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GREAT LAKES SHIPPING-PRICING BEHAVIOR OF THE MODES

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ABSTRACT: *In dependent market events, coupled with new pricing behaviors of Great Lakes waterborne and rail carriers, are shifting traditional commodity origin and destination pairs and the resultant commodity flows. Ports and harbors on the Great Lakes are experiencing new or changed infrastructure needs as a result of the change in commodity flow or mix. Historically, iron ore moved from Missabe and Upper Michigan iron ore mines to the steel mills on the Great Lakes and Upper Ohio River Valley. Coal moved from the Appalachian Mountains to Great Lakes steel mills and utilities in Canada and the United States. And wheat moved from the Upper Midwest and Canadian Prairie Provinces to lake flour millers and post-seaway export elevators. Today, steel mills are shifting to mini-mills, transport carriers are price deregulated, the "Clean Air Act of 1990" reduces the marketability of Appalachian coal, and the Canadian government has removed some of the transport subsidization of export wheat. Rail and waterborne carriers are consolidating and iron ore, coal, and wheat processors are consolidating. Observed rail carrier pricing behavior on the Great Lakes depicts the classic model of vertical foreclosure for iron ore, coal, and wheat. By contrast, the waterborne carriers pricing behavior depicts vertical integration of a mature industry. In conclusion, the issues become clouded as to whether the carriers or the shippers control the traffic patterns on the Great Lakes and what changes in infrastructure are required for the emerging new traffic patterns on the Great Lakes.*

INTRODUCTION

For three centuries, the Great Lakes system has provided a means for transporting commerce and has created economic prosperity for the people that live in close proximity to the Great Lakes. In each of the last three centuries, technologic change transformed the use of the Great Lakes from the canoe to the super vessels of today that exceed 1,000 feet in length. Now, new changes in economics, demographics, and social political regulation are creating impacts on Great Lakes shipping that transport technology and infrastructure must overcome. The economics of transport pricing, in particular the pricing of each mode of transportation, along with the change in social political regulation is shifting Great Lakes vessel traffic to alternative modes and new shipper vessel use patterns. The result of this shift in traffic requires public policy planners to creatively forecast commercial transportation and government agencies to construct the resultant infrastructure requirements.

This paper attempts to demonstrate how modal and regional carrier pricing of transportation services is shifting Great Lakes traffic that was unforeseen as recently as three to five years ago. Regulatory change coupled with pricing is rewriting the economic geography of the states that border the Great Lakes.

For this analysis a few definitions and terms need to be reviewed and understood. Great Lakes shipping consists of commerce moving from, to, or between Lakes Superior, Michigan, Huron, St. Clair, and Erie. While references to Lake Ontario and the St. Lawrence Seaway will be made, the unique economic and physical characteristics of this segment of Eastern Canada make their inclusion difficult to accommodate. "Salties" is a term to describe vessels that call on ports in the Great Lakes as well as the rest of the ocean shipping ports of the world. "Lakers" is a term for vessels that, by design, stay on the Great Lakes. "Vessel Class" refers to the sets of vessel sizes by the United States Army Corps of Engineers (Corps). For example, a Class 7 vessel is generally 72′ by 730′ in dimension with a cargo capacity of 27,000 to 34,000 metric tons. By contrast, a Class 10 vessel is generally 105′ by 1005′ in dimension with a cargo capacity of 62,000 to 70,000 metric tons. "Self-unloading" means a vessel with a conveyor and/or bucket elevator system that can discharge bulk materials at rates of 5,000 to 10,000 metric tons per hour. "The Staggers Act of 1980" refers to the 1980 Act of the United States Congress that greatly reduced federal and state regulation of rail transportation pricing, mergers, and abandonments. The Surface Transportation Board (STB) is the federal agency in the Department of Transportation that was created in 1995 to replace the Interstate Commerce Commission and to exercise limited economic regulation of the railroad industry. The Waybill Sample is an annual stratified data base of United States Class 1, regional, and large short-line railroad shipments collected by the STB.

