Modeling the Effects of the Single-Hull Tanker Phase-out on the World Oil Tanker Market

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Abstract

The dynamics of the global oil tanker market has long been studied by practitioners of System Dynamics. This paper does not seek to repeat what has been done, but rather to focus on an aspect which has recently taken on greater importance: the phase-out of single-hull tankers by 2010, and double-bottomed or double-sided (but not true double-hulled) tankers by 2015. In particular, questions of interest are: might the single-hull ban lead to extremely tight supply through 2010; and is it likely that the industry will overshoot the number of newbuilds necessary, leading to a crash in spot rates after 2010? Preliminary results indicate that the answer is yes to both questions.

Keywords: oil tankers, single-hull, phase-out, spot market

Introduction

The importance of a healthy global oil tanker market is clear. About 60% of all oil that is produced is traded (BP, 2005), and roughly 2/3 of the world's oil trade moves by tanker (EIA, 2005). The market for tanker transport capacity is just as much a commodity as the crude oil that is transported, and is a very competitive market.

Given this importance, it is not surprising that the discipline of System Dynamics has long been used to study various aspects of the oil tanker market. From Coyle's study of tanker chartering (Coyle, 1978) and Randers' study of the dynamics of the oil tanker market (Randers, 1981), to the more recent studies into the market for ice-class oil tankers (Koskinen and Hilmola, 2004) and tanker freight rates (Dikos et al., 2005), it is clear that issues surrounding oil tankers have been well-studied.

At the same time, regulations have come into force that could not have been foreseen by the earlier two studies cited, and which were not the primary focus of the latter. In April

2005, MARPOL (the International Convention for the Prevention of Pollution from Ships) regulations came into force which mandated the retirement of single-hull tankers without segregated ballast tanks (known as Category I, or pre-MARPOL tankers) by the end of 2005, and the retirement of even those single-hull ships with segregated ballast tanks (known as Category II, or MARPOL tankers) by the end of 2010 (IMO, 2005).

As MARPOL is ratified by 130 countries, and these countries have 97% of merchant tonnage registered under their flags, these regulations clearly affect the entire market (IMO, 2005). Given the fact that at the end of 2003, single-hull tankers made up just over 32% of the total oil tanker fleet, it is clear that the regulations will have a large impact on the market.

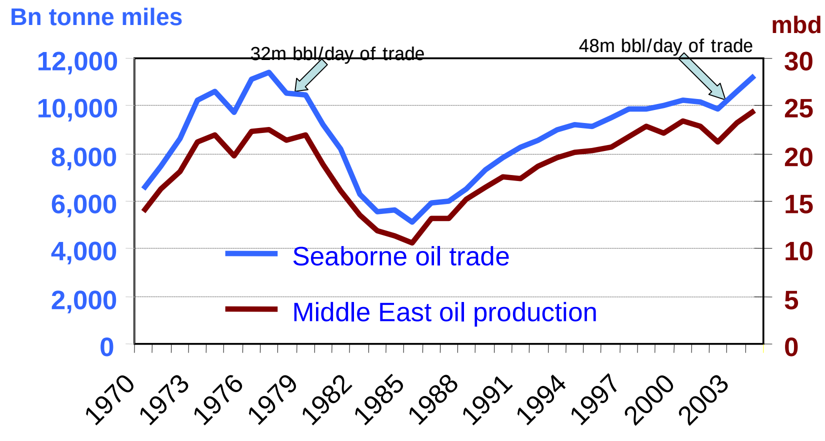
What kind of impact these regulations will have on the market is therefore an important question worth exploring. Not only is the question of whether the market through 2010 will be excessively tight of interest, but also whether it is likely that the industry will overshoot in orders for new ships – leading to a crash in spot market rates after 2010.

Oil Tanker Transport Capacity

Demand for crude oil transport and the capacity for that transport do not solely depend on the volume of oil to be transported or the holding capacity of tankers. Equally as important is the distance over which the oil must be transported. Therefore, demand for transport, as well as capacity for transport, is usually expressed in terms of tonne-miles.

An illustration of this fact is the graph below.

Figure 1: Total Crude Oil Tanker Demand vs. Middle East Oil Production



Source: Intertanko Beijing presentation (Fearnleys/BP data), 10/20/2005

Total tanker demand in 2005 (measured in tonne-miles) has reached roughly the same levels as the late 1970s, even though the amount of oil and oil products shipped per day increased from 32m bbl/day in 1980 to 48m bbl/day in 2004 – for an increase of about 50% (BP, 2005). High oil prices, due to OPEC supply constraints, encouraged oil development in more marginal fields – which happened to be closer to areas of consumption than the Persian Gulf is. The average distance crude oil was shipped declined from 7,200 miles in 1972, to 4,650 miles in 2002 (ISL, 2004).

