Maritime transport costs and trade flows

Tristan Smith, Ronald Halim, Isabelle Rojon
Tristan.smith@ucl.ac.uk

University College London www.ucl.ac.uk/energy
UMAS www.u-mas.co.uk
Content

• Context
• Maritime transport costs, potential for change
• Impacts on transport, global trade
• Concluding remarks
1.5 and climate activism go mainstream

Non-\( \text{CO}_2 \) emissions relative to 2010

Emissions of non-\( \text{CO}_2 \) forcers are also reduced or limited in pathways limiting global warming to 1.5°C with no or limited overshoot, but they do not reach zero globally.

Methane emissions

Black carbon emissions

Timing of net zero CO\(_2\)

Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios
Emissions on trade routes by economic status

<table>
<thead>
<tr>
<th>Economic Status</th>
<th>Developed</th>
<th>Transitioning</th>
<th>Developing</th>
<th>LDC &amp; SIDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed</td>
<td>78.03 Mt</td>
<td>9.73 Mt</td>
<td>140.03 Mt</td>
<td>17.25 Mt</td>
</tr>
<tr>
<td></td>
<td>15.6%</td>
<td>2.0%</td>
<td>28.1%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Transitioning</td>
<td></td>
<td>1.31 Mt</td>
<td>8.80 Mt</td>
<td>0.82 Mt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.3%</td>
<td>1.8%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Developing</td>
<td></td>
<td></td>
<td>196.47 Mt</td>
<td>41.28 Mt</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>39.4%</td>
<td>8.3%</td>
</tr>
<tr>
<td>LDC &amp; SIDS</td>
<td></td>
<td></td>
<td></td>
<td>5.08 Mt</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0%</td>
</tr>
</tbody>
</table>

IMO ISWG GHG 3-2-11
IMO GHG Objective 3:

Pathways for International Shipping's CO2 emissions

- Business As Usual
- 50% reduction in 2050 (85% reduction in carbon intensity)
- 100% reduction in 2050

If possible
Estimating policy-related changes in maritime transport costs
This means a rapid shift to wind assistance and zero emission fuels.
How do costs change relative to a conventional ship (9000TEU container)?

What additional carbon price / levy is needed to achieve different levels of ambition?

ZE machinery, energy efficiency options, wind assistance

Scenario assumptions

Carbon Price
0 $/t
50 $/t
100 $/t

GloTraM + Whole Ship Model

% reduction in 2030 and 2050 on 2008 emissions

BAU
-20%
30%

2008 2030 2050

CO₂

IMarEST: IMO ISWG-GHG 3-3
## Four scenarios, key assumptions

<table>
<thead>
<tr>
<th>Bioenergy availability</th>
<th>Fossil fuel price $/t</th>
<th>Hydrogen price $/t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2030</td>
<td>2050</td>
</tr>
<tr>
<td>High renewable price</td>
<td></td>
<td></td>
</tr>
<tr>
<td>low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>high</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low renewable price</td>
<td></td>
<td></td>
</tr>
<tr>
<td>low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>high</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
High renewable fuel price

Energy efficiency
Penetration of zero emission fuel
Fleet renewal

Cost of carbon per ton of CO₂ controlled

Abatement capacity relative to 2008 CO₂ emissions

2030
2050

-20%
0%
20%
40%
60%
80%
100%

-20%
0%
20%
40%
60%
80%
100%

$300/t

Biofuel
Low renewable fuel price

Penetration of zero emission fuel

Cost of carbon per ton of CO₂ controlled

$100/t

Abatement capacity relative to 2008 CO₂ emissions

75%+

- 2030 bio central, low price & Capex
- 2030 bio high, low price & Capex
- 2050 bio central, low price & Capex
- 2050 bio high, low price & Capex
50-100$/t CO$_2$ by 2030
Estimating impacts on trade and States
Impacts on States

• The impacts on States of a measure should be **assessed and taken into account** as appropriate **before adoption of the measure.** Particular attention should be paid to the needs of **developing countries, especially SIDS and LDCs.**

• Disproportionately negative impacts should be **assessed and addressed**, as appropriate.
What do we mean by impacts on states?

