations for this study.

Thea Freese is with the Hamburg University of Applied Sciences, Hamburg, Germany (e-mail: thea.freese@haw-hamburg.de).

II. Hypotheses and Problem Statement

A popular argument goes that increases in shipping freight rates will encourage cargo to leave the sea route, acknowledged by the European Commission and others to be the most environmentally friendly mode of transport. Scientific evidence of modal shift towards road and rail in the light of higher shipping freight rates is however weak. Estimates linked to SECA-related price increases range from 50% shift on certain routes [6] to the effect being non-existent [7], depending to some extent on the contractor of the study. The European Commission stated that modal shift would be an unwanted consequence of maritime environmental legislation, the problem does however seem to be too little understood to make educated guesses on its scope and probability of existence. In literature review, research gaps became apparent on the mechanisms how legislation leads to behavioural adaptations of shipping companies, how different actors might be differently affected by legislation and whether compliance is an important issue in determining effects for trade. All these variables might have an as-yet unstudied effect on freight rate changes. Hypotheses guiding this study (and forming the basis for the quantitative study) are thus:

H1 Maritime environmental legislation is causing a change in shipping freight rates in the specially protected areas of the North and Baltic Sea.
H2 Distinct types of trade will experience different changes in freight rates from maritime environmental legislation.
H3 Compliance levels influence effects on trade.
H4 There is a probability of modal shift.

A conceptual framework of main hypothetical relations as

developed from literature review can be seen in Fig. 1.

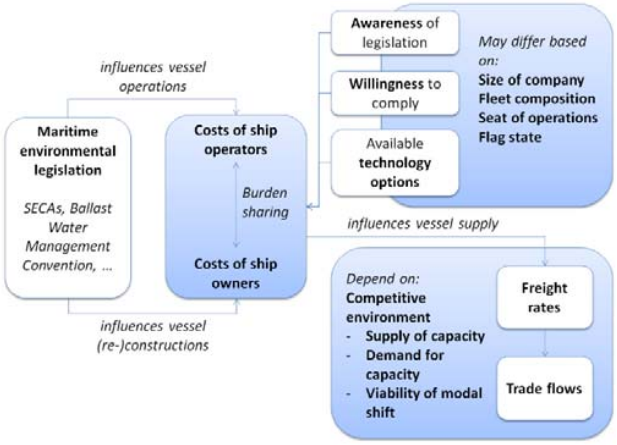

Fig. 1 Conceptual framework based on literature review

III. Research Objective and Questions

While qualitative researchers are looking for the production of meaning in a certain social context, quantitative questions are rather verifiable hypotheses that study the relationship between certain variables. Combining these two spheres of knowledge creation fitted the research objective perfectly, as the researcher wanted to understand the mechanisms leading from changes in environmental legislation to changes in freight rates and develop a theory before putting numbers on certain variables. The researcher thus worked with two different sets of research questions for the two phases of research. Questions guiding the qualitative expert interviews were:

QUA1. What practical significance does environmental legislation have for shipping companies?
QUA2. In what ways is their business affected by environmental legislation?
QUA2.1. Are ship operators aware of legislation?
QUA2.2. Are ship operators willing to comply with legislation?
QUA2.3. Are ship operators able to comply with legislation?
QUA3. How does legislation translate into action by shipping companies, e.g. changes in freight rates?
QUA4. How significant is the probability of modal shift?
QUA5. How are different shipping trades affected in different ways?

The aim of the qualitative study was to identify variables that had an important meaning for the shipping industry and that were influencing their decisions. Furthermore, the nature of the relation between these variables was aimed to be identified. A specific focus was put on understanding differences between shipping companies regarding these relations. The quantitative study was guided by the above-named hypotheses.

IV. Literature Review

Extensive literature review based on a theoretical framework of keyword matrixes, guidance questions, and inclusion and exclusion criteria was conducted using legal, economic and general knowledge databases. Economic theories on pollution legislation were studied, and official (IMO, MEPC, EU, …) legal publications were reviewed to develop a comprehensive framework of current legislation on operational vessel-source pollution.