Tanker speed, the percent of time tankers travel unloaded, scheduling and unloading delays, the amount of time a tanker spends in repairs also all have an impact on transportation capacity.

Crude Oil Tanker Fleet Description

The chart below contains three years of data on some of the most important variables describing the oil tanker fleet. Except for the Capacity Utilization factor, the data are in millions of deadweight tons (dwt), which is the total amount of weight the vessel can support.

Chart 1: Crude Oil Tanker Fleet Data

(in m dwt)	2002	2003	2004
Fleet Size (start)	290	294	305
Order Book (start)	62	56	75
Tanker Orders	19	49	36
New builds	24	30	27
Scrapping	18	18	8
Capacity Utilization	85%	89%	91.5%

Source: R.S. Platou, 2005 annual report

"Tanker Orders" represents the capacity that has been ordered in the current year. "New Builds" are the capacity of the ships that have been built in the current year. "Order Book" represents the capacity of the ships that have been ordered, but not yet been built – in other words, the order book can be seen as a stock, where tanker orders add to the stock and new builds subtract from it. "Scrapping" represents the capacity of ships that were sold for scrap metal in the current year. "Fleet Size" can be thought of as a stock, where new builds add to it and scrapping subtracts. Finally, "Capacity Utilization" is calculated by dividing the oil transport demand (in tonne-miles) by the oil transport capacity (also in tonne-miles).

Some experts (Platou Report, 2005) in the industry believe that a 90% capacity utilization factor means that the fleet is fully utilized.

At the end of 2003, the crude oil tanker fleet was composed as follows:

Double-hull	Double-hull / Double-side	Single-hull (0-15 yrs)	Single-hull (over 15 yrs)
58.6%	9.0%	16.1%	16.3%

Source: Teekay Shipping, Press Release of December 9, 2003 (data from Clarkson Research)

This means that at the end of 2003, single-hulled tankers were approximately 1/3 of the entire fleet, which is equal to about 100 dwt.

Model Assumptions

The model makes the following assumptions:

1. Tanker phase-outs are on a straight-line basis, with all single hull tankers scrapped by 2010, and all double-sided/bottomed tankers scrapped by 2015;
2. Converting single-hull tankers to double-hull or even double-bottom/side is too expensive, and in most cases would extend the expected life of a ship for too few years, to be undertaken on a large scale;
3. Decisions to order new tankers are made based on expected profitability of new tanker capacity, which is in turn based on a smooth of recent spot prices;
4. Worldwide demand for oil shipped by tanker continues to increase at the 1990 – 2000 average of 1.8% per year (McKillop);
5. Worldwide shipyard capacity for constructing crude oil tankers is roughly 25m dwt/yr, and can be boosted by as much as 15% through temporary measures, such as overtime;
6. Additional shipyard capacity is initiated as building ships becomes more profitable – and it is assumed that the greater the order book backlog, the more profit shipyards earn from shipbuilding (as an increasing backlog means that demand for ships is outstripping the capacity of shipyards to build them, and thus they should bid new ship prices up);
7. A fleet capacity utilization factor above 90% means that the fleet is fully utilized (Platou Report, 2005), therefore spot prices dramatically increase above that level, and drop quickly below it.

Key Variable Explanation

Fleet Transport Capacity is a function of tanker speed, percentage of time carrying cargo, and percentage of time that tankers not available (due to being in drydock for repairs, waiting to unload cargo, etc.)

Total Transport Demand is the volume of crude to be shipped multiplied by the average delivery distance.

