The Cost-Benefits of Ocean Vessel Shipping in the Great Lakes: Value to Industry vs. Environmental Damage

John C. Taylor

Grand Valley Statue University, taylorjohn@wayne.edu

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Seidman College of Business

The Great Lakes-St. Lawrence Seaway Maritime System, depicted in Figure 1, has been extremely important to the development of the North American mid-continent and continues to play a vital role in the West Michigan economy. The System allows ocean vessels to carry freight between the Lakes states and overseas destinations, and also allows for movement of goods on laker vessels both wholly within the Lakes and between the Lakes and eastern ports such as Montreal and Quebec City. However, the System's overall importance to the region's economy has been reduced, and the nature of the contribution has moved towards intra-lake commerce and away from Seaway ocean-related commerce.

At the same time, the Great Lake's position as the world's largest fresh water body and its role in tourism and the overall quality of life in the region has become more recognized. Changes in the Lakes-Seaway System's economic role in the region, and new concerns about invasive species suggest a need for reassessment of the System. Given the level of economic and environmental damage that has been caused by existing and potentially new invasive species, and the fact that most aquatic invasive species have been introduced to the Great Lakes by transoceanic waterborne commerce ballast water, it is important to assess the cost-benefits of continued use of the Seaway System for ocean vessel maritime commerce. The focus of the analysis needs to be on ocean vessel commerce because aquatic invasive species are introduced by ocean going vessels and not by laker vessels, defined as those vessels that remain within North America.

Ocean Shipping Traffic Volumes and Significance

In 2002, 12.3 million metric tons of ocean vessel tonnage passed through the section of the Seaway west of Montreal and into and out of the Lakes. This ocean vessel tonnage represented just 6.8% of the total Great Lakes and Seaway volume of 180 million tons that year. The other 167.7 million metric tons of system tonnage moved on laker vessels, not ocean vessels. The ocean tonnage moved on 1,137 ocean vessel passages through the Seaway, with 569 up-bound moves and 568 down-bound, or a little less than two moves per day. In 2003, 9.6 million metric tons moved into and out of the Lakes on ocean vessels and 11.0 million metric tons moved in 2004. The peak year for ocean traffic into the Lakes was in 1978 with 23.1 million metric tons.

In contrast to ocean vessel tonnage, laker moves totaled 17.7 million metric tons in 2002. Total Seaway laker and ocean tonnage was 30.0 million metric tons in 2002. Overall, the traffic data suggests that ocean shipping volumes are a relatively small portion of overall Lakes tonnage. For West Michigan the role of ocean shipping is even less significant. For instance in 2002, only one West Michigan port was visited by ocean ships, that being Ludington, with just one arrival. In other years, there may have been a few more vessels; however, the number is surprisingly small.

While the public may believe that ocean-going container ships move container loads of manufactured goods in and out of the lakes, in reality that is not the case. In fact, there were no container ship passages into and out of the Lakes in 2002, and there has not been any such shipping in many years. Very few of the world's container ships would even fit in the System today given that the Seaway Locks were undersized even at the time they were built and container ships have grown longer, wider, and deeper since the Seaway opened in the 1950s.
What does move through the Seaway is ocean-going bulk cargo ships carrying primarily imported specialty steel into the Lakes and grain back out to overseas destinations. For those ships that did enter in 2002, the ocean freight consisted of 2.1 million tons of Canadian grain exports from Thunder Bay, 2.0 million tons of U.S. grain exports from Duluth, and 4.6 million tons of U.S. and Canadian steel imports. These goods accounted for some 70% of the 12.3 million tons of ocean tonnage. The remaining 3.6 million tons consisted of pulp, minerals, chemicals, fuels, sugar, and some other port grain imports and exports.

In terms of Lakes ocean shipping, it is important to note that this route accounts for just 1.9% of all U.S. grain exports and 10.9% of all Canadian grain exports. For the U.S., the ocean route to the Lakes also accounts for just 6.3% of all iron and steel imports, while for Canada the ocean direct route accounts for 21.4% of total steel imports. It should be noted, however, that laker vessels also carry a similar volume of U.S. and Canadian grain exports from the upper lakes to Montreal and ports below, where the cargo is offloaded to ocean-going vessels.

**Transportation Cost-Benefits of Ocean Shipping**

In order to estimate the transportation cost benefits of ocean shipping into and out of the Lakes, it was necessary to estimate the door-to-door costs of the 12.3 million tons of goods moving by ocean vessel including the costs related to North American inland shipping, transfer handling costs, and ocean shipping costs. The next step was to evaluate each of the alternative options for shipping these goods including rail and laker moves for Canadian grain exports; rail, barge, and laker for U.S. grain exports; and rail, barge, or truck for steel imports. For each of these options, the door-to-door cost per ton was estimated. The third step was to estimate the “most likely” mix of alternative means of shipping each of the three major categories of goods. The “most likely” alternative was based in part on how the goods move during the three months of the year when the Seaway is closed and, in part, on the estimated costs for each alternative route/mode. The costs for the “most likely” scenario for each major commodity group could then be calculated and compared to the current ocean vessel costs. Over all, the analysis involved review of 95 prior reports and articles on this subject and interviews with 58 organizations.