Emission reductions of SO_2, NO_x, CO_2, and particulate matter, ballast water management requirements, limits on sewage and oily water discharges, rules on the dumping of waste, laws on anti-fouling systems, the regulation of noise pollution – although no multi-source impact assessment could be identified by the researcher, studies exist dealing with most sub-segments of legislation on operational vessel-source pollution. The researcher has reviewed impact assessments on all types of vessel-source pollution, with most assessments focusing on current legislation of air pollution and ballast water management. As an example, 24 studies on SECA and NECA rules on the Baltic and North Sea were discussed extracting information contained on cost, freight rate, and trade effects as well as modal shift, as shown in Fig. 2.

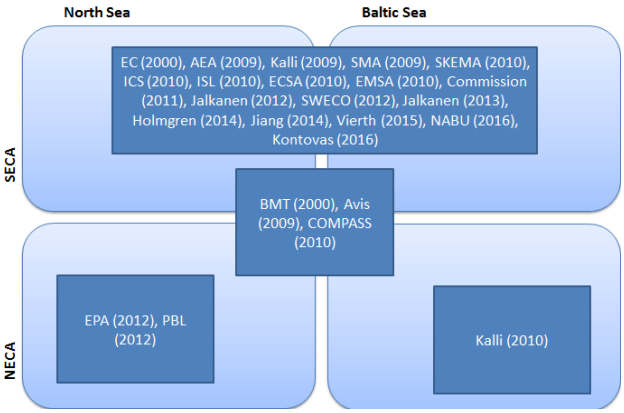

Fig. 2 Scope of economic studies on maritime air pollution legislation

Literature on variables identified during literature review and represented in the conceptual framework was subsequently reviewed, namely compliance and differences between ship operators. Few sources could be found discussing these variables, and further research gaps became apparent during review. The total costs to industry of environmental measures and the combined effect on freight rates on the North and Baltic Sea could not be determined from existing studies. A discussion of possible interactions between different rules has not been found in available publications, and the likely effect on trade could not be identified. With this project, the researcher will take a broader look at maritime environmental legislation not just focusing on one specific measure, but aiming to identify effects of a bundle of measures affecting the industry simultaneously. Furthermore, not only final outcomes in terms of cost and freight rate increases, but also mechanisms leading to these effects will be studied. Compliance decision-making within companies is an important determinant of trade effects of

environmental legislation, including decisions for non-compliance influencing the actual effect of legislation negatively. Contributing to closing these knowledge gaps is the aim of this research.

V. Research Approach and Methods

The nature of this research is of a kind to mix qualitative and quantitative data collection with the aim of both developing a deeper understanding of the research problem and in a second step validating the emerging theory numerically. An exploratory sequential mixed methods design [8], [9] is employed as depicted in Fig. 3 where qualitative data collection and analysis serves to identify the social reality of shipping companies, their beliefs and motivations, their decision-making strategies and behaviour in relation to environmental legislation.

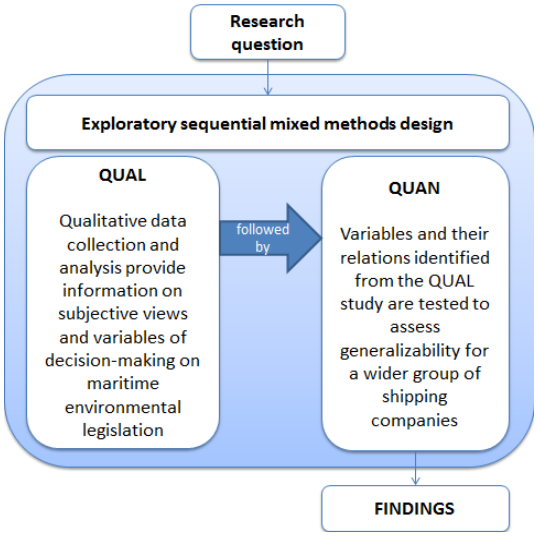

Fig. 3 Exploratory sequential mixed methods design

Building on the variables identified in the exploratory study the second quantitative phase is built to test and generalize the initial findings and to assess the prevalence of categories identified for a larger number of shipping companies. An exploratory sequential design fits the purpose of this research well, as variables influencing compliance behaviour are widely unknown and need to be identified inductively from qualitative data aimed at building a purposeful theory. Once the important constructs are identified assessing the generalizability of the theory to a larger part of the industry is of great interest.