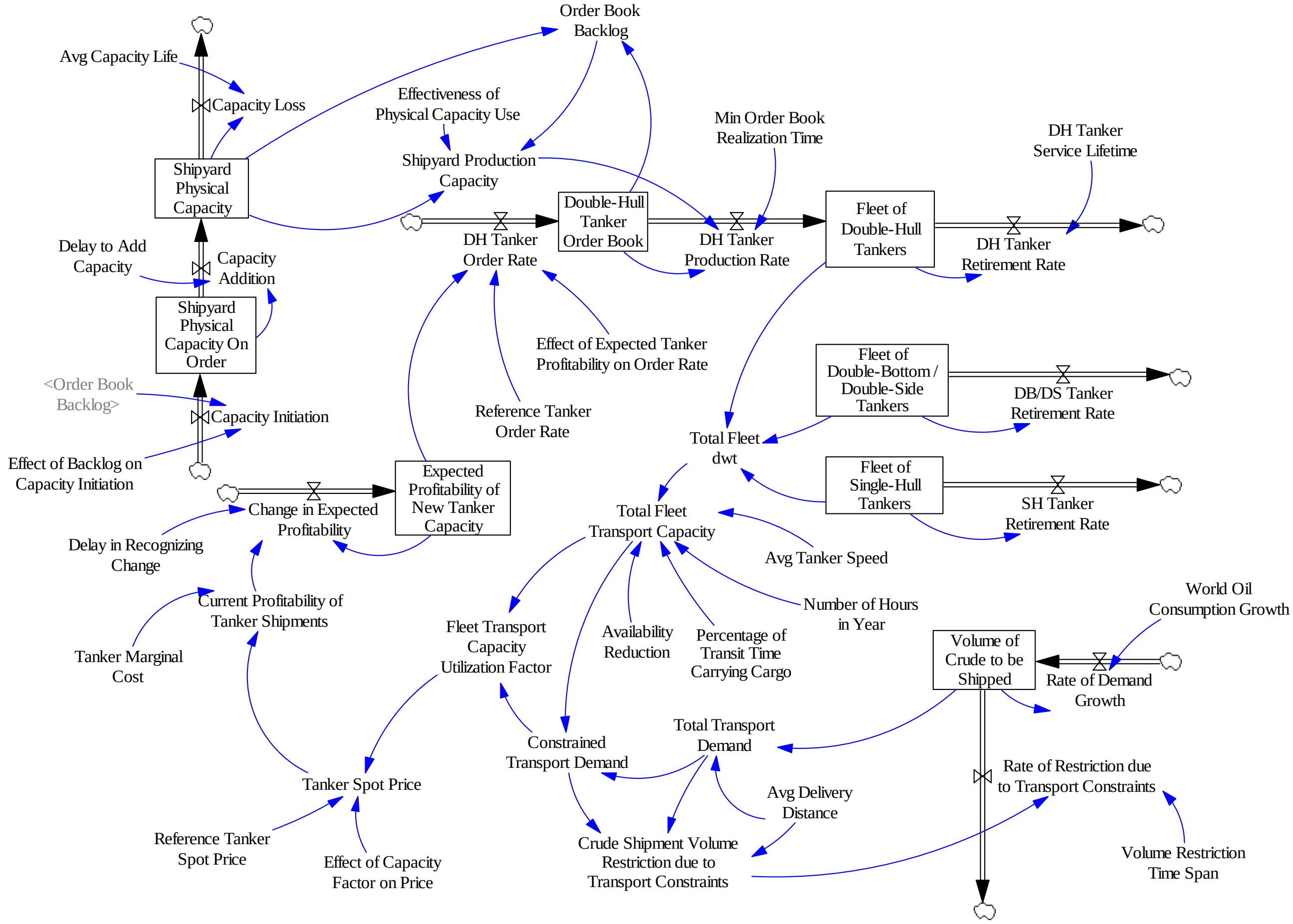
The Fleet Transport Capacity divided by the Total Transport Demand yields the Capacity Utilization Factor, which is an indicator of how stretched the global tanker fleet is in meeting oil transport demand.

The Tanker Spot Price is a function which takes the Capacity Utilization Factor as an input. The Tanker Spot Price function gradually increases to yield a 1 when the Capacity Utilization Factor approaches 0.9. As the Capacity Utilization Factor increases towards 1, the Tanker Spot Price function increases exponentially. This captures the nonlinearity in spot market prices – when there is a lot of excess capacity, prices are low, but once excess capacity decreases beyond a certain threshold, prices are volatile and rise very quickly.

Shipyard Physical Capacity orders are initiated as the Order Book Backlog (measured in years) climbs. Likewise, Shipyard Physical Capacity is lost over time as equipment depreciates. Shipyard Production Capacity is different from Shipyard Physical Capacity, in that the physical capacity can be used more effectively when it is profitable to do so (by having people work overtime or hiring more people, for example). The Order Book Backlog is used as a proxy for how profitable shipbuilding is, where the larger the backlog, the more profitable shipbuilding is assumed to be.

Finally, only Double-Hull Tankers can be ordered and built, which reflects reality. The Fleet of Double-Bottom / Double-Side and Single-Hull Tankers both start out at their 2003 levels and retire in a straight-line fashion.