In this context, the term "vertical foreclosure" is a description of carrier pricing where the railroad mode serves both an alternative, intermediate surface mode of transportation as well as the final destination for the commerce. The strategy is for the rail mode to price high to the alternative modes access terminal and to price low for the all-rail movement to the final destination, affecting the reduced price margins for the alternative surface mode. The term "vertical integration" is a strategy of mature manufacturers to gain ownership or control of the raw material suppliers, the transportation companies, and other vendors or distributors. Typically, vertical integration occurs in the mature stage of the manufacturer's life cycle prior to the industry's decline due to competition or diseconomies of scale.

For this paper, three bulk commodities--iron ore, coal, and grain--will be utilized to depict traffic and pricing patterns on the Great Lakes. Historically, these commodities have represented over 70% of the traffic shipped on the Great Lakes, and they also demonstrate the changes in shipping patterns on the Great Lakes.

IRON ORE

The production of iron ore in the Great Lakes region is located in the Mesaba Range of Minnesota, the Upper Peninsula of Michigan, and the Lake Ontario area of the Province of Ontario. Generally, iron ore is mined and shipped to a pellet concentration plant, and the concentrate is shipped to an integrated steel mill. A small quantity of iron ore concentrate is powdered and shipped for use as a heavy-media, coal-washing compound, paint pigment, or iron oxide. It should be noted that the iron ore concentration plant at Taconite, Minnesota, is located on Lake Superior for direct, vessel-loading access.

The integrated steel mills that use Mesaba Range ore are located at Chicago, Illinois; Gary, Indiana; Sault Ste. Marie, Michigan; and Wana, Ontario; Hamilton, Ontario; Detroit, Michigan; Cleveland, Ohio; Warren, Ohio; the upper Ohio River Basin; and the AK Steel Mills at Ashland, Kentucky; and Middleton, Ohio. The integrated steel mills can be characterized as either located on the Great Lakes with direct vessel access or off the Great Lakes whereby a transfer dock and rail transport are required.

Beginning in 1970, steel production in the United States started to shift away from the integrated steel mills to specialized, electric mini-steel mills that utilized scrap iron, pig iron, briquette iron ore, and direct reduction iron ore. The new mini-mills are located along the Inland Waterway System or in areas adjacent to deepwater ports for access to imported iron ore products and scrap iron. It has been reported that the trans-portation cost of the mini-mill is 2.5 times the cost of energy used in production[iii]. Furthermore, these new mini-mills have caused a steady decline in the consumption of Great Lakes iron ore, with the resultant decline in demand for Great Lakes vessels. Today over 50% of all North American steel production is produced from mini-mills[iv].

In 1977, the Great Lakes iron ore vessel fleet saw the introduction of the first Class 10 self-unloading iron ore vessels, advancing transport technology to the lowest unit costs for Great Lakes shipping. These vessels, with a cargo capacity of 70,000 metric tons and discharge rates in excess of 10,000 metric tons per hour, coupled with new high-speed, dockside loading systems, allow for 2.5 to 3.0 million tons per vessel per year of iron ore to be transported on the Great Lakes. Today, 14 super-size, self-unloading vessels (Class 8, 9, or 10) operate on the Great Lakes; due to the Jones Act restrictions, all of these vessels are in the USA fleet. A further constraint to the use of super-size vessels is that their size restricts the vessel to the Great Lakes due to the Welland Canal Locks length of 755 feet[v].