1 geographic remoteness of and connectivity to main markets;
2 cargo value and type;
3 transport dependency;
4 transport costs;
5 food security;
6 disaster response;
7 cost-effectiveness; and
8 socio-economic progress and development.
The nature of potential policy-related changes in transport cost

Increased capital costs and fuel costs – increase in transport cost

Increased capital costs but lower operating cost – no net increase or even a decrease in transport costs
Diverse share of maritime transport costs in product values e.g. 5% (manufactury) vs. 11% (agriculture) vs. 24% (raw materials industry)

Wide range of transport costs across products and countries of origin and destination

Source: Rojon et al. (2018)
The Importer’s perspective

Source: Rojon et al. (2018)

Present Decarb

0.4-16% increase

Change in transport cost

$10-50/t

PRESENT

DECARB

Change in cost of import

<1%

Manufacturing costs

Transport cost

PRESENT DECARB

Change in trade costs
The exporter’s perspective

- Consumers will substitute products from different producers depending on the changes in import prices.
- States with higher import costs might not be favorable over states with lower import costs anymore causing **shift of volume of demand**.

Consumption: 100t

<table>
<thead>
<tr>
<th>State</th>
<th>Import costs</th>
<th>Import volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$50/t</td>
<td>70t</td>
</tr>
<tr>
<td>B</td>
<td>$70/t</td>
<td>30t</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

State A: Consumption 100t, Import costs $50/t, Import volume 70t
State B: Import costs $70/t, Import volume 30t
State C: Import volume
The exporter’s perspective

- Potential asymmetric increase in import costs due to GHG mitigation measures could lead to:
  - Decline of export in State C which could lead to decline in GDP
  - Increase of export in State B could lead to increase in GDP
  - Reduced consumption in State A
  - Increased domestic production in State A
Generally, modest impact on:

- GDP of individual countries (-0.02% to -1%)
- Mode shift from sea to land based transport (-0.16%)

<table>
<thead>
<tr>
<th>Literature</th>
<th>GHG mitigation measures</th>
<th>Economic Indicators</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lee et al. (2013)</td>
<td>Carbon price 30, 60, 90 USD/ton CO2 for the year 2007</td>
<td>Real GDP</td>
<td>-0.002% to +0.004%, Global average: -0.0003%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Volume of container flows</td>
<td>Reduction of 925 KTEU (Twenty-Foot Equivalent Units) globally</td>
</tr>
<tr>
<td>Sheng et al. (2018)</td>
<td>Carbon price 40 USD/ton CO2 by 2030</td>
<td>Real GDP</td>
<td>-0.06% to +0.001%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GDP growth</td>
<td>-0.17% to +0.01%</td>
</tr>
<tr>
<td>L.A. Tavasszy et al.</td>
<td>Carbon price 49 euros/ton CO2 by 2040</td>
<td>Global trade flows</td>
<td>-0.9% in total trade flows</td>
</tr>
<tr>
<td>(2014)</td>
<td></td>
<td>Commodity trade flows</td>
<td>-0.2% (food) to 4.2% (agriculture)</td>
</tr>
<tr>
<td>Anger et al. (2013)</td>
<td>Carbon price 10,30,50 euros/ton CO2 by 2025</td>
<td>Real GDP</td>
<td>&lt;0.01% in global GDP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>real GDP changes for developing countries</td>
<td>-1% GDP for one country &lt;0.2% for majority</td>
</tr>
<tr>
<td>Halim et al. (2018)</td>
<td>Slow steaming (25-65% speed reduction), and carbon price on maritime transport with 100% increase in maritime transport by 2030</td>
<td>Volume of international maritime transport</td>
<td>-34 Mtonnes in demand for maritime transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shift to freight rail mode (e.g. Eurasian railways)</td>
<td>-0.16% in modal share of maritime transport</td>
</tr>
</tbody>
</table>
Policy options to mitigate impacts – could have an impact…

• Exemptions (routes/ships/cargos)
• Revenues
  – To reduce negative impacts, incl. increase in transport costs
  – To support countries’ general climate change mitigation & adaptation plans
  – To support the decarbonisation of the maritime industry
• Capacity building/development
Concluding remarks

• Landscape
  – In 2030, we will have hit 1.5, ~44 countries will be in major existential and economic crisis
  – Political pressure driven by disasters/impacts will increase over time

• Technology costs
  – The sector’s move from fossil fuels needs to start in 2030’s
  – An estimate of the potential cost increase can be derived from modelling of the carbon price, $50-250/t can provide a basis to test the sensitivities of impacts

• Impacts
  – GHG reduction policy related trade impacts have received particular prominence
  – Globally trade volume, GDP and modal shift impacts appear small
  – However, the case of individual countries could be different
  – Importers and exporters have different perspectives and risks
  – Little work has been done so far on transport cost increases related to upper bound of cost
  – Further work is needed, particularly to understand the case for SIDS and LDCs
  – Policy to address potential impacts is under-studied and may also create its own impacts
Yara and Engine 50MW Green NH3 (2021)

~100MW Solar array
50MW electrolyser
80tpd ammonia