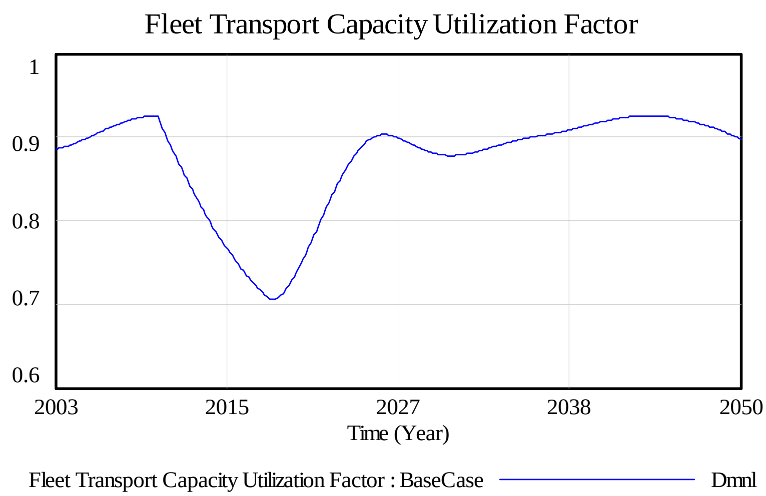
Model Diagram



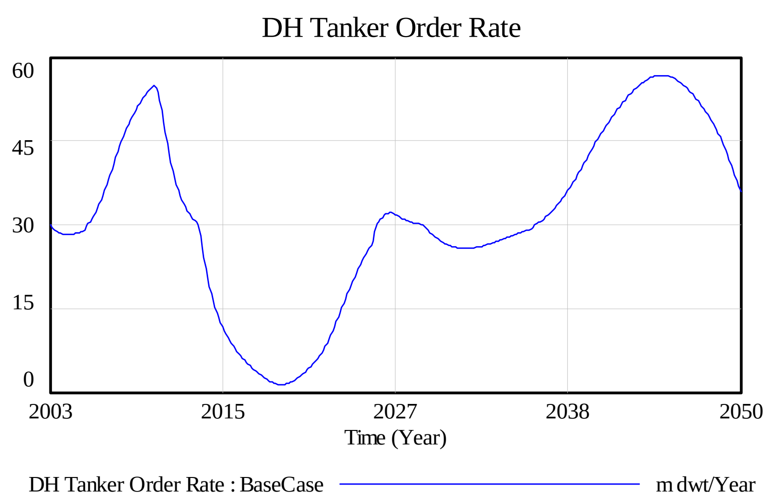
Model Output

The base case of the model assumes a 1.8%/year growth in volume of oil to be shipped, and a constant average shipping distance.

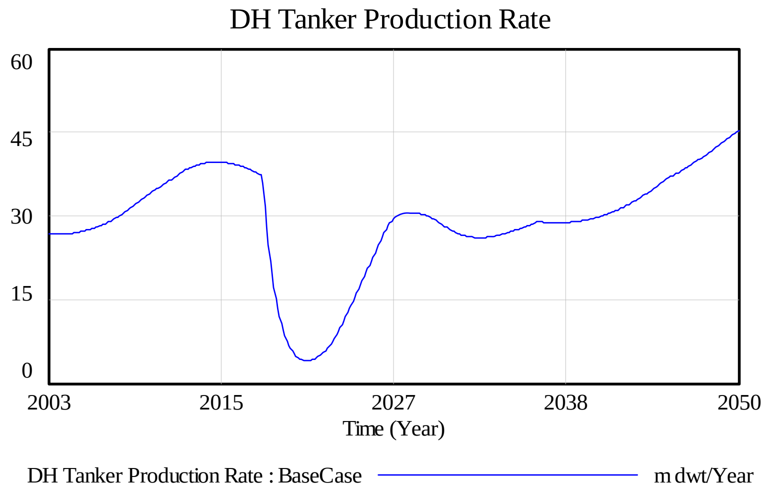
As we see below, the capacity utilization factor increases until around 2010, at which point it plummets, recovering to a steady state years later.