Table 1. Freight Tons of United States Carried on Great Lakes (thousand tons)[i]

YEAR	TOTAL		FOREIGN		DOMESTIC		
		Intraport	Overseas	Canadian	Coastwise	Lakewise	Internal
1994	175,275	9,571	41,571	4	114,807	4,610	5,036
1993	159,628						
1992	160,004						
1991	151,051						
1990	167,140						
1989	168,902						
1988	168,816						
1987	148,108						
1986	137,918						
1985	148,147						

Table 2. United States freight tons carried on Great Lakes by Type of Traffic and Commodity in 1994 (thousand tons)[ii]

	Foreign	Domestic	Total
Coal	10,417	26,288	36,705
Crude & Petroleum Products	1,442	4,438	5,880
Chemicals & Fertilizers	1,061	528	1,589
Forest Products	44	3	47
Stone, Sand, Gypsum	4,883	29,003	33,886
Iron Ore	12,043	56,122	68,165
Iron & Steel Scrap	183	171	354
Marine Shells	0	4	4
Non-Ferrous Ores & Scrap	318	55	373
Sulfur, Clay, and Salt	363	46	409
Slag	66	633	699
Non-Metallic Minerals	3,200	1,265	4,465
Paper Products	25	0	25
Lime, Cement, Glass	2,498	3,188	5,686
Primary Iron & Steel	5,373	1,596	6,969
Non-Ferrous Metal Products	171	234	405
Primary Wood Products	31	0	31
Food & Farm Products	7,880	762	8,642
Manufactured Equipment & Machinery	720	65	785
Other	76	80	156
Total	50,794	124,481	175,275

Today, iron ore shipping on the Great Lakes can be identified as vertically integrated in that ownership of the railroads, vessels, and docks is held in the hands of the integrated steel mills or operating partnerships with the iron ore mining companies. Prevailing vessel rates for shipments from Superior/Duluth to docks on Lake Erie range from $6.00 to $7.50 per net ton; by contrast, vessel costs range from $5.75 to $7.25 per net ton[vi].

A recent transportation rate study commissioned by the Detroit District of the Corps identified iron ore distribution costs from the pellet concentration mills to various integrated steel mills. Representative observations, shown in Table 3, include both the modal and handling costs for each movement identified. The vessel class for the origins

Table 3. Iron Ore Distribution Cost Per Net Ton On The Great Lakes[viii]

Origin Dock	Destination Dock	Cost Via Vessel	Cost Via All Land	Difference
Marquette	Detroit	11.72	25.94	14.22
Marquette	Ashtabula	20.35	20.50	.15
Marquette	Dearborn	11.72	19.79	8.07
Marquette	Cleveland	14.21	17.66	3.35
Presque Isle	Dearborn	11.90	20.69	8.79
Presque Isle	Ashtabula	21.07	20.49	(0.58)
Presque Isle	Cleveland	13.97	16.50	2.53
Superior	Chicago/Gary	11.65	12.25	0.60
Superior	Detroit	11.57	20.71	8.14
Superior	Ashtabula	20.33	20.68	0.35
Superior	Lorain	15.05	18.26	3.21
Superior	Hamilton	17.78	18.34	0.56
Two Harbors	Chicago/Gary	12.92	14.40	1.48
Two Harbors	Conneaut	23.80	22.72	(1.08)
Two Harbors	Lorain	16.23	19.91	3.68
Silver Bay	Toledo	16.29	20.89	4.60
Taconite	Chicago/Gary	9.13	13.92	4.79
Taconite	Lorain	12.56	19.82	7.26
Duluth	Toledo	22.29	19.87	(2.42)
Duluth	Nanticoke	14.14	21.72	7.57

of Marquette and Presque Isle is Class 7; for the other origins, it is Class 10. The vessel class for Hamilton as a destination is Class 7. Each of the vessels was self unloading and had no backhaul[vii]. It is interesting to note that the transfer docks at Ashtabula, Conneaut, and Toledo, Ohio, are operated by railroads; they produce very low or negative savings when comparing the vessel routes to the all-land rail routes. One contrast is that higher savings are observed when integrated steel mills are vertically integrated and are located on the Great Lakes.