This work follows a law and economics approach touching upon and combining the research fields of environmental law and environmental economics as well as maritime law and maritime economics. It is a work of applied sciences in the sense that it applies economic and legal theory to interpret and explain the practical economic phenomenon of trade effects from maritime environmental legislation.

VI. Results to Date and Their Validity

Qualitative data from Step I has been evaluated and first tentative results may be presented. Of the seven sources of operational pollution shown in Fig. 2, legislation on only two areas was identified as significant by experts, namely air pollution and ballast water management. Environmental legislation was found to be of high importance to the industry where it influenced costs and had the potential to drive companies out of the market, but the development of demand was deemed even more important. Experts widely agreed that levels of awareness about legislation were high, except for shipping companies who had decided to leave shipping associations, whereas apprehension was sometimes lacking. Especially, smaller companies and territorial outsiders were among the actors struggling most with understanding what was asked of them. With respect to their willingness to comply, some experts believed that the shipping industry was the best available alternative for the environment and felt little need to enhance efforts further, while others saw a clear demand for improvement.

Compliance with the rules was seen by many as “pure self-interest” and the “license to operate”, while ten out of 12 experts agreed that non-compliance is an issue on the Northern European seas. The main reasons for non-compliance named by experts were lacking financials, and willing disregard of the rules in the belief of not getting caught. Main reasons for compliance were the conviction that companies had no other choice as well as a commercial advantage arising from compliance. Enforcement was deemed to have improved, but a lack in frequency, difficulty to control outside of ports and the observation of several stakeholders that port state control stayed clear of substandard vessels was claimed to still leave plenty of room for willing offenders. A lack of port reception facilities, reliable systems, installation space or economic viability of solution might pose technical problems to full compliance with environmental rules. Data on modal shift and cost and trade effects was inconclusive still leaving many open questions to be addressed in the QUAN study.

Certain measures were taken to increase credibility, dependability and transferability of results. Experts have been sampled purposefully based on contrasting cases, meaning that they shall come from different backgrounds representing a variety of stakeholder interests and being characterized by distinct characteristics like superior knowledge, but also on their social relevance, meaning that they had to hold an official position with decision-making competences. A social-representative approach was chosen with the aim of increasing the validity of results. Further measures to increase validity were taken by trial-coding, re-coding at another point in time, and having a part of the data re-coded by a student assistant and two fellow PhD students to ensure transferability of the coding system. Although qualitative analysis does not serve to build a universally valid model, it helps to achieve a deeper understanding of the variables and their relation from the specific point of view of a certain expert.

VII. Dissertation Status and Next Steps

The raw data from 12 semi-structured expert interviews have been fully transcribed, translated into English where necessary and coded using MaxQDA and following qualitative content analysis. Results have been evaluated and are currently compared with the theoretical model developed from literature review. Advancing and adapting this model including theory developed from expert interviews will form the output of the QUAL study and the basis for the QUAN study. Next steps will be establishing a sampling procedure and developing purposeful questionnaires to study the hypotheses named above. The final PhD thesis is supposed to be submitted in April 2018.

VIII. Current and Expected Contributions

Insights from industry experts have helped clarify mechanisms of company decision-making on environmental legislation and have greatly advanced knowledge on determinants of compliance. A theory could be built on inductively developed variables linking environmental rules and freight rates that can be numerically tested. The data to be collected in Phase II should contribute to calculating effects on costs, freight rates, and modal shift on the Baltic and North Sea. This study is contributing to a better understanding of mechanism of vessel-source emission legislation and may support legislators in making sounder choices for increasing overall welfare from trade by sea and a healthy environment.

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