U.S. tanker transport: Current structure and economic analysis

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\section*{A R T I C L E I N F O}

\begin{tabular}{ll}
JEL classification: & R41 \\
& R48 \\
& Q34 \\
& Q41 \\
& Q47 \\
& L71 \\
& L91 \\
& O51 \\
& O13 \\
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\section*{A B S T R A C T}

With the advent of hydraulic fracturing, e.g. “fracking” in North America and United States policy changes on the export of crude oil and natural gas, it is anticipated that major structural changes will occur in the maritime transport of these commodities. The impact of these changes are global; however, regional transportation in North America is also expected to have profound impacts. This paper investigates these structural changes and the potential impact in the short-term and long-term effects on tanker shipping with data from tanker traffic in the major U.S. liquid bulk ports as well as crude oil and oil product movements recorded by the U.S. Energy Information Administration. We find a significant increase in U.S. oil and oil based product exports and a corresponding decline in imports in the recent years and the near future. The domestic market shows an increase in tanker traffic from the Gulf Coast to the East Coast of the U.S. Based on these current developments, four potential scenarios emphasize the growth or decline of tanker shipping (also tanker freight rates) connected to the U.S. waterborne wet bulk trades. Both public and private decision makers need to make delicate investment choices strongly tied to oil price variations. Considering the prospective on rising oil prices in the long-run, a significant downside of crude oil shipping and uprisings of tanker product shipping are some fundamental results to be considered by key decision making units in the industry.

\section{1. Introduction}

For over 40 years, the United States has relied heavily on imported oil from the Middle East, Africa and the Caribbean to fulfill its energy needs. Due to the advent of practical hydraulic fracturing (fracking) to better utilize large North American oilfields, there has been major shifts within the United States with regard to the energy market. The production, supply, distribution and consumption of oil energy have led to a restructuring of the modes of transportation utilized to supply fuel. Further, with the removal of federal restrictions in December 2015 on exporting U.S. crude oil, the US is now an oil exporting nation (Blas, 2016).

It is anticipated that the bulk of this US produced oil will be transported from its production areas to major consumption areas by sea. This will take place as the global oil energy market is transitioning in the type of oil fuels refined (light vs. heavy crude), in energy alternatives such as Liquefied Petroleum Gas (LPG) and Liquefied Natural Gas (LNG), in the volume of fuels supplied and consumed, and in the modes of transportation utilized to transport these fuels. In the U.S., the oil tanker market is already readjusting to these new developments and changes in the overall world economy.

Within the energy market, in addition to crude oil, refined petroleum products are the most common types of tanker cargo. Generally, both crude oil and refined petroleum products are transported on tankers chartered or leased by oil marketers, oil refiners, chemical companies, and other business or government entities. Contract terms will vary with the length of the lease, the route of transportation and the quantity transported. Ownership of tankers is comprised of diffuse set of owners to accommodate the spot market as a means of distributing oil (Glen & Christie, 2010).

A significant factor in the design of tank vessels is not only safety, but economy. Vessel size and cargo capacity is expressed in the Average Freight Rate Assessment (AFRA) Scale and measured in dead-weight tonnage (DWT) (Table 1). Developed by Royal Dutch Shell in the 1950s as a method to standardize the petroleum shipping market and currently overseen by the London Tanker Brokers’ Panel, the AFRA Scale divides the world tank vessel fleet into groupings based on DWT. The largest tankers in the world market are the seldom-used Ultra-Large Crude Carriers (ULCC) of 320 to 550 thousand DWT and the marginally smaller but more frequently used Very-Large Crude Carriers (VLCC) of 200 to 320 thousand DWT, the vast majority of which are non US-flagged. Long Range 2 tankers range from 80 to 160 thousand DWT;
Table 1
Size and capacity of crude oil and product tankers (estimations).

<table>
<thead>
<tr>
<th>Product tankers</th>
<th>Size</th>
<th>Capacity (barrels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handysize (also Handymax)</td>
<td>10 k–60 k</td>
<td>80 k–450 k</td>
</tr>
<tr>
<td>Panamax</td>
<td>60 k–80 k</td>
<td>500 k</td>
</tr>
<tr>
<td>Aframax</td>
<td>80 k–120 k</td>
<td>750 k</td>
</tr>
<tr>
<td>Suezmax</td>
<td>120 k–200 k</td>
<td>1000 k</td>
</tr>
<tr>
<td>Very large crude carrier</td>
<td>200 k–300 k</td>
<td>2000 k</td>
</tr>
</tbody>
</table>