In 1995, the Great Lakes iron ore vessel operators shifted part of the super-size vessel fleet from the iron ore trade to the coal trade, reflecting the low margins on iron ore shipping and the higher revenues associated with coal movements. In 1995, Class 10 vessels transported 27.4 million net tons of iron ore, 11.1 million tons of coal, and 0.7 million tons of crushed stone. With slightly more than 68 million tons of iron ore shipped on the Great Lakes, super-size vessels represented 40% of the iron ore shipped, with the remaining tonnage shipped in the smaller, less-efficient Class 6 or 7 vessels[ix].

Today, the shipping of iron ore on the Great Lakes is in transition. The industry is shifting from the most cost-efficient Class 10 vessels to smaller-sized Class 6 or 7 vessels. The outlying destinations of the Great Lakes are closing or shifting to all rail transportation. The electric mini-steel mills are competing with the integrated steel mills to reduce the total quantity of iron ore consumed from Great Lakes' sources. All in all, the iron ore shipping on the Great Lakes is stagnating, with greater emphasis to mills located on the Great Lakes themselves.

COAL

The transportation of coal on the Great Lakes is a classic story of a tale of two decades. In 1964, the Port of Toledo transferred 36 million tons of coal from rail to vessel; however, in 1994, the total quantity of coal shipped on the Great Lakes was 36 million tons[x]. In 1964, the source of coal was Appalachia, Western Kentucky, Ohio, and Indiana. In 1994, the source of Great Lakes coal was dominated by the Western United States and Western Canada. The shifting of coal origination on the Great Lakes demonstrates the profound effect of regulatory change and carrier pricing in the 1990s.

Starting with the Clean Air Act of 1990 and subsequent amendments, air emission standards for sulfur, ozone, and fine particulates were created to protect the air environment. The standards require industries and utilities that burn coal to either burn very low-sulfur coal or to scrub the smoke stack emission to limit pollution. The response of many utilities is to shift the source of coal to very low-sulfur, compliance coal, found in the Western United States and Canada. Very low-sulfur coal is defined as coal with a sulfur content of less than 0.7%.

As shown in Table 4, compliance coal on the Great Lakes moves in unit trains from the Western United States and Western Canada to docks at Superior, Thunder Bay, and Chicago for furtherance by vessel. In 1995, 11.1 million net tons of coal moved in super-size, self-unloading vessels (Classes 8, 9, or 10), or approximately 30% of the total coal traffic[xii].

A second regulatory change has placed coal in a very unique situation relative to transportation pricing and traffic shifting on the Great Lakes. The Staggers Act of 1980 reduced both the federal and state regulations of railroad pricing by allowing railroads to enter into confidential contracts for carriage of commerce. The timing of this regulatory change, the shift to compliance coal from the West, and the deregulation of the electric utility industry have provided rate structures on coal that are transforming shipping patterns on the Great Lakes.

In 1995, the national average percent of variable cost to ship coal by rail was 215%. The rail movement of coal from the Powder River Basin to the Great Lakes or Mississippi River Gateways was done at 130-170% of variable cost, the movement of coal from Appalachian origins to the Great Lakes averaged 280-300%, and the movement of coal to New England ranged from 300-500% of variable cost.[xiii]

The historically high coal pricing by rail in the Eastern United States has afforded the western railroads the opportunity to price coal low for large volume shippers to Great Lakes and Mississippi River Gateways. Likewise, short-line and regional railroads in the East have established low-priced niche markets for coal shipping to the Great Lakes to compete with the Class I railroads. The result of these two situations is what drives the growth potential for the use of vessels on the Great Lakes.

It should be remembered that the electric utilities have the option of installing scrubbers to remove the pollution emissions, allowing higher-sulfur Appalachian coal to replace western compliance coal. Furthermore, Eastern Class I railroads can reduce coal transport prices, thus removing the niche markets for the short-line railroads. Also, the Eastern Class I railroads could cooperate with the Canadian railroads in Eastern Canada and competitively price unit train coal service to electric utilities in Ontario.

