When Will be the END of “Slow-steaming”? 

Ma Shuo 

30 September 2014
Current Situation of “Slow-steaming”

• Based on a recent market survey of over 200 shipping companies, of both liner and tramp, about 75% of them apply “slow-steaming” to various extents.

• Degrees of “Slow-steaming” in container shipping

<table>
<thead>
<tr>
<th></th>
<th>Speed</th>
<th>Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full steaming</td>
<td>24</td>
<td>0%</td>
</tr>
<tr>
<td>Slow steaming</td>
<td>21</td>
<td>13%</td>
</tr>
<tr>
<td>Extra slow steaming</td>
<td>18</td>
<td>25%</td>
</tr>
<tr>
<td>Super slow steaming</td>
<td>15</td>
<td>38%</td>
</tr>
</tbody>
</table>

• There are about two dozen published research papers dealing with the issue of slow-steaming: most (over 40%) from viewpoint of ship cost; some (over 30%) from ship and cargo costs and some (about 20%) from environment cost.

• My research differs in both scope and methodology

• Although liner is discussed, principles are same for tramp
Influential Factors on “Slow-steaming”

- Freight level
  - Optimal speed
    - Bunker cost
    - Ship cost
    - Cargo cost
    - Interest rate
    - Environmental cost

Source: Ma Shuo, 2014
Objectives of Optimal Speed

• For Carriers
  1. Objective: Maximization of surplus
  2. Factors to consider: freight level, ship speed, bunker price, ship costs, interest rate, operating cost
  3. Formula: \((\text{Max})GS = \frac{(Fr/teu \times \text{total teu})}{(d/s \times 24)} - pks^3 - (VsI)/365 - C_R\)
     \(GS=\)daily gross surplus, \(Fr=\)freight rate, \(d=\)distance, \(s=\)speed, \(p=\)bunker price, \(k=\)constant, \(Vs=\)ship cost, \(I=\)interest rate, \(C_R=\)daily operating cost

• For Shippers
  1. Objective: Minimization of cost (or speed changes lead to more savings than costs)
  2. Factors: ship speed, bunker price, cargo cost, interest rate
  3. Formula: \((Vc \times \text{teu}) \times \frac{I}{365} \leq pk_s^3\)
     \(p=\)bunker price, \(k=\)constant, \(s=\)speed, \(d=\)distance, \(Vc=\)cargo value (mean), \(I=\)interest rate

• For Society
  1. Objective: Maximization of social surplus (in a competitive market)
  2. Factors to consider: freight level, ship speed, bunker price, cargo cost, ship costs, interest rate, operating cost, environmental cost
  3. Formula: \((\text{Max})GS = \frac{(Fr/teu \times \text{total teu})}{(d/s \times 24)} - pks^3 - (Vc \times \text{teu} + Vs)xI/365 - C_R - (ks^3gC_E)\)
     \(GS=\)daily gross surplus, \(Fr=\)freight rate, \(d=\)distance, \(s=\)speed, \(p=\)bunker price, \(k=\)constant, \(Vc=\)cargo value (mean), \(Vs=\)ship cost, \(I=\)interest rate, \(C_R=\)daily operating cost, \(g=\)ton of CO\(_2\)/ton of bunker, \(C_E=\)cost/ton of CO\(_2\)
Method Testing

Scenario

- A 8,000 TEU container ship
- Trading between Shanghai and Rotterdam (12,000 miles)
- Loading factor: 100%
- Bunker price at US$650/ton (IFO180)
- Ship cost: US$100 m, containers, etc.: US$20 m
- Operating cost (crew, insurance, maintenance) at: US$8500/day
- Value (mean) of cargo at US$60,000/TEU
- Interest rate (yearly) at: 3%
- Emission cost: US$30/ton of fuel consumed
Influential Factors on “Slow-steaming”

- Freight level
- Optimal speed
- Bunker cost
- Ship cost
- Cargo cost
- Interest rate
- Environmental cost

Source: Ma Shuo, 2014
Container Shipping Freight Rates, 2000–2012

Shanghai Containerized Freight Index
2010-2012

Source: BIMCO, Shanghai Shipping Exchange
Container Trades Statistics all-in monthly freight rate index. Average rate in each trade lane for 2008 = 100

<table>
<thead>
<tr>
<th>Tradelane</th>
<th>Oct-13</th>
<th>Nov-13</th>
<th>Dec-13</th>
<th>Jan-14</th>
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<td>76</td>
<td>80</td>
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<td>North America to Europe</td>
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<td>90</td>
</tr>
<tr>
<td>Europe to Western Asia*</td>
<td>87</td>
<td>87</td>
<td>87</td>
<td>85</td>
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<tr>
<td>Western Asia* to Europe</td>
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<tr>
<td>Europe to South &amp; Central America</td>
<td>105</td>
<td>103</td>
<td>105</td>
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<tr>
<td>South &amp; Central America to Europe</td>
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<td>Australasia to Europe</td>
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<td>101</td>
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<td>95</td>
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<tr>
<td>Europe to Sub-Saharan Africa</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>68</td>
</tr>
</tbody>
</table>

Notes: * Western Asia = South Asia and Middle-East region, +Tenerife to Lobito.