The analysis indicates that ocean vessel shipping saves U.S. and Canadian shipper/receivers US$54.9 million per year. The cost comparisons for each commodity are shown in Table 1 below. If ocean vessels were not available, the largest impact would be associated with steel product imports and the least impact

### Table 1

**Summary of Cost Via Ocean Vessels and Alternative Modes**

<table>
<thead>
<tr>
<th></th>
<th>Grain from Thunder Bay</th>
<th>Grain from Duluth</th>
<th>Steel</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tonnage</strong></td>
<td>2098</td>
<td>2042</td>
<td>4556</td>
<td>3589</td>
<td>12285</td>
</tr>
<tr>
<td><strong>% of Total</strong></td>
<td>17.1</td>
<td>16.6</td>
<td>37.1</td>
<td>29.2</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Ocean Vessel</strong>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>US$ Cost per Metric Ton</strong></td>
<td>$78.39</td>
<td>$72.00</td>
<td>$74.56</td>
<td>$80</td>
<td>$76.38</td>
</tr>
<tr>
<td><strong>Total Cost (Mills of US$)</strong></td>
<td>$164.5</td>
<td>$147.0</td>
<td>$339.7</td>
<td>$287.1</td>
<td>$938.3</td>
</tr>
<tr>
<td><strong>Most Likely</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>US$ Cost per Metric Ton</strong></td>
<td>$81.86</td>
<td>$73.61</td>
<td>$80.34</td>
<td>$85</td>
<td>$80.85</td>
</tr>
<tr>
<td><strong>Total Cost (Mills of US$)</strong></td>
<td>$171.7</td>
<td>$150.3</td>
<td>$366.1</td>
<td>$305.1</td>
<td>$993.2</td>
</tr>
<tr>
<td><strong>Ocean Savings per Metric Ton (US$)</strong></td>
<td>$3.47</td>
<td>$1.61</td>
<td>$5.78</td>
<td>$5.00</td>
<td>$4.47</td>
</tr>
<tr>
<td><strong>Ocean Savings (Million of US$)</strong></td>
<td>$7.3</td>
<td>$3.3</td>
<td>$26.4</td>
<td>$17.9</td>
<td>$54.9</td>
</tr>
</tbody>
</table>

*Represents costs associated with existing ocean vessel movements into the Great Lakes.

**Represents costs associated with alternative rail, truck, barge, and laker vessel mode/routes to carry cargo previously carried by ocean vessels.
would be associated with the grain exports. The “all other” category would face the second biggest impact.

In order to fully understand the implications of the transportation cost savings provided by ocean vessels entering the Lakes, it is important to have some perspective on the significance of the numbers. The total savings represent a 5.9% benefit when compared to the estimated US$938.3 million total direct ocean door-to-door transportation costs for these goods.

**Economic and Environmental Costs of Invasive Species In the Great Lakes**

A total of 170 invasive species have been introduced into the Great Lakes to date. At least 43 invasive species have been introduced since the opening of the Seaway System in 1959, 73% of which have been attributed to discharge of ballast water. However, another transmission vector for invasive species is through ships’ hulls and other surfaces fouling. This is an important vector to consider since treatment of ballast water, an approach currently being developed, does not address hull fouling by invasives. In addition to past contamination, scientists indicate that invasive species continue to enter the Great Lakes at a rate of approximately one new species per year. While the authors have conducted no calculations of invasive species costs and are not experts on such costs, a literature review of scientific journals suggests minimum costs are in the range of $200 million to several billion dollars. The wide range in estimates is due to variation in species considered and in types of damage evaluated.

**Conclusions**

In conclusion, ocean shipping on the Great Lakes generates a transportation cost savings for Canadian and U.S. shipper/receivers of US$54.9 million per year. This cost savings represents 5.9% of the current door-to-door transportation cost for the goods presently moving via ocean shipping in the Great Lakes. The relatively small benefit is due to the limited volume of goods currently moving on ocean vessels, just 12.3 million tons, and the relative competitiveness of alternative routes/modes for moving the goods. Finally, it should be noted that very little, if any, of the savings relate to the West Michigan economy, in that only a few ocean ship calls per year are made on West Michigan ports.

The best estimates of the costs of existing invasive species in the Great Lakes are in the range of $200 million to several billion dollars per year. While it is difficult to say what the costs of future invasives might be, scientists estimate that the Lakes are seeing about one new invasive species per year and that this trend is likely to continue.

The cost-benefit calculation then can be estimated at a minimum of about 4:1 on a conservative basis, meaning that for every dollar in transportation cost savings, there are at least $4 in current invasive species cost impacts. For West Michigan, the cost-benefit ratio is far worse, in that there are very small benefits, and a disproportionate level of negative environmental and tourism related costs. These North American-wide and regional cost-benefits should be considered by bi-national, national, and state/provincial regulators.

The most commonly discussed method for controlling invasive species is treatment of ballast water. However, this approach would not address vectors related to “hull fouling” of ship sides and piping. A more comprehensive approach would be for regulators to restrict ocean vessel entry while continuing to allow lakers to move into and out of the Lakes as they do not pose a significant invasive species threat. However, if ocean shipping had to pay the full societal costs of existing or future invasive species, or in economic terms, the externality costs, it is possible that ocean ship owners would decide on their own that entering the System was not a productive use of their assets. It is also important to note that the U.S. Seaway section currently does not impose passage cost recovery tolls on ships as is the case in the Canadian section. Should such tolls be charged, this would further limit the transportation cost savings currently enjoyed by shipper/receivers of goods and would serve as an additional disincentive to ocean ships entering the Lakes. Finally, if history is any indicator, one might expect that the Seaway’s competitiveness will remain limited given the System’s dimensions, while other modes, such as rail, are likely to continue to make competitive advances in both cargo capacity and productivity, thereby further eroding the System’s competitiveness. While the authors take no policy position on how to control the System, policymakers should consider the benefits and costs of ocean shipping in deciding how to regulate the industry in the future.

**Dr. Taylor is an Associate Professor of Marketing and Logistics at Grand Valley State University, and Zornitsa Boshnakova is a Graduate Assistant at Grand Valley State University. Jim Roach is a retired Manager of the Intermodal Freight Section at the Michigan Department of Transportation and Transportation Consultant.**

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**References**