The coal distribution costs in Table 5 on the Great Lakes were derived from transportation rate studies commissioned by the Detroit and Buffalo Districts of the Corps. These observations depict the cost to transport and handle coal from the mine mouth to the point of consumption (electric utility or industry) in the first quarter of 1997. It should be noted that the margins on coal are generally higher than the margins on iron ore; thus, the margins provide the motive to shift more super-size vessels into this trade.

The transportation of coal by Great Lakes vessels is on the rebound due to the electric utility demand for low-sulfur compliance coal from the Western United States and Canada. The growth in compliance coal usage is dependent upon the Clean Air Act standards and the enforcement actions of the Environmental Protection Agency, as well as the available capacity of Class 10 vessels to handle the traffic.

GRAIN

In the 1990s, Great Lakes grain and oilseed shipping reflects the struggle of the Canadian and United States governments to modernize harbors and docks to encompass the transport technology. The struggle is exacerbated by the pricing strategies of transport carriers and the docks that handle grain and by the historic shipping patterns of railroads in the grain growing regions of North America.

Table 4. Coal Characteristics By Origin Great Lakes 1995[xiii]

Origin-Location	BTU	Ash%	Sulfur
Colorado-Raton Mesa	12,500	11.5	0.8
Colorado-Green River	10,500	8.1	0.6
Kentucky-Big Sandy	13,300	8.2	1.2
Kentucky-Licking River	12,700	9.2	1.9
Montana-Powder River	9,300	7.2	0.9
Ohio-Belmont County	12,900	10.5	3.0
Pennsylvania-Green County	13,100	10.2	3.0
West Virginia-Monongahela	13,300	9.5	2.4
Wyoming-Powder River	8,600	24.5	0.4
Alberta-Foothills	13,000	9.2	0.2
British Columbia-East Kootney	13,100	8.6	0.5
British Columbia-Peace River	13,000	9.7	0.5

Table 5. Coal Distribution Cost Per Net Ton On The Great Lakes[xiv]

Origin Dock	Destination Dock	Cost Via Vessel	Cost Via All Land	Difference
Superior	Muskegon	$19.98	$22.60	$2.62
Superior	St. Clair	20.18	26.99	6.81
Superior	Monroe	20.49	24.38	3.89
Thunder Bay	Chicago	40.09	33.61	(6.47)
Thunder Bay	Detroit	36.47	45.75	9.28
Chicago	Marquette	24.60	36.74	12.14
Ashtabula	Marquette	25.13	33.19	8.06
Ashtabula	Superior	30.86	34.24	3.38
Toledo	Sault Ste. Marie	20.67	36.17	15.50
Conneaut	Nanicoke	15.09	21.66	6.57

Table 6. Observed Unit Train Rate Structure For The Great Lakes 1995[xvi]

Origin	Destination	Commodity	Percent-Variable Cost
USA	USA	Wheat	165
USA	USA	Corn	145
USA	USA	Soybeans	160
USA	USA	Canola	170
ND/SD	MN/WI	Wheat	240
ND/SD	NY	Wheat	120
ND/SD	OH	Wheat	190(a)
ND/SD	PQ	Wheat	125
AB/MB	ON	Wheat	135
AB/MB	PQ	Wheat	125

(a) Single car

The dominant market for Great Lakes grain and oilseeds is overseas export; however, domestic grain consumption in Canada and the United States creates significant transport pricing abnormalities in the Great Lakes region.

The overseas export grain market on the Great Lakes consists of three parts. First, there is the rail or truck transportation movement from the country elevators to the lakeside elevators at Thunder Bay, Duluth/ Superior, Chicago, and Toledo. Second, there is the movement on the Great Lakes by either a partially loaded salty or a fully loaded Class 6 or 7 laker. Third, there is the movement of a fully loaded salty from a post-St. Lawrence Seaway elevator to the final destination elevator in Ireland, Europe, former Soviet block countries, the Middle East, or the Pacific Rim countries. The development of this historical, logistical pattern was based upon the constraints of the locks in the Welland Canal and the St. Lawrence Seaway that restricted vessels to less than 755 feet and a draft of 26.5 feet. The laker vessels employed to shuttle grain from Thunder Bay to areas east of Montreal are flat deck vessels without self unloading. To facilitate the export grain market, the Canadian government and its agencies sponsored the con-struction of specialized, grain-cleaning equipment at Thunder Bay and the construction of high-speed, loading/ unloading elevators at Montreal, Port Cartier, and Sorel, PQ. The objective of these actions was to produce a very high-quality grain that could command a premium price and to reduce the unit cost of topping off or loading salties to 45- to 50-foot drafts. It needs to be noted that the new dock and elevator facilities east of Montreal are not served by rail.