Source: Container Trades Statistics
International Trade per Capita, 2011

Source: WTO World Trade Statistics 2011
Global Seaborne Trade, 1970 - 2012 and 2030 Forecast
(tons of cargo loaded)

- **Integrated**
- **Status quo**
- **Protectionist**

2013 Ma Shuo compiled from UN, Lloyd's and other sources
Container Shipping Freight Index, 2012–2014

Source: Shanghai Shipping Exchange, 2014
Table A

Gross Profit (8,000TEU, Shanghai-Rotterdam) at Various Freight Levels
Freight Income Minus Ship's Capital, Running and Bunker Costs

- Interest rate: 3%/year
- Ship/container value: $120m
- Ship running cost: $8,500/day
- Bunker cost: $650/tonne

Gross Profit per Day, $'000

<table>
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</tbody>
</table>
Influential Factors on “Slow-steaming”

- Freight level
- Optimal speed
  - Bunker cost
  - Ship cost
  - Cargo cost
  - Interest rate
  - Environmental cost

Source: Ma Shuo, 2014
Container Ship Speed versus Fuel Consumption

\[ C = kS^3 \]
Bunker Prices, 2005 - 2014
IFO180, IFO380, Singapore

Source: Bunkerworld, 2014
Fuel Efficiency Improvement, The Year of built from 1965 to 2013

Fuel consumption of a 60,000-DWT Bulk Carrier, tonnes/day at 14.5 knots

Source: Clarkson, 2013
More Companies Are Losing Money
due to low freight rate caused by over-supply and high bunker cost
(2010 = 100)

Sources: Alphaliner; BCG analysis.
1TEU = twenty-foot equivalent unit.
2In December 2010, the index value was 100.
Fuel Cost Becomes the Biggest Cost Item
Daily charter rate of 1-year Aframax vs. daily fuel costs (Rotterdam)

Source: Clarkson, 2013
Oil Consumption per capita – 2012

Source: BP 2013

>3.0 (Canada, Saudi Arabia); 2.25-3.0 (USA, Benelux); 1.5-2.25 (Australia, Norway, Finland); 0.75-1.5 (West Europe, Japan, Russia etc.); 0-0.75 (China, India, Latin America, Africa, etc.)
Influential Factors on “Slow-steaming”

Freight level

Optimal speed

Bunker cost

Ship cost

Cargo cost

Interest rate

Environmental cost

Source: Ma Shuo, 2014
Impact of Ship Speed on Costs
A 8000 TEU Ship Sailing between Far East and Europe

Source: Vartsila, 2010
# Stagnating Wages

**Representative Income Structure, Bulk carrier, Chinese crew, 2013**

Daily manning cost: US$1850

<table>
<thead>
<tr>
<th>Rank</th>
<th>Wages</th>
<th>Leave</th>
<th>Overtime</th>
<th>Subsist.</th>
<th>Social Security</th>
<th>Other</th>
<th>Misc. allowance</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>MSTR</td>
<td>1,836</td>
<td>367</td>
<td>1,240</td>
<td>1,407</td>
<td>200</td>
<td>100</td>
<td>2,050</td>
<td>7,200</td>
</tr>
<tr>
<td>C/O</td>
<td>1,185</td>
<td>237</td>
<td>800</td>
<td>915</td>
<td>200</td>
<td></td>
<td>3,163</td>
<td>6,500</td>
</tr>
<tr>
<td>2/O</td>
<td>949</td>
<td>190</td>
<td>641</td>
<td>618</td>
<td>200</td>
<td></td>
<td>402</td>
<td>3,000</td>
</tr>
<tr>
<td>3/O</td>
<td>915</td>
<td>183</td>
<td>618</td>
<td>597</td>
<td>80</td>
<td></td>
<td>107</td>
<td>2,500</td>
</tr>
<tr>
<td>C/E</td>
<td>1,669</td>
<td>334</td>
<td>1,127</td>
<td>1,307</td>
<td>200</td>
<td></td>
<td>2,363</td>
<td>7,000</td>
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<tr>
<td>2/E</td>
<td>1,185</td>
<td>237</td>
<td>800</td>
<td>915</td>
<td>200</td>
<td></td>
<td>3,163</td>
<td>6,500</td>
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<td>3/E</td>
<td>949</td>
<td>190</td>
<td>641</td>
<td>618</td>
<td>200</td>
<td></td>
<td>402</td>
<td>3,000</td>
</tr>
<tr>
<td>AB</td>
<td>566</td>
<td>113</td>
<td>382</td>
<td>20</td>
<td></td>
<td></td>
<td>7</td>
<td>1,088</td>
</tr>
</tbody>
</table>
Table C