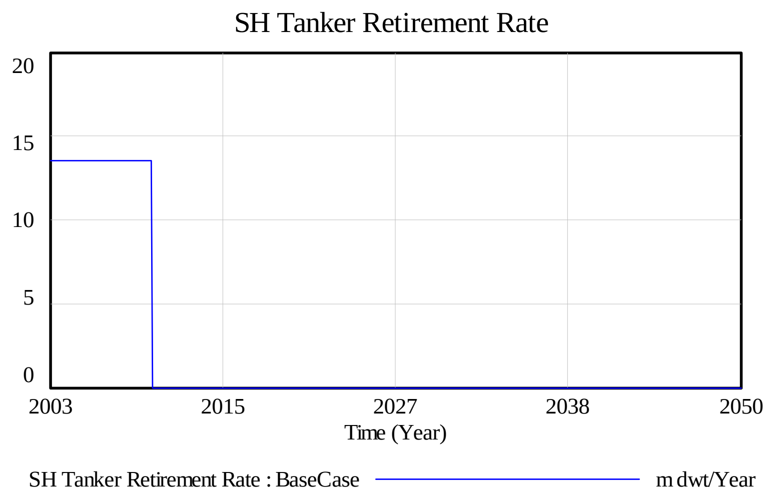
We see below that the double-hull tanker order rate rapidly increases through about 2010, in response to the high capacity utilization factor (and therefore spot price). It drops off sharply as the spot price falls.



However, since binding orders were placed, they must be filled. The time delay from placing an order to receiving a ship comes into play, and new ships enter the fleet long after they are needed, and act to further depress the spot price.



The graph below represents the single-hull tanker retirement rate, which creates an extremely tight market through 2010, but is not properly taken into account by all the market players in their ordering newbuilds – which leads to a bust cycle in the market.



Model Boundary / Behaviors not in the Model

This model does not project the annual growth rate in crude oil volumes traded. Instead, the average growth rate for the decade from 1990 to 2000 was used. A reasonable approximation was chosen instead of modeling world GDP and oil prices, and then determining how these impact crude oil demand -- since modeling these parameters would be a tremendous undertaking with arguable results, and would divert attention away from the object of this study, the oil tanker market itself. The negative side of this decision is that in the model, the volume of oil traded increases exponentially (with volumes traded in 2050 more than twice what they were in 2003), not being checked by oil prices.

Moreover, whereas the average crude oil shipping distance has decreased over time, the model takes this number to be a constant (set at the 2002 average of 4650 miles). In reality, one can project that since the Middle East has most of the world's oil reserves, substantial increases in production will likely come from that region – increasing the distance tankers must travel, and therefore reducing the available tanker transport capacity. This would be the opposite of the trend that has occurred since the late 1970s. At the same time, if oil prices remain high, then it is entirely possible that more marginal fields that are closer to areas of consumption will continue to be discovered and produced, and that alternative energy sources (such as Alberta's oil sands) will become serious players and begin to take market share away from traditional oil production. Again, these dynamics were not included, as it is not clear which one will dominate -- this is a problem which merits separate treatment and is beyond the scope of this study.

Another behavior not in the model concerns technological advances in tankers. Newer ships are faster and require fewer repairs, and therefore as the fleet becomes newer, transport capacity increases. However, the increase in speed and decrease in repair time is a small factor compared with much larger uncertainties – such as the worldwide growth in oil consumption – and therefore was not included.

Finally, the model does not distinguish between single-hull tankers with segregated ballasts (Category II, or MARPOL tankers) and those without (Category I, or pre-MARPOL tankers). Instead, the total number of single-hull tankers at the beginning of 2003 is reduced to zero by the end of 2010 in straight-line fashion. This is not entirely correct, as all Category II tankers had to be either retired or converted to Category I tankers by the end of 2005, and Category I tankers must be scrapped on their 25th anniversary or by the end of 2010. Therefore, in reality we will see a lumpy, rather than an even, retirement schedule. However, the number of ships retired through the end of 2010 will be the same in either case – and since the main interest was in the overall trend rather than a year-to-year accounting of changes, the straight-line retirement schedule was chosen.

Conclusion

Though the capacity of the tanker fleet through 2010 can be projected fairly well (given the mandatory retirement schedule and the newbuild orderbook), the demand for oil transport is much more difficult to project. Even so, assuming historic levels of growth in oil volumes to be transported by tanker, it seems likely that the market for oil transport will remain tight through 2010 – but that a crisis seems unlikely.

At the same time, if past behavior is a guide, it is likely that the industry as a whole will place too many orders for newbuilds while spot prices are high, leading to a prolonged period of overcapacity and depressed spot market rates after 2010. This will happen despite the awareness of individual players of the mandatory single-hull retirement schedule, and an understanding of what overcapacity means for the industry. This is true because while it is in the industry's interest to have a high capacity utilization factor, it is in each firm's interest to add one more ship to take advantage of the high spot market rates – and to hope their competitors refrain from doing the same. In the absence of collusion, over the long term competition will insure that profits are driven down to the minimum the industry needs to exist.

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