In 1996, the Canadian Government discontinued its program of subsidizing the rail transportation rates for grain shipments to export ports. This action, along with harvest patterns in the prairie provinces, shifted large quantities of wheat from Thunder Bay to Vancouver.

In 1994, less than 10% of the domestic and Canadian grain shipments on the Great Lakes was transported by United States flag carriers. In contrast, Canadian flag vessels in 1997 quoted a depressed freight rate from Thunder Bay to East of Montreal Elevators at $14.00-16.00 metric ton; in 1997, one grain-hauling Canadian flag vessel was converted to a bulk self-unloading vessel for the iron ore and stone trade. The question now to be answered is, "What is causing the depressed grain vessel rates and the ships exiting from the Great Lakes grain trade when they command in excess of 90% of the vessel market?"[xv]

The answer becomes apparent when one examines the railroad rate structure in the Great Lakes region. The squeezing of vessel margins has been achieved by the railroads through vertical foreclosure. Rail rates on grain and oilseeds from country elevators to the vessel-loading docks are above the average rate, whereas the rate from the country elevator to final destination is below average. In the example of wheat, the spread in rates is over 100 points.

While export shipments of grain dominate the Great Lakes, the impact of domestic and Canadian grain shipments on rates can be felt. Vessel rates are a function of the transit time on the Great Lakes and the capacity of the vessel (draft). Typical unloading rates at non-export terminals range from 500 to 1500 metric tons per hour, and the harbor drafts are 20 to 24 feet. A further complication is the requirement of the vessel owner to utilize "scoopers" to manually shovel grain in the hole of the vessel to the unload vacuum hose. Each of these inefficiencies adds cost to the vessel movement allowing for rail to ship grain.

CONCLUSION

In the 21st century, shipping on the Great Lakes should experience many subtle changes when compared to traditional Great Lakes shipping of the past. The changes in traffic flows will result from carrier pricing and social economic regulation.

Competitive railroad pricing will funnel iron ore to integrated steel mills located on the Great Lakes, to harbors that possess both a steel mill and a transload iron ore dock, and to integrated steel mills located a very short distance from the Great Lakes. Integrated steel mills located in the Ohio River Valley will receive rail-direct iron ore from the pellet concentration plants. Total iron ore traffic on the Great Lakes should decline slightly.

The increased utilization of low-sulfur compliance coal by eastern electric utilities will increase the vessel traffic on the Great Lakes. Coal traffic will be in existing Class 10s, with growth in traffic in the Canadian Class 7s from Thunder Bay. Existing Lake Erie origin coal traffic will be replaced by coal from docks on Lake Superior. Total tons will grow due to the lower BTU rates of compliance coal and the favorable pricing of western rail carriers to Great Lakes docks on Lake Superior.

Finally, domestic wheat transportation by Great Lakes vessels will diminish due to aggressive rail price competition; export movements will be a function of the world demand for Midwest and Canadian Prairie grain and of the backhaul vessel rates from Duluth/Superior and Thunder Bay.

The public transportation infrastructure (dredging, lock operations, and harbor and port construction) will require planners to look more closely at the vessel traffic on the Great Lakes. The trends in the traffic caused by modal pricing and regulatory change point to the need for multipurpose projects to serve both transfer docks and lakefront industries. Single-dock harbors will lack the traffic base to support public infrastructure expenditures.

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