**Different Ship’s Cost per Voyage and Optimal Speed**

(ship's costs include: capital and operating costs, Shanghai to Rotterdam)

- Interest rate: 3% / year
- Bunker cost: $650/tonne

©: Ma Shuo
Influential Factors on “Slow-steaming”

- Freight level
- Optimal speed
  - Bunker cost
  - Ship cost
  - Cargo cost
  - Interest rate
  - Environmental cost

Source: Ma Shuo, 2014
Composition of Containerized Cargo, Far East – Europe (2013)

Source: Maersk 2013

Composition of Containerized Cargo, Far East – N. America (2011)

Source: Dong Z. 2011
Representative Value of Containerized Cargo, Far East – N. America and Volume

Source: Dong Z. 2011
Table D

Different Value of Cargo per TEU and Optimal Speed

(Cargo's cost per voyage for a 8,000TEU ship from Shanghai to Rotterdam)

- Interest rate: 3% / year
- Bunker cost: $650/tonne

![Graph showing the relationship between cost per voyage and ship speed for different values of cargo per TEU.]
Influential Factors on “Slow-steaming”

- Freight level
- Optimal speed
- Bunker cost
- Ship cost
- Cargo cost
- Interest rate
- Environmental cost

Source: Ma Shuo, 2014
Low Interest Rate, Cheap Capital
(23 Sept. 2014 LIBOR USD 12-month rate: 0.58%)

In the 1980s interest rates were the killer

1990-1999
Average 5.5%

2000-2010
Average 3.2%

Source: LIBOR
Superior Quality ≠ More Profit

Sources: Drewry Maritime Research; Alphaliner; BCG analysis.
Note: Sample included 20 carriers, which made up approximately 85 percent of total market volume.
Table G
Capital Cost of Ship & Cargo at Various Interest Rate and Optimal Speed
(Cargo's cost per voyage for a 8,000TEU ship from Shanghai to Rotterdam)

- Mean value of cargo: $60000/teu
- Bunker cost: $650/tonne
- Ship/container value: $120m
- Ship running cost: $8,500/day

Cost per Voyage, $'000

<table>
<thead>
<tr>
<th>Ship Speed in knots</th>
<th>Cost per Voyage</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>8000</td>
</tr>
<tr>
<td>14</td>
<td>7000</td>
</tr>
<tr>
<td>15</td>
<td>6000</td>
</tr>
<tr>
<td>16</td>
<td>5000</td>
</tr>
<tr>
<td>17</td>
<td>4000</td>
</tr>
<tr>
<td>18</td>
<td>3000</td>
</tr>
<tr>
<td>19</td>
<td>2000</td>
</tr>
<tr>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td>21</td>
<td>0</td>
</tr>
</tbody>
</table>

©: Ma Shuo
Influential Factors on “Slow-steaming”

Freight level

Optimal speed

Bunker cost
Ship cost
Cargo cost
Interest rate
Environmental cost

Source: Ma Shuo, 2014
Increasing Pressure on Control of Air Emissions from Ships

• Technical requirements
  – Energy Efficiency Design Index (EEDI)

• Operational requirements
  – Ship Energy Efficiency Management Plan (SEEMP)

• Market based instruments
  – Bunker tax, Tradable emission rights
Trading Prices of CO₂ at the European Market

Spot contract carbon price per metric ton of carbon dioxide
Trading Prices of CO2 at the European Market

(1 Euro = 1.3 USD)
Table H

Gross Profit (8,000TEU, Shanghai-Rotterdam) at Various CO₂ prices

Freight Income Minus Ship's Capital, Running, Bunker and CO₂ Costs

- Freight rate: USD$800/teu
- Interest rate: 3%/year
- Ship/container value: $120m
- Ship running cost: $8,500/day
- Bunker cost: $650/tonne
### Table A