Note: Capacity estimations for crude oil are based on common tonnages in the fleet.

while the smaller Long Range 1 vessels have a capacity of 45 to 80 thousand DWT. Positioned between the two Long Range classes is the Aframax class; while not an official AFRA classification, it is used to classify a tanker with a capacity of 80 to 120 thousand DWT. This vessel is prevalent among the world fleet because of its economy and logistical convenience. Smaller tank vessels, mostly used for the transport of distillate products trade. Most U.S.-type vessels; both are largely utilized for the short-sea and coastal petroleum product rather than crude, include the Medium Range (25 to 45 thousand DWT) and the General Purpose (10 to 25 thousand DWT) type vessels; both are largely utilized for the short-sea and coastal distillate products trade. Most U.S.-flag tankers fall into the Medium Range and General Purpose categories.

A further wrinkle in the complexity of moving oil and refined oil products within the United States is the federal Cabotage Law; the Merchant Marine Act of 1920 (P.L. 66-261), more commonly known as the Jones Act. This law requires that any goods shipped from one U.S. port to another U.S. port must travel on a ship built in the U.S., with U.S. crew and nominally owned by U.S. citizens. Due to the cost of U.S. built tankers relative to foreign-flag ships and shifting supply patterns, it is often cheaper for refiners in the Gulf Coast to move product to refineries in Eastern Canada rather than the northeastern United States abroad foreign flag vessels rather than on Jones Act-eligible ships (Frittelli, 2014).

The cost of moving oil and oil products by water (tanker prices) reflect the supply and demand for crude oil and a variety of refined products including gasoline for automobiles and trucks, heating oil, marine diesel fuel, synthetic resin for plastics and other oil derived chemicals. The demand for refined oil prices in the US is not uniform across the 50 US states. Furthermore, state taxation, seasonal blending changes, pollution abatement requirements, and disparate distribution systems all impact oil product pricing. Thus, the need for tankers, and subsequently their charter rates, is impacted by these factors as well as the price for imported crude as the Brent (Brent Crude Spot Price) and domestic crude as WTI (West Texas Intermediate price). Currently, a decline in oil prices has lowered crude tanker companies’ prices leaving many tankers idled (Angell, 2016).

In this paper, we analyze how these various factors related to changes in U.S. crude oil production impact tanker shipping in the US. As the United States once again becomes one of the largest global oil and natural gas producers, will this alter demand for tankers and the routes taken? We utilize a co-integration analysis to illustrate relationship between U.S. oil imports and tanker freight rates to clarify the impact of policies developed for U.S. oil industry. The results suggest that the potential growth of the U.S. tanker market will take place in four possible scenarios having much to do with the role of Canadian oil reserves.

The fundamental research question of this paper based on above circumstances is “What are the potential prospects in the U.S. oil industry and therefore in U.S. tanker shipping?” Response to this question is twofold: First, there are particular dynamics behind the U.S. industry which are connected to a much more complex policy problem. The nature of U.S. oil industry is investigated in depth through Sections 2 and 3. Second, the link between the U.S. oil imports and exports (mostly in the future) with tanker shipping market is another uncertain area and an empirical study is presented to shed light into the co-trended behavior of both markets (Sections 4 and 5). Finally, various scenarios and their potential results are investigated in Sections 5 and 6 with discussion, implications for management and scholarly contribution.

2. The shaping of the present U.S. tanker market: The shale revolution and its aftermath in the oil statistics

2.1. U.S. crude import and production

The U.S., as a single country, has been the largest crude oil importer and has remained in this integral role within the crude oil market (World Fact Book, 2016). However, during the early 1970’s and 1980’s U.S. crude oil imports were reduced due to geopolitical events in the Middle East (Nerurkar, 2012). This changed from the late 1980’s to the mid 2000’s, when U.S. imports gradually scaled up with the economic and industrial growth of nation (Nerurkar, 2012). Oil prices continued to climb as overall world demand pushed WTI prices to over USD$145 per barrel by June 2008 (CNBC, 2015). Higher oil prices initiated a rationalization of alternative resources in the U.S. with a significant role for new discoveries led by the expansion of shale oil/gas (tight oil, tight gas) production facilities (Hamilton, 2008).

According to Bartis, LaTourrette, Dixon, Peterson, and Cecchine (2005), the cost of shale oil production ranges from USD$70–90 per barrel so when the price of oil exceeds this range this alternative

![U.S. Energy Information Administration, EIA, 2014; Clarkson's SIN Database.](image)
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