REGULATE ME, IF YOU CAN!
HUNTING SHIPPING’S RESPONSES TO ENVIRONMENTAL POLICIES

YEWEN GU
NHH CENTRE FOR SHIPPING AND LOGISTICS
SNF - CENTRE FOR APPLIED RESEARCH AT NHH
Can an Emission Trading Scheme really reduce CO₂ emissions in the short term? Evidence from a maritime fleet composition and deployment model

Yewen Gu<sup>a</sup>, Stein W. Wallace<sup>b</sup>, Xin Wang<sup>b</sup>

<sup>a</sup>Department of Business and Management Science, Norwegian School of Economics, Bergen, Norway
<sup>b</sup>Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Trondheim, Norway

**ARTICLE INFO**

**Keywords:**
- Maritime Emissions Trading Scheme
- Fleet composition and deployment
- Greenhouse gas
- Market-based measures
- Emission reduction

**ABSTRACT**

Global warming is a major challenge for this planet, and its solution requires efforts throughout society. Maritime transportation, which carries more than 90% of the global trade, plays a critical role in the contribution of greenhouse gas (GHG) emissions. However, the GHGs emitted by the global fleet still fall outside the emission reduction scheme established by the Kyoto Protocol. Alternative solutions are therefore sought. Several market-based measures have been proposed and submitted to IMO for discussion and evaluation. In this paper, we focus on one of these measures, namely the Maritime Emissions Trading Scheme (METS). An optimization model that integrates (global or regional) METS into the classical fleet composition and deployment problem is proposed. This model is used as a tool to study the impact of METS on fleet operations and their CO₂ emissions. The results of the computational study suggest that, in the short term, the implementation of METS does not lead to emission reduction in most scenarios. However, in the case of low bunker prices, high allowance costs or global METS coverage, a more significant CO₂ decrease in the short term can be expected.
Background Information

• Shipping is vital for our global economy

• Shipping is a relatively green mode of transportation comparing to road or air

• However, it is still one of the major sources of CO$_2$, the absolute volume of emission from vessels is still enormous

• No regulation yet covers the emission from global fleet
Background Information

• Market-based measures (MBM) are needed

• MBM:
  1. Offers economic incentives rather than command-and-control
  2. More cost-effective emission reduction

• 7 MBM proposals are submitted to IMO for discussion and evaluation

• Maritime Emissions Trading Scheme (METS) and GHG fund are the most popular options
Background Information

• METS → Long term and short term emission reduction

➢ Long term: technological innovation
  1. New energy
  2. More efficient engine
  3. Better hull design

➢ Short term: Operational adjustment
  1. Speed reduction
Background Information

• Research question:

  Whether or to what extent can METS affect ship’s emission in the short term involving all determining factors?

• Tool:

  Model integrating the classical fleet composition and deployment problem with the application of METS (global or regional)
Case

- Test trade lanes and contracts

Table 2: Trade Lanes and Contracts

<table>
<thead>
<tr>
<th></th>
<th>Trade Lane 1</th>
<th>Trade Lane 2</th>
<th>Trade Lane 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin port</td>
<td>Mongstad</td>
<td>Houston</td>
<td>Ras Tamura</td>
</tr>
<tr>
<td>Destination port</td>
<td>Saint John</td>
<td>Luanda</td>
<td>Rijeka</td>
</tr>
<tr>
<td>Frequency</td>
<td>12 visits per year</td>
<td>12 visits per year</td>
<td>10 visits per year</td>
</tr>
<tr>
<td>Total freight demand (1000 cu.m.)</td>
<td>490</td>
<td>450</td>
<td>95</td>
</tr>
</tbody>
</table>

Figure 6: Three trade lanes in the case
Case

• The ships (data collected from Clarkson World Fleet Register)

<table>
<thead>
<tr>
<th></th>
<th>Type 1</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deadweight tonnage</td>
<td>49503</td>
<td>10239</td>
</tr>
<tr>
<td>Cargo Capacity (cu.m.)</td>
<td>45127</td>
<td>10921</td>
</tr>
<tr>
<td>Draft</td>
<td>12.96</td>
<td>8.05</td>
</tr>
<tr>
<td>Speed - Low/Medium/High (Knots)</td>
<td>12.5/14.4/15.5</td>
<td>12.5/14.4/15.5</td>
</tr>
<tr>
<td>Fuel Consumption - Low/Medium/High (Tonne/Nautical mile)</td>
<td>0.084/0.091/0.101</td>
<td>0.042/0.054/0.058</td>
</tr>
<tr>
<td>No. of vessel owned</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>
## Computational Study

- Test scenarios

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Bunker Price</th>
<th>Allowance Price</th>
<th>Charter Rate</th>
<th>METS Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Business-as-usual</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>High</td>
<td>Normal</td>
<td>Regional</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td></td>
<td>High</td>
<td>Global</td>
</tr>
</tbody>
</table>
Computational Study

• Regional METS (exclusive economic zone)

Figure 8: The geographical scope of the regional METS
Conclusion

• What did we find:

1. The implementation of METS will not guarantee a short term emission reduction
   *Other factors, for example charter rate, may have the overwhelming influencing power on the fleet's operational decisions in certain situations, while the impact of the METS becomes minor. In certain special case, a regional METS can even increase the CO2 emission.*

2. High allowance cost or Global coverage of METS may lead to more emission reduction

3. METS works better in a low bunker price scenario (in terms of short term emission reduction)
Conclusion

• Factors that affects ship’s sailing behavior (speed and routing)

1. Allowance cost (METS)

2. Bunker cost

3. Charter rate
Conclusion

• Main results (low bunker price, low charter rate, high allowance cost, regional METS)

- Loop 1 & 2 have less METS involvement
- Loop 6 has shorter total sailing distance

Figure 9: Different METS coverage of loop 1, 2 & 6
CENTRE FOR SHIPPING AND LOGISTICS