**Gross Profit (8,000TEU, Shanghai-Rotterdam) at Various Freight Levels**

Freight Income Minus Ship's Capital, Running and Bunker Costs

<table>
<thead>
<tr>
<th>Ship Speed in knots</th>
<th>Gross Profit per Day, $'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>US$600/TEU</td>
</tr>
<tr>
<td>14</td>
<td>US$800/TEU</td>
</tr>
<tr>
<td>15</td>
<td>US$1000/TEU</td>
</tr>
<tr>
<td>16</td>
<td>US$1200/TEU</td>
</tr>
<tr>
<td>17</td>
<td>US$1400/TEU</td>
</tr>
<tr>
<td>18</td>
<td>US$1600/TEU</td>
</tr>
</tbody>
</table>

- Interest rate: 3%/year
- Ship/container value: $120m
- Ship running cost: $8,500/day
- Bunker cost: $650/tonne

### Table I

**Gross Profit (8,000TEU, Shanghai-Rotterdam) at Various Freight Levels**

Freight Income Minus Ship's Capital, Running, Bunker, Cargo and CO₂ Costs

<table>
<thead>
<tr>
<th>Ship Speed in knots</th>
<th>Gross Profit per Day, $'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>US$600/TEU</td>
</tr>
<tr>
<td>14</td>
<td>US$800/TEU</td>
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<tr>
<td>15</td>
<td>US$1000/TEU</td>
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<tr>
<td>16</td>
<td>US$1200/TEU</td>
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<tr>
<td>17</td>
<td>US$1400/TEU</td>
</tr>
<tr>
<td>18</td>
<td>US$1600/TEU</td>
</tr>
</tbody>
</table>

- Interest rate: 3%/year
- Ship/container value: $120m
- Ship running cost: $8,500/day
- Bunker cost: $650/tonne
- Cargo value: $60,000/tonne
- Environment cost: $25/ton CO₂

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**Container freight rate up to end of 2014, FE-Europe**

<table>
<thead>
<tr>
<th>Freight rate</th>
<th>Apr. 2014</th>
<th>Sept. 2014</th>
<th>Q4 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia to North West Europe (US$ per teu)</td>
<td>1,075</td>
<td>908</td>
<td>975</td>
</tr>
</tbody>
</table>

Source: Shanghai Shipping Exchange, 23 Sept.2014
Concluding Remarks

- Each of the six influential factors changes, by and large, independently. They should be monitored separately.

- During an observation period, e.g. 1 year, there are 3 aspects to look into:
  1. The possibility ($P_i$) of change in factor $i$
  2. The direction ($\pm$) and degree ($D_i$) of change in factor $i$
  3. The effect ($E_i$) of the change in factor $i$ on optimal speed
     - The effect ($E_i$) is the ratio of % change in optimal speed caused by % change in factor $i$. It is non-linear.
     - Each factor carries a different “weight” in the equation. So, at a certain speed range, $E_i$ is proportional to the weight of $i$.

- If “P” and “D” could be estimated, the importance ($I$) of factors can be ranked based on $I = P \times D \times E$
# Concluding Remarks

## Factors to Watch in the next 12 months

<table>
<thead>
<tr>
<th>Factor</th>
<th>Possibility (P)</th>
<th>Degree (D)</th>
<th>Effect (E)</th>
<th>Importance (I)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight rates</td>
<td>100%</td>
<td>15%</td>
<td>53.83%</td>
<td>8.1%</td>
</tr>
<tr>
<td>Bunker prices</td>
<td>100%</td>
<td>-10%</td>
<td>37.64%</td>
<td>-3.8%</td>
</tr>
<tr>
<td>Ship's cost</td>
<td>90%</td>
<td>10%</td>
<td>35.72%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Cargo's value</td>
<td>80%</td>
<td>5%</td>
<td>30.00%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Interest rates</td>
<td>60%</td>
<td>5%</td>
<td>42.57%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Environmental cost</td>
<td>60%</td>
<td>5%</td>
<td>3.79%</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

## Factors to Watch in the next 36 months

<table>
<thead>
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<th>Factor</th>
<th>Possibility (P)</th>
<th>Degree (D)</th>
<th>Effect (E)</th>
<th>Importance (I)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight rates</td>
<td>100%</td>
<td>25%</td>
<td>53.83%</td>
<td>13.5%</td>
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<td>42.57%</td>
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<td>37.64%</td>
<td>5.6%</td>
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<tr>
<td>Ship's cost</td>
<td>100%</td>
<td>15%</td>
<td>35.72%</td>
<td>5.4%</td>
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<tr>
<td>Cargo's value</td>
<td>100%</td>
<td>10%</td>
<td>30.01%</td>
<td>3.0%</td>
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<tr>
<td>Environmental cost</td>
<td>100%</td>
<td>20%</td>
<td>3.79%</td>
<td>0.8%</td>
</tr>
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</table>

Reliability 100% 50% 80% 0.40

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Q & A